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Wojciech Cellary Editors

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Louis Freund
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Preface

This book is concerned with an emerging field we refer to as "The Human-Side of Service Engineering." If there is any one element to the engineering of service systems that is unique, it is the extent to which the suitability of the system for human use, human service, and excellent human experience has been and must always be considered. Contributors to this book explore the wide range of ways in which Human Factors Engineering, Ergonomics, Human Computer Interaction (HCI), Usability Testing, Attitude and Opinion Assessment, Servicescape Designs and Evaluations, Cognitive Engineering, Psychometrics, Training for Service Delivery, Co-Creation and Co-Production, Service Levels and Cost Effectiveness, Call Center Engineering, Customer Support Engineering, and many other areas relate to and impact the human-side of engineering service systems.

The book is organized into fourteen sections that focus on the following subject matters:

1. Integrating Human and Artificial Services
2. UX as a Service (UXaaS)
3. New Directions in Teaching and Learning Services
4. Software as a Service: Achieving Security via Usability, Trust, and Privacy for the Internet of Services
5. Managing the Complexity in Transformative Service Design
6. Practice Based Innovation: Collaborate and Learn in Innovating
7. Quality Management in Service Engineering
8. Research on Human Behavior, Ethics and Decision Making in Smarter Service Systems
9. The Education of Service Innovators: Bridging the Gaps Between Business and Academia
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11. Service Innovation and Governance: Reframing the Concept of Service Innovation
12. Service Fascination
13. Innovation in Healthcare Intelligence and Smart Communities
14. System Innovations: A New Perspective in Servitization

Each of the chapters of this book were either reviewed or contributed by the members of Editorial Board. For this, our sincerest thanks and appreciation goes to the Board members listed below:

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This book will be of special value to a large variety of professionals, researchers and students interested in the human-side of service engineering from multiple perspectives ranging from industry sectors (healthcare) to tools and methods (service innovation, service design, organization & change) to broader issues (societal factors, service system frameworks, value co-creation). We hope this book will excite curiosity in many discipline areas and lay a foundation to attract others to contribute to this emerging area of research and practice. We want to thank the contributors, and encourage the readers to get involved - there is much work to do, and great opportunities to make lasting contributions!

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Section 1

Integrating Human and Artificial Services

Variability Handling in Multi-Mode Service Composition

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ABSTRACT

Information services are designated for information processing intensive tasks and may require different levels of human involvement in their execution, e.g., in information processing and analysis. The handling of variability in information service systems incorporates the concern of human involvement in service execution or, as we denote it, functioning mode of service. The existence of different functioning modes of services raises a problem of multi-mode service composition. In the paper we propose the use and the extension of variability representation model to represent variability in the information service system and present the multi-mode service composition approach to derive consistent flows of both abstract and concrete services.

Keywords: Information service system, multi-mode services, feature modeling, service composition

INTRODUCTION

In this paper we consider information services and information service systems. Information service provides information and is "*a component of an information system representing a well defined business unit that offers capabilities to realize business activities and owns resources (data, rules, roles) to realize these capabilities*", whereas the information service system is a collection of interoperable information services (Ralyté, Khadraoui, & Léonard, 2013). In information service system the role of human actor is important because she/he can participate in service execution with different levels of involvement. To denote the level of human involvement, we use the term "functioning mode" of the service. We distinguish between the following three types of service functioning modes (Rudzajs, Kirikova, & Strazdina, 2013):

- *manual* - the service is performed by human actor (perhaps, using some office software, but there are no specific software services or tools included in the service system for implementing this service).
- *automatic* - the service is performed by dedicated software and/or hardware that does not require human actor intervention.
- *semi-automatic* - the service is performed by dedicated software and/or hardware that requires human involvement, e.g., a human performer should provide the input data and review and approve data processed and/or generated by the tool.

The term *multi-mode service* (Rudzajs et al., 2013) is used to characterize the service that can be instantiated in different functioning modes. The awareness and the use of different functioning modes in the service system raise the level of variability that should be handled when composing services. Variability in software engineering usually is defined as ability of software or software artifact (e.g. component) to be changed so that it fits a specific context

(van Gurp, Bosch, & Svahnberg, 2001). As variability is an important factor in almost every contemporary system, many types of systems are built with the variability in mind. There are different types of variability, such as variability in features or in business processes (Galster, Avgeriou, & Tofan, 2013). The variability in features, particularly, variability in functioning modes of services is one of the concerns that should be considered in information service system. Not only services can be performed either by human performers (manually) or automatically, or semi-automatically; in some information service systems, one and the same abstract service can be instantiated in any of aforementioned functioning modes depending on the information handling situation. Currently variability handling is mainly considered in the context of single functioning mode of systems and their components. In this paper our goal is to focus on how to compose services with variable functioning modes.

The paper is organized as follows: The related work is briefly outlined in the next section. We propose the use and the extension of variability representation model to represent variability in the information service system and present the multi-mode service composition approach in the section "Functioning mode based variability of services". The extended variability representation model and multi-mode service composition approach are illustrated in the section "Example of extended feature model based service composition" using practical examples on education demand and offer monitoring service system (Rudzajs, 2012). Brief conclusions are stated in the last section of the paper.

RELATED WORK

Service composition involves the selection of appropriate services to satisfy particular user intention and can be defined as the process of combining and linking existing services (atomic or composite) to create new working services (Kapitsaki et al., 2007). Several surveys of service composition methods have been presented (Kapitsaki et al., 2007), (Regev, Favre, & Hayek, 2011), (Rao & Su, 2005), (Beek, Bucchiarone, & Gnesi, 2006), (Beek, Bucchiarone, & Gnesi, 2007), (Liu, Peng, Law, Wiederhold, & Sriram, 2005). The authors of aforementioned papers propose high variety of approaches that can be used for service composition. However, these approaches mainly consider different ways of composing application services with automatic functioning mode (Rudzajs et al., 2013). In this paper we are addressing various types of services from the point of view of their functioning modes. Variety of functioning modes poses the necessity to solve also the variability handling problem.

We propose to handle variability by (1) variability modeling and (2) multi-mode service composition approach that facilitate the inclusion of variability in information service systems. The proposed variability modeling approach is based on the following related work on variability in service systems and software engineering: (1) main variability research focus and application points, such as service variability modeling, service identification, service reuse, service configuration and customization, dynamic software product line, adaptive systems by Mohabbati et.al. (Mohabbati, Asadi, Gašević, Hatala, & Müller, 2013); (2) classification of variability in different dimensions that capture key facets of variability by Galster et.al. (Galster, Weyns, Tofan, Michalik, & Avgeriou, 2014). In Galster et.al. (2014) the dimensions of variability are organized in two clusters: type and mechanism. The type cluster includes dimensions for introduction and specification of variability, such as requirement type, representation, artifact, and orthogonality dimensions. The mechanisms of variability refer to the way the variability is realized. Our work considers the *Representation* dimension of the variability, namely, the application of service variability modeling and analysis by well known feature model (Kang, Cohen, Hess, Novak, & Peterson, 1990). Petersen et.al. (Petersen, Bramsiepe, & Pohl, 2006) propose model to support customer decisions by documenting alternatives in feature model and to communicate alternatives to a customer. In this paper we use the idea that feature models can serve as simple means to document and communicate alternatives of multi-mode service flows to particular stakeholders of the service system.

The main focus in the related work on variability handling is on services performed automatically by software components. Although some researches exist that concern several automation levels of services, e.g., (Sasa, Juric, & Krisper, 2008), (Sasa & Krisper, 2011), (Parasuraman, Sheridan, & Wickens, 2000), they do not consider the mix of different levels of automation. Also none of the authors discuss the services with different functioning modes. However the work of (Gu, Cuadrado, Lago, & Dueñas, 2013) propose three architectural viewpoints framing concerns about service automation. The viewpoints express architectural decisions about automation, identify the degree of automation, and represent specific data to support automation in services. In the model they illustrate service automation with different colors and identify which particular stakeholders are involved in particular service and what guides a stakeholder to provide the input for service. In the service composition they consider abstract services instead of concrete services realizing particular abstract service. In this paper we consider concrete services in the feature model and when composing multi-mode services. Thus our approach extends the approach presented

in (Gu et al., 2013) by means of detailing service functioning mode to concrete services instead of just abstract services. This work also extends the related work (Gu et al., 2013) in a way that before composing the service flow we introduce the feature model that also can capture service automation concerns.

In the remainder of the paper we propose the composition of multi-mode services based on variability representation model extended with the service functioning modes.

FUNCTIONING MODE BASED VARIABILITY OF SERVICES

We discuss the functioning modes of services in more detail and describe how they can be represented in the feature model in the first subsection of this section. The second subsection is devoted to the description of multi-mode service composition approach. The third subsection discuses some features of the proposed approaches of variability modeling and service composition.

Extending Feature Model

Well known feature models show the variability in service systems (Wittern & Zirpins, 2011). However, they do not address directly the issue of functioning modes of services. Therefore the feature model has to be extended to accommodate aforementioned variability of functioning modes. To achieve this, in the model we represent services as features provided by the information service system. Other representation types also could be considered (e.g., ontologies (Lamprecht, Naujokat, & Schaefer, 2013)), but they are out of the scope of this paper. In the feature model we distinguish between two types of services, namely, *abstract services* (represented as variation points in rectangular boxes in Figure 1) and *concrete services* (represented as variants in boxes with rounded corners in Figure 1). By variation point we denote a particular place in a system where choices are made as to which variant to use (Svahnberg, van Gurp, & Bosch, 2005). Variant is a particular option of a variation point. These concrete services are supposed to implement abstract services. We use the abbreviation *AS* for abstract services and *CS* for concrete services. An abstract example of feature model consisting of one abstract service (variation point) and three concrete services (variants) is presented in left part of Figure 1.

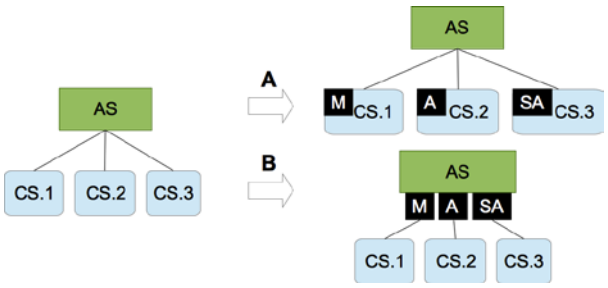

Figure 1. Feature model extended with the service functioning mode. Functioning modes are represented as A (automatic), M (manual), and SA (semi-automatic).

We discuss two options of feature model representation concerning the functioning mode of service (see the right part of Figure 1). In the first option the functioning mode is directly captured in concrete service as a parameter (see part A of Figure 1). Whereas in the second option the functioning mode is captured at an additional layer of abstract service (see part B of Figure 1). Main difference is in how the feature model is structured. First option does not introduce new layer for abstract services. In this case it becomes harder to manage the model when the variability of concrete services and their functioning modes grows. In the second option the functioning modes of abstract service are grouped within the additional layer thus making the feature model more structured and manageable when growing. With respect to this concern, further in the paper we use the second option to represent the variability of functioning modes in the feature model. Within this option each concrete service should be reviewed and assigned to particular group of functioning mode (e.g., the concrete service CS.1 is assigned to manual functioning mode of abstract service AS in part B of Figure 1).

Essential benefits from the feature model extension by functioning modes are the possibility to clearly identify the services where human involvement is necessary (manual and semi-automatic functioning modes) even before the composition of services and the possibility to identify the alignment of interfaces when composing multi-mode services.

Composition of multi-mode services

In this subsection we propose an approach to identify consistent compositions (service flows) of abstract and concrete services based on extended feature model.

Availability of the property of functioning mode and "required by" relationships in the feature model provide basis for further decisions to ensure consistent service flow. While the feature model itself lacks the ability to represent the composition of services (service flow), since this is not the aim of the feature model, still, the feature model with depicted service functioning modes could serve as a solid basis for composing multi-mode services. An abstract example of feature model consisting of four abstract services AS (variation points) and eight concrete services CS (variants) for three abstract services is presented in Figure 2. We will use this example to discuss the steps of multi-mode service composition (MMSC) approach presented further in this section. Figure 2 illustrates the following types of "required by" relationship (see corresponding numbers in circles): (1) between abstract services, (2) between abstract service and concrete service, (3) between concrete services.

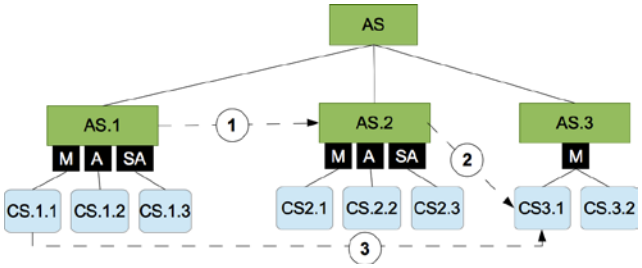

Figure 2. An abstract example of feature model extended with functioning modes of services. Abstract services (AS) are represented in rectangular boxes, concrete services (CS) – in boxes with rounded corners. Functioning modes are represented as additional layer for abstract services as A (automatic), M (manual), SA (semi-automatic). Dotted arrows are used for "required by" relationship.

By service composition we mean the arranging of services in a particular service flow. The service flow indicates the sequence of execution of services that is prescribed at the design time. Multi-mode service composition (MMSC) approach has to be performed in the following steps:

1) *Based on the intention user wants to achieve, compose the flow(s) of abstract services.* In the feature model, the variants of abstract services are either concrete services or other abstract services. When designing the flow of abstract services we should choose only abstract services for which the variants are concrete services (with particular functioning mode). We call abstract services, for which the variants are other abstract services, as *grouping services* and consider them only when checking the service flow for consistency (e.g., in the 1.b and 1.c sub-steps below). Consistent service flow is the service flow composed of services (abstract or concrete) satisfying the "required by" relationships given at the feature model. The flow of abstract services is composed by the following sub-steps:
   a) Choose initial abstract services from the feature model and arrange them in the flow.
   b) For each abstract service check *directly required* abstract services (e.g., AS.2 directly requires AS.1, indicated as (1) in Figure 2) or grouping services and update the service flow with the new services if necessary.
   c) For each abstract service check *indirectly required* abstract services. Indirectly required services can be determined in the following way: for each concrete service of the abstract service check directly required 1) abstract services, e.g., CS.3.1 directly requires AS.2, indicated as (2) in Figure 2; 2) concrete services, e.g., CS.3.1 directly requires CS.1.1, indicated as (3) in Figure 2; or 3) grouping services. Include appropriate abstract services as "optional" in the flow if they are required by at least one concrete service. In the current example, AS.2 is included in the flow as optional abstract service (see part A of Figure 3).
2) *Derive the service flows of concrete services* by the following sub-steps:
   a) Choose concrete service for each abstract service in the initial flow.
   b) For chosen concrete services include directly (e.g., (3) in Figure 2) and indirectly (e.g., (2) in Figure 2) required concrete services and mark appropriate optional abstract service as required (e.g., see flow 1 in right hand side of part B of Figure 3).
   c) Repeat 2.a) and 2.b) sub-steps until all eligible concrete services are arranged in flows

d) Arrange the flows by adding the flows with the initial abstract services at the beginning of the list. For the abstract flow in this particular example we have 3 options for concrete flows with 2 initial services and 9 options for concrete flows of 3 services. Concrete flows are illustrated in part B of Figure 3.

3) *Identify stakeholders involved in the service flows*. Both M and SA functioning modes of service require the involvement of human actors in the execution of service.

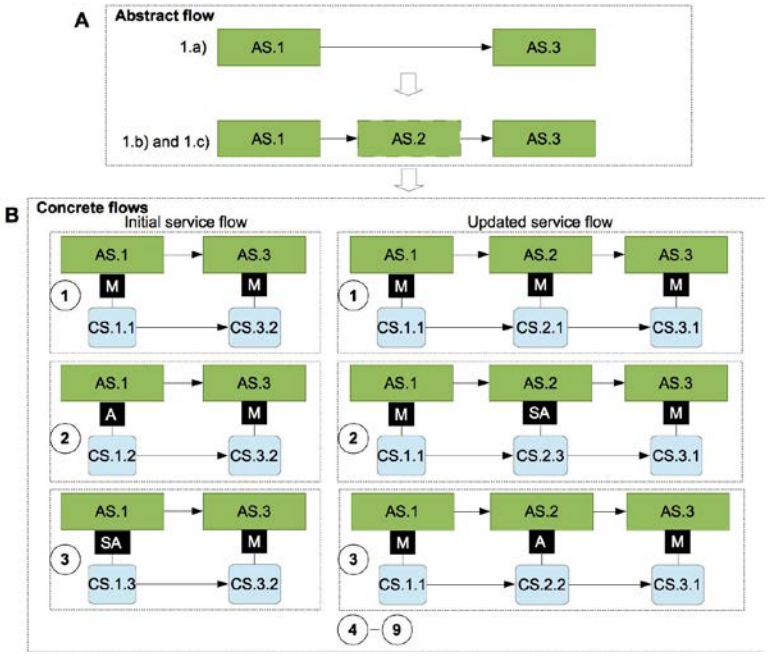

Figure 3. MMSC approach illustrated on an abstract example. Part A of the figure illustrates the 1.a) to 1.c) steps of the approach. Part B of figure illustrates the flows of concrete services organized by the initial service flow and the updated service flow (includes *optional* service AS.2).

When dealing with multi-mode services, the alignment of service interfaces becomes one of the main concerns to enable service interaction. Typically, in service oriented systems the alignment is done between services with automatic functioning mode only. In multi-mode information service systems due to variety of functioning modes the number of possible interfaces increases. This highlights the variability issue in the alignment of service interfaces. The following alignment possibilities of (multiple) input and output interfaces or communication possibilities can be designated or provided for passing and retrieving information to/from concrete service with particular functioning modes:

- *From automatic service to automatic service.* Application level service interfaces should be aligned between services in composition. Human actor is not involved.
- *From automatic service to manual service.* User interface should be established allowing particular stakeholder of service with manual functioning mode to review the output of service with automatic functioning mode. Human actor is involved.
- *From manual service to automatic service.* User interface should be established (usually as input forms) allowing particular stakeholder the preparation of the result of service with manual functioning mode for input into service with automatic functioning mode.
- *From manual service to manual service*. Specific application level interfaces are required (usually as input forms); business level communication is possible.
- *SA involved*. Depending on the specifics of the service with semi-automatic functioning mode, it may require only application level interface, only business level communication, or both.

By taking into account the alignment of service interfaces, we extend the MMSC approach to revisit the concrete service flows derived by steps 1, 2 and 3 of the MMSC approach by considering the applicable transitions between services with the same or different functioning modes. Thus we add step 4 to the MMSC approach:

4) *Revisit the options of concrete service flows* by considering the alignment of interfaces necessary in composition of two services and omit the unwanted/not reliable alignment of interfaces between services, thus omitting also the particular flows of concrete services.

Remaining flows of concrete services should be considered for implementation in information service system.

Discussion

The above-presented MMSC approach currently gives an opportunity to utilize the variability clearly stated in the extended feature model. The following issues are important for manual composition of services:

- MMSC approach mainly uses "required by" relationship to derive consistent flow of abstract and concrete services. "Required by" relation is important in the feature model because it allows finding appropriate flows of concrete services, as well it allows crosschecking the abstract service flow for consistency.
- Human actor determines the sequence of services in all cases. MMSC approach allows to compose consistent flow by using 1.b) and 1.c) steps and it allows to reason about the alignment of interfaces involved in the service flow, that could be considered for design and implementation of the information service system where the variability in functioning modes of services exists. Service flow could be implemented in software system, i.e., software system can initiate the services in the particular sequence.
- Certainly, the feature model can change during design and evolvement of the information service system. Each change in the feature model should be reflected also in the flows of abstract and concrete services to maintain consistent service flows.

To be able to automatically derive consistent service flows with multimode services, the feature model should be extended with algorithms employing formal rules. This is one of our future research goals.

EXAMPLE OF EXTENDED FEATURE MODEL BASED SERVICE COMPOSITION

This section presents the feature model and apply MMSC approach for education demand and offer monitoring system (EduMON) (Rudzajs, 2012).

Description of Functional Variability in EduMON

EduMON is information service system for information handling with respect to different information sources and stakeholders. It is aimed at supporting education demand and offer monitoring process by the following activities (feature model of EduMON is provided in Figure 4):

- *Providing* activity is for providing documents from available reachable information sources. The documents available in information sources should reflect the information about demanded and offered knowledge, skills, and competences and are retrieved from different types of textual sources (e.g., Web sites, databases, XML-based files).
- *Processing* activity aims at extracting education information (knowledge, skills, and competences) from the information sources (particularly, from the documents) available in the system and, by comparing information from different sources, to depict the education demand and offer correspondence.
- *Consuming* activity distributes the processed information to the stakeholders of the system via graphical and tabular reports.

Various stakeholders (e.g., teachers, students, employers, and others) are involved in each above-mentioned activity. They are grouped with respect to the activity they are involved, namely, *Providers*, *Processers* and *Consumers*. Stakeholders interact via, with, and within EduMON to fulfill specific information handling intentions.

Providing and *Processing* activities are targeted to particular information sources and their documents (represented in part I of Figure 4), however, the *Consuming* activity is for representing the processed information from multiple information sources to users via graphical and tabular reports (part II of in Figure 4). In the feature model provided in Figure 4, solid lines represent the types (mandatory or optional) and relationships (OR or XOR) of abstract services. Dashed lines represent the "required by" relationship between abstract and/or concrete services. For instance, to execute any of the concrete services of *Extraction* abstract service (see 2.1 in Figure 4), the execution of any of the concrete services of *Retrieval* abstract service (see 1.2 in Figure 4) is required.

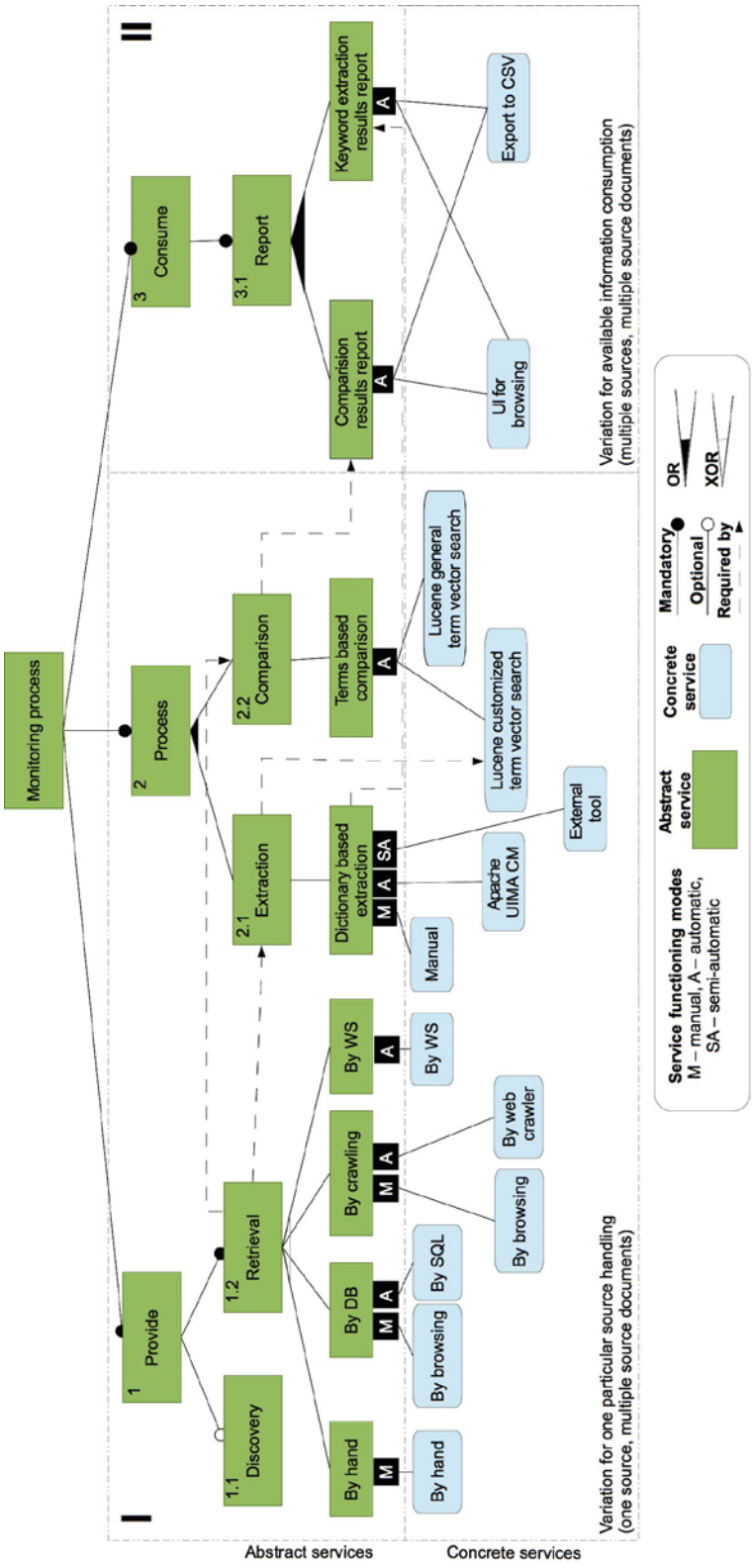

Figure 4. The functional variability of EduMON represented by the feature model extended with functioning modes of abstract services and their concrete implementations.

Multi-Mode Service Composition in EduMON

In this subsection we discuss the application of MMSC approach to EduMON information service system.

1) First we compose the flow of abstract services. Suppose, our intention is to add new information source by hand and perform its comparison against other information sources in EduMON (e.g., add new curriculum and compare it with other curricula to find similar courses).
   a) Initial service flow includes two abstract services, namely, *Retrieval by hand* and *Terms based comparison* (see part A of Figure 5).
   b) There are no directly required abstract services for *Retrieval by hand* and *Terms based comparison*, thus the service flow is not updated at this sub-step.
   c) For the concrete service *Lucene customized term vector search* directly required abstract service can be identified, namely, *Dictionary based extraction* (see Figure 4). Thus we update abstract service flow and include *Dictionary based extraction* as optional abstract service (see part A of Figure 5), because it is required by one concrete service of *Terms based comparison* abstract service.
2) Now we derive the flows of concrete services to achieve the intention stated in Step 1 (see part B of Figure 5). There is one option for initial flow of abstract services and three options for updated flow of abstract services.
3) The stakeholders involved in each particular flow of concrete services belong to stakeholders of *Providing* and *Processing* activity groups. The *Provider* stakeholder group is responsible for the *Retrieval by hand* service with manual functioning mode, whereas the *Processer* stakeholder group - for the *Dictionary based extraction* service with manual and semi-automatic functioning mode. As *Terms based comparison* service is performed with automatic functioning mode the involvement of human actor is not necessary. Discussion about the groups of stakeholders is available in (Rudzajs et al., 2013).
4) By reviewing the options of concrete service flows and considering the alignment of interfaces necessary in the composition of two services, we conclude that all flows are feasible to be implemented in the system. For instance, the service *Retrieval by hand* with manual functioning mode is in composition with the service *Dictionary based extraction by Apache UIMA ConceptMapper* with automatic functioning mode (see the first updated flow of concrete services in part B of Figure 5). In this case we should establish interface to allow the passing the retrieved document from service *Retrieval by hand* to the service *Dictionary based extraction by Apache UIMA ConceptMapper*. This interface can be implemented as input form where the human actor passes the document, e.g., study course description, to automatic keyword extraction service.

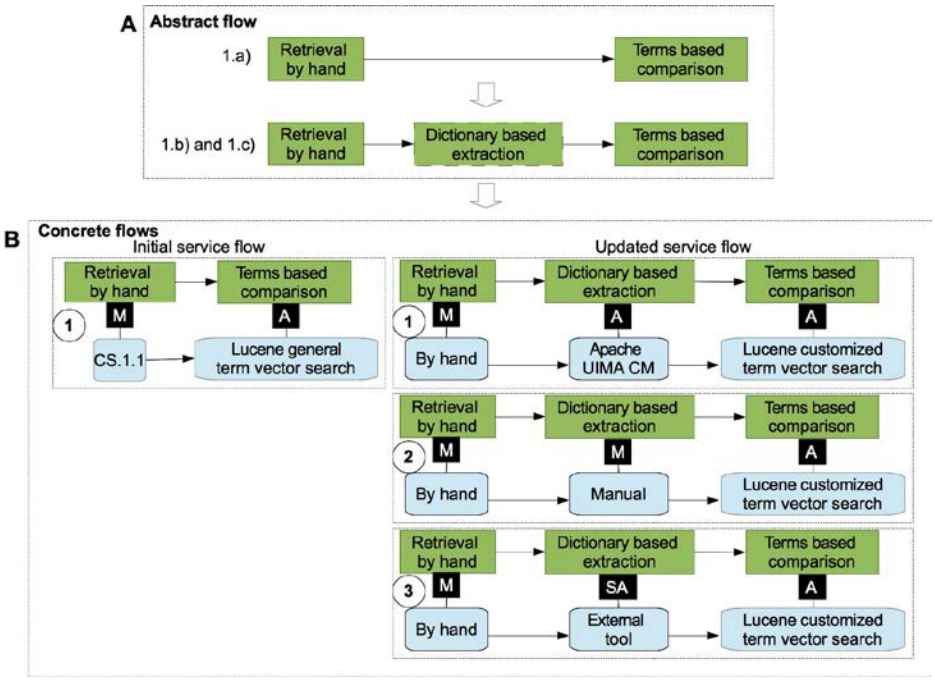

Figure 5. EduMON multi-mode service composition for intension "add new information source by hand and perform its comparison to other information sources".

The application of the MMSC approach to EduMON information service system enabled us to analyze the system from the viewpoint of variability, thus allowing to derive potential usage scenarios involving the services with different functioning modes. Because of relatively few "required by" relationships in the feature model (see Figure 4), the composition of multi-mode services were quite straightforward; however, for systems with greater functional variability the automated approach might be more feasible.

CONCLUSIONS

In this paper we approached the problem of variability handling in multi-mode service composition. To solve the problem, we suggested to extend the well known feature model for service representation and proposed the approach of service composition (MMSC approach) that is based on the extended feature model. With the extension the feature model becomes more expressive since it reflects the concern about functioning modes of services in information service system. We showed two options how the feature model can be extended, namely, by assigning the functioning mode directly to the concrete services or by assigning concrete services to particular group of functioning mode of abstract service. Second option provides more structured and manageable feature model. The extended feature model provides the possibility to clearly identify the services where the human involvement is necessary even before the actual composition of services; as well it serves as the ground for MMSC approach to derive consistent flows of both abstract and concrete services. Application of extended feature model and the MMSC approach facilitates the handling of variability in information services systems where the variability of functioning modes of services is present.

Further research direction includes the extension of feature model with formal rules allowing automatic derivation and maintenance of consistent service flows with multi-mode services.

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A Semi-Automatic Approach for the Integration of Structural Karlstad Enterprise Modeling Schemata

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ABSTRACT

In this paper, we describe and discuss a semi-automatic approach for the integration of structural Karlstad Enterprise Modeling (EM) Schemata. The focus is on the implementation-independent level and therefore we treat an EM schema as a high-level description of data for some part of the future information system. Our point of departure is the classic four-phase integration process comprised of pre-integration, comparison of the schemata, conforming the schemata and, merging and restructuring. In relation to the semi-automatic approach described and discussed, we argue that several rules and knowledge repositories should be used to facilitate the whole integration process. However, it is also argued that the domain experts are still a very important source of knowledge and should therefore also be involved during the whole integration process. The research approach is inspired by design science in which the end product should be a useful artifact. In this paper, the artifact is provided in the described semi-automatic approach for the integration of Structural Karlstad EM schemata. As its main contribution, the paper offers a holistic view of the described and discussed semi-automatic approach for the integration of structural Karlstad EM schemata.

Keywords: Schema Integration, Semi-Automatic Approach, Karlstad Enterprise Modeling Approach, Implementation-Independent level

INTRODUCTION

Schema integration is the problem of integrating two or more source schemata into one integrated schema. Batini et al. (1986) describe schema integration as "the activity of integrating the schemas of existing or proposed databases into a global, unified schema." (p. 323). Schema integration is a key issue when developing new information systems, including standalone applications, e-services, and so forth. This is motivated since the new information system is often described and illustrated in a set of schemata with or without textual descriptions. However, each schema illustrates some part of the new information system with a focus on how some domain expert and/or group of domain experts describe their part of the information system often making it into a set of heterogeneous schemata. A schema might also be represented in many forms. Bernstein et al. (2011) emphasize this and describe as schema as "a formal structure that represents an engineered artifact, such as a SQL schema, XML schema, entity-relationship diagram, ontology description, interface definition, or form definition" (p. 695). In this paper, however, we focus on the notation of the Karlstad Enterprise Modeling (EM) approach and therefore treat and describe a schema as a graphical description illustrating the structural (static) part, the data, of an information system being modeled using the EM approach. Schema integration can also be conducted on at least two levels of abstraction: on an *implementation-independent level* closer to humans, and on an *implementation-dependent level* closer to

programming languages and computers. In this paper we focus on the former, the *implementation-independent level*.

Automation of the schema integration process has been a dream for many researchers in the field. However, due to its complexity it is not realistic to aim at full automation (Stumptner et al., 2004). The idea of aiming for a semi-automatic approach, however, was addressed in the mid-80s. For instance, in Convent (1986) the author emphasizes that computer applications should be used to assist the domain experts and designers doing schema integration. In our approach we have therefore also chosen the semi-automatic approach, in which not only rules and domain repositories are used but the domain experts are also very much involved during the whole integration process.

As a result, this paper presents a semi-automatic approach for the integration of structural Karlstad EM schemata. Within each phase of the integration process, we address important aspects that need to be taken into consideration in a semi-automatic approach. We emphasize the usage of rules and domain repositories to aid in the schema integration process and also the involvement of domain experts during the whole integration process since they are also very important sources of knowledge.

This paper is structured as follows: in section two we present the Karlstad EM approach focusing on the structural part (static dependencies). In section three, we describe the adopted research approach and in section four the main contribution of this paper: the described and discussed semi-automatic approach for integration of structural Karlstad EM schemata. In section four we also describe related work and distinguish it from our own. In section five, we give a small and illustrative example on how parts of the semi-automatic approach for integration of structural Karlstad EM schemata could be used. Finally, the paper closes with a summary and future work.

THE KARLSTAD ENTERPRISE MODELLING APPROACH

The Karlstad Enterprise Modelling (EM) approach that is adopted in this work refers to a modeling approach developed at Karlstad University, Sweden. The modeling approach has primitives for illustrating the *pragmatic*, the *semantic* (both static and dynamic aspects) and the *syntactic* aspects of the information system that is being modeled. The pragmatic aspects are modeled using a set of pragmatic dependencies illustrating goals, problems and opportunities (Gustas and Gustiené, 2008). Among these goals, problems and opportunities it is also possible to illustrate positive and negative influences. The semantic aspects are modeled using a set of static aspects and a set of dynamic aspects. The dynamic aspects can further be divided into communication dependencies (actors, actions and flows) and state dependencies (states and conditions). The syntactic aspects are modeled using a set of CASE-tools dependent syntactic elements (Gustas and Gustiené, 2004). Nevertheless, in this work we focus on the structural aspects, static dependencies (Figure 1), used to illustrate concepts and dependencies between these.

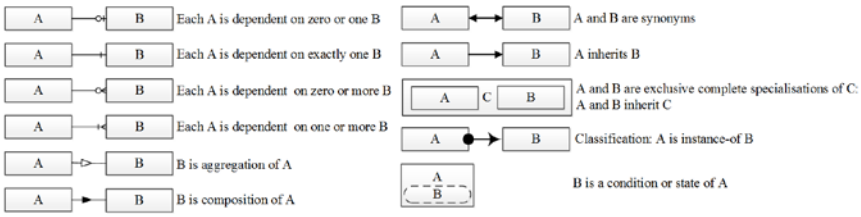

Figure 1. Representation of static dependencies in EM (adapted and modified from Gustas and Gustiené, 2004)

Within the structural aspects, the only primitive in EM that is given a name (a label) are concepts. A concept is drawn as a box and the label is written in it. To illustrate that two concepts are connected to each other through a dependency, a line between them is drawn. Besides that, it is possible to mark cardinality and to specify a part-of dependency (aggregation and composition), that two concepts are synonyms, an is-a dependency (inherits and specialization), an instance-of dependency (classification), and a condition or state.

Finally, it should be noted that in EM we do not distinguish between classes (entities) and properties (attributes) but instead draw them all as concepts (boxes). This is motivated since we here focus on concepts and dependencies between concepts illustrating an implementation-independent level of the information system being modeled.

RESEARCH APPROACH

The approach adopted in this research is inspired by design science (Hevner, 2007; Hevner and Chatterjee, 2010; Hevner et al., 2004; Iivari, 2007; March and Smith, 1995). In design science research the IT-artifact is always at the center, or as Hevner et al. (2004) puts it: "The result of design-science research in IS is, by definition, a purposeful IT artifact created to address an important organizational problem" (p. 82). Furthermore, in design science the IT-artifact, the research output, might either be a *construct*, a *model*, a *method* or an *instantiation* (Hevner et al., 2004; March and Smith, 1995). March and Smith (1995) describe the four research outputs as follows:

- "*Construct* or concepts form the vocabulary of a domain. They constitute a conceptualization used to describe problems within the domain and to specify their solutions." (p. 256)
- "A *model* is a set of propositions or statements expressing relationships among constructs. In design activities, models represent situations as problem and solution statements." (p. 256)
- "A *method* is a set of steps (an algorithm or guideline) used to perform a task." (p. 257)
- "An instantiation is the realization of an artifact in its environment." (p. 258)

However, to end up with an IT artifact, a research output, it is important to follow some research method and/or research guidelines. In Hevner et al. (2004) the authors describe seven research guidelines that should "assist researchers, reviewers, editors, and readers to understand the requirements for effective design-science research" (p. 82). In this work the seven guidelines have been applied in the following way.

1. *Design as an Artifact*. The proposed semi-automatic approach for the integration of structural Karlstad EM schemata is the research outcome. This means that the proposed approach is the artifact and it can be classified as a method according to the list of research outputs described by March and Smith (1995).

2. *Problem Relevance.* Almost 30 years ago Navathe et al. (1986) stated that schema integration is a complex, time-consuming and error-prone task. This statement is still true. Research conducted in the area has solved many problems related to schema integration. However, since new approaches, methods and modeling languages are developed and old ones change new research problems and questions are stated and tackled all the time. For instance, schema matching, the second phase in the integration process, has many application areas where Bernstein et al. (2011) mention the database field, knowledge-based applications, health care, and web applications as four examples.

3. *Design Evaluation.* Hevner et al. (2004) mention five design evaluation methods: *observational*, *analytical*, *experimental*, *testing* and *descriptive*. In this work we have evaluated the research results using the descriptive method, which includes both informed arguments and scenarios. However, since building a tool, an instantiation (March and Smith, 1995), for our approach is part of future work we do claim that we have conducted all three cycles (relevance cycle, rigor cycle, and design cycle) as described in Hevner (2007).

4. *Research Contribution.* Several delimited studies on how to semi-automate parts of integrating structural Karlstad EM schemata have been reported (e.g. Bellström, 2010b; 2012). However, to our knowledge there is no semi-automatic approach for integrating structural Karlstad EM schemata that deals with all four phases of the integration process as described by Batini et al. (1986).

5. *Research Rigor*. In our approach we combine approaches, methods and strategies to propose an integration process for the Karlstad EM approach. Several of these methods, approaches and strategies have been implemented and tested (e.g. Bellström and Vöhringer, 2011a; 2011b; Vöhringer, 2010) in what March and Smith (1995) describe as an instantiation, a software prototype, while other methods, approaches and strategies are based on rules developed for future implementation (e.g. Bellström, 2010b; 2012).

6. *Design as a Search Process*. Our approach has been developed incrementally and iteratively for some time. During these iterations we have developed and search for applicable approaches, methods and strategies to all four phases of the integration process as described by Batini et al. (1986). However, since the modeling approach adopted in this work differs from the more classic modeling approaches, such as the ER and the UML, several adaptions to the identified approaches, methods and strategies have been made.

7. *Communication of Research*. In Hevner et al. (2004) the authors state that research output of design science should be communicated to a technology-oriented audience as well as to a management-oriented audience. Since the research results described in this paper should be viewed as a the first step towards a semi-automatic approach for the integration of structural Karlstad EM schemata our usage of the language should appeal to both target groups, meaning that the paper as such is part of fulfilling the last research guideline.

Finally, it should be mentioned that design science research is not a new research approach. It has been adopted and used in many disciplines, such as Computer Science, Software Engineering and Information Systems, for a rather long time now (Iivari, 2007). Examples of recent research that has adopted design science are given in Persson and Stirna (2010), in which the authors used design science to define a competence profile for practitioners of enterprise modeling and in Bellström and Kop (2012), in which we used design science to develop a framework for schema quality in the schema integration process.

A SEMI-AUTOMATIC APPROACH FOR SCHEMA INTEGRATION

In our semi-automatic approach we follow the classic four phase integration process as proposed by Batini et al. (1986) comprised of *pre-integration*, *comparison of the schemata*, *conforming the schemata* and, *merging and restructuring* (Figure 2).

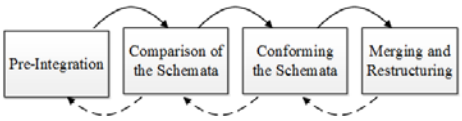

Figure 2. The four phases of the schema Integration process (adapted and modified from Bellström, 2006a).

In the first phase, *pre-integration*, the input schemata are processed and adapted to facilitate the following three phases of the integration process. In the second phase, *comparison of the schemata*, the input schemata are compared with the aim to identify similarities as well as differences and in the third phase, *conforming the schemata*, the identified similarities and differences are resolved. Finally, in the fourth and last phase, *merging and restructuring*, the schemata are first merged into an intermediate schema and after that restructured to fulfill several quality criteria and/or quality factors. At the end of this phase the designers should have a global schema that can be passed to the phases implementing the information system. In the rest of this section we go through each phase of the integration process. In doing so, we both state and argue for the usage of methods, approaches and strategies (e.g. rules and repositories) that can aid in the process of integrating structural Karlstad EM schemata. More specifically this means describing and discussing the research output of this paper: the proposed semi-automatic approach for the integration of structural Karlstad EM schemata. One last remark is required before we continue with each integration phase in the integration process. In developing the proposed semi-automatic approach we have not only been inspired but also influenced by the work first introduced in Bellström and Vöhringer (2009) and later on developed and extended in Bellström and Vöhringer (2011a; 2011b). However, in these publications we focused on developing a language independent integration approach whereas in this work we focus on developing a semi-automatic approach for the integration of structural Karlstad EM schemata, which is a clear and important distinction between the approaches.

Pre-Integration

Pre-integration is the first phase in the integration process and its main purpose is to collect as much information of the input schemata as possible and adjust the input schemata to facilitate the phases that follows. In earlier research within the area of schema integration, this phase has not always been mentioned. For instance, in Batini et al. (1986) only three out of twelve analyzed methods mentioned pre-integration as a phase in the integration process. Also Song (1995) pointed out that pre-integration has often been overlooked. However, over the years the importance of the pre-integration phase and the tasks to perform during it has been emphasized. For instance in Song (1997) the author states that pre-integration is an important phase within the schema integration process.

In pre-integration several tasks should be carried out. In Batini et al. (1986) the authors stated that the integration strategy should be decided. Furthermore, these strategies could be divided into binary strategies including ladder and balanced and n-ary strategies including one-shot and iterative. In Song (1995) the author stated three tasks to be

performed in pre-integration: translate all input schemata into the modeling language chosen, recognize and resolve conflicts within each schema and choose the integration strategy. In our approach we follow the work reported in Bellström and Vöhringer (2011b), and in Bellström et al. (2012) also adapted and modified to behavioral schemata, and therefore carry out at least the six tasks addressed below.

(1) Translating the input schemata into the chosen modeling language is applicable if the information system is modeled using different modeling languages. In our case we translate all input schemata into the Karlstad EM approach since that is the modeling language chosen and used in our research. Once again it should be noted that in the presented research we focus on the structural aspects (static dependencies) of the modeled information system and leave out the dynamic aspects for future research. In Bellström and Kop (2012) we addressed semi-automatic schema pre-integration and in the comparison of related work, translation of input schemata was one of the tasks that was mostly addressed, although not always defined as a pre-integration task.

(2) Analyzing the input schemata to adapt concept names is conducted to first of all facilitate comparison of the source schemata. In Bellström et al. (2008) we pointed out that standardization of concept notions was one task to perform to facilitate the following integration phases. Standardization could be carried out through the usage of naming guidelines in which, for instance, concept names are written in singular. Besides this, in Bellström and Vöhringer (2009) it was mentioned that a stemmer (Hull, 1996) could be used to bring a concept name to its base form. To aid in the process of standardization of concept names the approach proposed in Sorrentino et al. (2009) could also be used. In Sorrentino et al. (2009) the authors proposed and described a semi-automatic method that normalizes the schema labels meaning, abbreviations, acronyms, and expands compound terms. Nevertheless, irrespective of method used to adapt concept names, the approach should counteract the occurrence of semantic loss (Bellström, 2009).

(3) Analyzing the input schemata to disambiguate concept names is a task that is conducted to collect information for the domain experts in order to manually verify or decline a suggestion from an integration tool. This task could either be conducted manually by the domain experts or automatically by an ontology (Gruber, 1993) and/or lexicon such as WordNet (Miller, 1995). A more detailed discussion on how to disambiguate concept names is given in Vöhringer (2010).

(4) Analyzing the input schemata aiming to recognize and resolve intra-schema conflicts is a task that is conducted to both recognize and resolve problems within one schema. In doing so, not only homonyms but also synonyms should be recognized and resolved. Within each source schemata we also need to deal with hypernym-hyponym dependencies (is-a) and holonym-meronym dependencies (part-of). For this reason, this task could be viewed as a minor version of phase two and three in the integration process. However, as will be discussed in more depth in conforming the schemata, while resolving conflicts it is important that we do not lose any concept names and/or dependencies since these might have a meaning for one or several domain expert(s). Losing a concept name and/or dependency would in most cases cause semantic loss (Bellström, 2009).

(5) Introducing missing concepts and relationships is a task that is performed if the input schemata include so called many-to-many dependencies (links) and/or if a domain ontology (Gruber, 1993) and/or taxonomy is available. So-called many-to-many dependencies can be translated into two many-to-one dependencies with a new concept placed in between the two. This task can either be performed automatically or manually together with the domain experts. Introduction of missing relationships are performed if and only if a domain ontology and/or taxonomy is available and the purpose is to automatically enrich and add relationships to the schemata prepared for integration.

(6) Selecting the integration strategy is the task in which the integration processing strategy is decided. In our approach we have decided to use the binary ladder strategy (Batini and Lenzerini, 1984; Batini et al., 1986; Batini et al., 1992). This is motivated since binary ladders do not only simplify comparison and conforming the schemata (Batini et al. (1986) but also ensure that enough intermediate schemata are produced for quality insurance (Bellström and Kop, In press).

Comparison of the Schemata

Comparison of the schemata is the second phase in the integration process. Over the years it has received a lot of attention in the research community. Comparison of the schemata has for instance been mentioned as “The most challenging problem in schema integration” (Johannesson, 1993, p. 19). It has also been called an important (Song, 1995) and difficult (Doan et al., 2004; Ekenberg and Johannesson, 1996; Lee and Ling, 2003) phase of schema

integration. Finally, schema matching has also been recognized as an important research problem to study as a topic independent of application area (Madhavan et al., 2001). The main purpose of this phase is to recognize not only similarities but also differences between two source schemata. In our approach we have decided to adopt what Rahm and Bernstein (2001) called a composite schema based matching approach. It is schema based since we are working with conceptual schemata and composite since we are combining the results from several matchers into one matching result. This is motivated since using several matching approaches and combining them into one result should produce a better matching result than the using of one single matching approach (Rahm and Bernstein, 2001). Before presenting our approach to the comparison of the schemata, a comment of the usage of schema and instance based matching is needed. Using EM it is possible, through the classification dependency, graphically to illustrate that one concept is an instantiation of another concept (see Figure 1). This does not, however, mean that the concept that is an instance-of another concept is what Rahm and Bernstein (2001) call *instance-level data*. We therefore classify our approach as a composite schema based matching approach. Finally, in our approach the comparison of schemata is divided into two tasks: comparison of the concepts as such (also known as element level) and comparison of the concepts neighborhood (also known as structural level).

In our approach we begin with *concept name comparison* in which the names of the concepts in one schema are compared with the names of the concepts in another schema. Such a comparison might yield the following results: **Match,** the concept names are the same, **No Match,** the concept names are not the same, and **Partly Match,** the whole or parts of one concept name is part of another concept name. If comparison of concept names results in a **Partly Match** we continue and apply two so called linguistic rules (Bellström and Vöhringer, 2011a) in which it is indicated if one concept '**belongs-to**' another concept, if one concept is '**related-to**' another concept or if one concept '**is-a**', a specialization, of another concept. In Bellström and Vöhringer (2011a) we formulated these two rules as follows:

> *A.* If the compared concept names are available in the form of A and AB (i.e., A corresponds to the compound AB minus the head B), then the relationship "AB belongs/related to A" can be assumed.
>
> *B.* If the compared concept names are available in the form B and AB, where A is the head of the compound AB, then the relationship "AB is a B" can be assumed. (p. 26)

If comparison of concept names results in **No Match,** we continue and check concept definitions if these are available. Checking the concept definitions might result in **No Match** or **Synonyms**. Finally, as addressed in Bellström and Vöhringer (2011b), if domain ontology exists, it is possible to carry out a domain ontology-based comparison of concept names.

After having focused on the concepts as such, we continue and perform comparison of concepts neighborhood. In our approach concept neighborhood is defined as the directly connected concepts to the concept that is currently analyzed for similarities and differences. However, before conducting comparison of concepts neighborhood several influence factors such as *polysemy count* (the number of meanings a concept has in a given language), *valency* (the number of parameters, other words, a concept needs to get its meaning in a given language) and *domain weight* (each concept might have a specific weight, a number that has been given manually by the domain experts) should be taken into account since these might indicate if comparison of concepts neighborhood is even necessary to perform (Bellström and Vöhringer, 2009).

If it is decided to go ahead with comparison of concepts neighborhood, which is often the case since we only get indications from the influence factors, we first apply a set of rules. The usage of the rules might yield the following results: **Match,** the concepts neighborhood are the same, **No Match,** the concepts neighborhood are not the same and finally, **Partly Match,** parts of the concepts neighborhood are the same but some still differ.

The rules were first presented in Bellström (2010a) and later on adapted and modified in Bellström (2010b) and Bellström and Vöhringer (2011a; 2011b). In total, we apply seven rules when we have a **Match** of concept names and four rules when we have a **Partly Match** of concept names. The seven rules we apply for comparison of concepts neighborhood when we have a **Match** of concept names are as follows. If comparison of concept names yields **Match** and comparison of concepts neighborhood yields:

(1) **Match** THEN *equivalent* concepts can be assumed.

(2) **No Match** THEN *homonymic* concepts can be assumed.

(3) **Partly Match** THEN *synonymic* concepts can be assumed IF one concept in each source schemata is named differently

(4) **Partly Match** THEN an *association dependency* can be assumed IF one concept is named with a following addition to the other one AND cardinality between these concepts is one-to-one.

(5) **Partly Match** THEN a *hypernym-hyponym dependency* can be assumed IF one concept is named with prior addition to the other one.

(6) **Partly Match** THEN *a holonym-meronym dependency (composition)* can be assumed IF one concept is named with a following addition to the other one AND cardinality between these concepts is one-to-many.

(7) **Partly Match** THEN *a holonym-meronym dependency (aggregation)* can be assumed IF one concept is named with a following addition to the other one AND cardinality between these concepts is zero-to-many.

The four rules we apply for comparison of concepts neighborhood when we have a **Partly Match** of concept names are as follows:

(1) IF comparison of concept names yields **Partly Match**, one concept is named with a following addition to the other one, AND comparison of concepts neighborhood yields **Partly Match** or **Match** THEN *an association dependency* can be assumed IF cardinality between these concepts is one-to-one.

(2) IF comparison of concept names yields **Partly Match**, one concept is named with a follow addition to the other one, AND comparison of concepts neighborhood yields **Partly Match** or **Match** THEN *a holonym-meronym dependency (composition)* can be assumed IF cardinality between these concepts is one-to-many.

(3) IF comparison of concept names yields **Partly Match**, one concept is named with a follow addition to the other one, AND comparison of concepts neighborhood yields **Partly Match** or **Match** THEN *a holonym-meronym dependency (aggregation)* can be assumed IF cardinality between these concepts is zero-to-many.

(4) IF comparison of concept names yields **Partly Match**, one concept is named with a prior addition to the other one, AND comparison of concepts neighborhood yields **Partly Match** or **Match** THEN a *hypernym-hyponym dependency* can be assumed.

In Bellström (2012) we also proposed two rules for the recognition of power types and homonyms that are applicable when integrating schemata that are designed on different levels of abstraction (schema level and instance level) and includes the classification dependency (see Figure 1) in at least one of the input schemata. A power type is by OMG (OMG UML, 2011) described as "a class whose instances are subclasses of another class" (p. 76) indicating that a power type includes two levels of abstraction. The rules for recognition of power types (1) and homonyms (2) might shortly be summarized and explained as follows:

(1) If comparison of concept names yields **Match** between three concepts, e.g. S1.A = S2.A, S1.AB = S2.AB and S1.C = S2.C, and comparison of concepts neighborhood yields **Partly Match** meaning, cardinality is the same between the concepts A and AB in S1 and S2, e.g. A many-to-one AB (one A might have one and only one AB while AB might have zero or many A), **AND** S1.C 'is-a' S1.A **AND** S2.C is 'instance-of' S2.AB **THEN** it can be assumed that AB is a *power type*. The rule is even stronger if AB is a composite name of concept name A with a following addition B.

(2) If comparison of concept names yields **Match** between three concepts, e.g. S1.A = S2.A, S1.AB = S2.AB and S1.C = S2.C, and comparison of concepts neighborhood yields **Partly Match** meaning, cardinality is the same between the concepts A and AB in S1 and S2, e.g. A many-to-one AB (one A might have one and only one AB while AB might have zero or many A), **AND** S1.C 'is-a' S1.A **AND** S1.C is 'instance-of' S1.AB **AND** S2.C is 'instance-of' S2.A THEN it can be assumed that C is a *homonym*. Also this rule might be stronger if AB is a composite name of concept name A with a following addition B.

In Batini et al. (1986) the authors divide conflicts into name conflicts (homonyms and synonyms) and structural conflicts (type, dependency, key and behavioral conflicts). In our approach a *dependency conflict* might also appear. A dependency conflict can be assumed if comparison of concept names yields **Match** between two concepts and comparison of concepts neighborhood yields **No Match** between the same concepts.

Finally, as discussed in Bellström and Vöhringer (2011a; 2011b), if domain ontology exists it might be used for neighborhood comparison. Besides this, taxonomy based matching using the Lesk algorithm (Lesk, 1987; Banerjee and Pederson, 2002) might also be used as a matching approach during neighborhood comparison (Vöhringer and Fliedl, 2011).

Since we are applying what Rahm and Bernstein (2001) called a composite schema based matching approach, we also take into account the result of all the used matching approaches. In doing so, it is decided if and how the input schemata concepts are similar or different. The recognized and documented similarities and differences are now passed on to the following phase in the schema integration process in which they are resolved.

Conforming the Schemata

Conforming the schemata is the third phase of the integration process and this phase has also received a lot of attention by the research community. For instance, Spaccapietra and Parent (1994) mention this phase as a key issue and Lee and Ling (2003) as the most critical issue of schema integration. Nevertheless, depending on the chosen modeling language and the modeled level of abstraction the right resolution methods should be chosen not only to improve the schema quality (Bellström and Kop, In press) but also to prevent that semantic loss occurs (Bellström, 2009). Since the EM schemata are implementation-independent, several resolution methods for the recognized similarities and differences differ compared with schemata that are implementation-dependent such as the ER and the UML.

In Bellström (2010a) a summary of resolution methods of so-called linguistic conflicts for EM are presented and illustrated. More specifically this means that for *homonyms* prefixing together with the inheritance dependency is the chosen solution. For *synonyms* the mutual inheritance dependency is the chosen solution and for *cyclic generalization* (Song, 1995) and *reverse subset relationships* (Batini et al., 1992) more precise concept names (including the original ones) should be introduced. For the *inter-schema hypernym-hyponym property* the inheritance dependency should be used when the concepts are not exclusive, and the subset-of dependency when the concepts are exclusive. Finally, for the *inter-schema holonym-meronym property* the aggregation dependency should be used when the dependency includes a zero-to-many cardinality and the composition dependency when the dependency includes a one-to-many cardinality. However, it should be noted that the recognized inter-schema hypernym-hyponym properties and the inter-schema holonym-meronym properties should be documented and passed to the last phase of the integration process in which it should be used as a guidance (knowledge repository), while merging the input schemata and restructuring the integrated schema (Bellström and Kop, In press).

If a dependency conflict has been recognized, a one is chosen over zero and many over one on the cardinality. This is motivated since changing a one into a zero, thus introducing a weaker dependency, might instead change the meaning of the dependency for one or several domain experts.

In Bellström (2012) the problem of integrating schemata on two different levels of abstraction (schema level and instance level) was addressed. In this context this involves how to resolve recognized power types and homonyms that include not only the classification but also inheritance dependency. Resolving *power types* both the instance-of and the inheritance dependency are included and resolving *homonyms,* more precisely concept names (including the original ones), are introduced together with a new instance-of dependency.

Inference rules (Gustas, 2005) might also be used while resolving several of the recognized similarities and differences (Bellström, 2006b; Bellström, 2012). Applying inference rules makes it possible not only to deduce new dependencies but also new concepts from already existing ones.

Finally, independent of resolution method, it is important that the recognized similarities and differences are resolved without losing any of the concepts (including their names) and/or dependencies since these might actually mean something to one or several of the domain experts. Ignoring this could instead cause semantic loss (Bellström, 2009), which in the end could cause the integrated schema to be incomplete and hard to understand for the domain experts.

Merging and Restructuring

Merging and restructuring is the fourth and last phase of the integration process. In this phase the input schemata are first merged, resulting in a first intermediate schema, and later on restructured to fulfill several quality criteria (Batini et al., 1986; Batini et al., 1992) and/or quality factors (Moody and Shanks, 2003). Schema merging has also been recognized as an important research problem to study as a more generic topic (Pottinger and Bernstein, 2003; Quix et al., 2007). To aid in merging and restructuring the earlier recognized inter-schema properties should also be used as guidance; they can even be viewed as a knowledge repository (Bellström and Kop, In press). In EM we merge the two source schemata and restructure the integrated schema based on the following reasoning.

If two concepts are recognized as *independent,* they are both included in the integrated schema.

If two concepts are recognized as *equivalent,* they are merged into one concept and included in the schema.

If two concepts are recognized as *synonyms,* they are both included in the integrated schema with a mutual inheritance dependency placed in between.

If two concepts are recognized as *homonyms,* they are both included in the integrated schema. However, the concept names should have been resolved by either giving one or both concepts more precise names and/or giving the concept names a prefix and introducing an inheritance dependency between the prefixed concept (the specialization) and the original concept (the generalization).

If two concepts are recognized as having a *hypernym-hyponym dependency* (is-a), both concepts are included in the integrated schema and either an inheritance dependency or a subset-of dependency is drawn between them. The documented inter-schema properties should be used to decide which dependency to use. The concepts that are truly redundant (the hypernym and hyponym might have concepts in common) are thereafter deleted since they might instead be inherited.

If two concepts are recognized as having a *holonym-meronym dependency* (part-of), both concepts are included in the integrated schema and either a composition dependency or an aggregation dependency is drawn between them. The documented inter-schema properties should be used to decide which dependency to use.

Finally, it should be noted that the last phase, merging and restructuring, may well partly overlap with the former phase, conforming the schemata, not only since both phases are dealing with issues on how to actually merge the schemata, but also since both phases are dealing with issues on how to counter the occurrence of semantic loss.

A SMALL AND ILLUSTRATIVE EXAMPLE

In this section we give a very small and illustrative example of how parts of the described and discussed semi-automatic approach for the integration of structural EM schemata could be applied. More specifically, this means how to semi-automatically integrate schema one (S1) and schema two (S2) in Figure 3a.

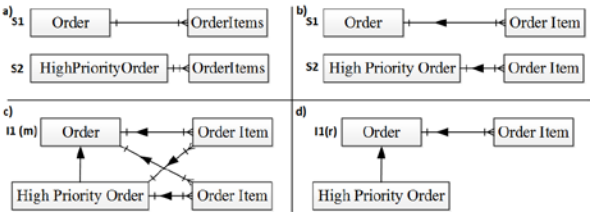

Figure 3. A small and illustrating example

Our example starts with pre-integration and the task of adapting the concept names used in the input schemata (S1 and S2). In doing so, 'OrderItems' in S1 is altered to 'Order Item'. In S2 'HighPriorityOrder' is altered to 'High Priority Order' and 'OrderItems' to 'Order Item'. In other words, compounded concept names are expanded and concept names are reduced to their base form. However, the concept names used in Figure 3a are of course saved not only to prevent semantic loss but also for reasons of traceability since the process should be reversible. Moreover, in this specific case a stemmer is not used. The last task for the pre-integration phase that we conduct in

our example is to analyze the input schemata for intra-schema conflicts. In doing so, a minor version of phase two and three of the integration process is conducted. In both S1 and S2 we have a Partly Match of concept names and therefore continue to apply the first linguistic rule. For S1 this means that 'Order Item' belongs/is related to 'Order' and for S2 this means that 'Order Item' belongs/is related to 'High Priority Order' which is also illustrated in Figure 3a. However, continuing with the comparison of concepts neighborhood and the second rule for Partly Match of concept names, it can be assumed, since there is one-to-many cardinality, that a holonym-meronym dependency (composition) exists between 'Order' and 'Order Item" and, between 'High Priority Order' and 'Order Item', resulting in the new versions of the schemata illustrated in Figure 3b.

We now continue with the comparison of the schemata by comparing the concept names of each schema. The comparison of concepts names results in one Match, 'S1.Order Item' = 'S2.Order Item', and three Partly Match 'S1.Order' ~ 'S2.Order Item', 'S2.High Priority Order' ~ 'S1.Order Item' and 'S1.Order' ~ 'S2.High Priority Order'. Since we have Partly Match of concept names, we continue and apply the two linguistic rules resulting in the following: 'S2.Order Item' belongs/related to 'S1.Order', 'S1.Order Item' belongs/related to 'S2.High Priority Order' and 'S2.High Priority Order' is-a 'S1.Order'. After comparing the concept names as such we continue with the comparison of concepts neighborhood.

Since the comparison of concept names resulted in one Match 'S1.Order Item' = 'S2.Order Item' we continue and check concepts neighborhood with the seven rules for Match of concept names. In doing so, rule three and five are applicable. Rule three states that it can be assumed that 'S1.Order' and 'S2.High Priority Order' are synonymous concepts while rule five states that it can be assumed that 'S2.High Priority Order' is-a 'S1.Order' (a hypernym-hyponym dependency). Comparison of concepts names also resulted in three Partly Match and we therefore also continue and check concepts neighborhood with the four rules for Partly Match of concept names. In doing so, rule two is applicable for 'S1.Order' ~ 'S2.Order Item' and 'S2.High Priority Order' ~ 'S1.Order Item', which states that a holonym-meronym dependency (composition since the cardinality is one-to-many) can be assumed between the two concepts. Rule four is applicable to 'S1.Order' ~ 'S2.High Priority Order', which states that a hypernym-hyponym dependency (is-a) can be assumed between the two concepts.

In conforming the schemata, the recognized conflicts are resolved and the recognized inter-schema properties are documented and passed to the last phase in which they are applied as a guidance while merging and restructuring the integrated schema. In our example we did not recognize any conflicts. Although a synonym conflict was indicated, we decided that 'S2.High Priority Order' is-a 'S1.Order' since several of the used comparison methods indicated this. Nevertheless, three inter-schema properties were recognized: 'S1.Order Item' part-of (composition) 'S2.High Priority Order', 'S2.Order Item' part-of (composition) 'S1.Order' and 'S2.High Priority Order' is-a 'S1.Order' which are also passed to the last phase of the integration process.

In merging and restructuring, we first merge S1 and S2 in Figure 3b resulting in the integrated intermediate schema in Figure 3c. However, the integrated schema contains redundant concepts and dependencies that we need to get rid of. Since 'High Priority Order' is-a 'Order' and therefore also inherit 'Order Item', we can get rid of the redundant 'Order Item' concept that was part of S2 from the beginning. In doing so, we also get rid of three composition dependencies (part-of), resulting in the schema in Figure 3d, which is also in this case the end result of the integration process. Finally, even though the example is very small it still indicates how complex schema integration might be and how the described and discussed semi-automatic approach might facilitate the integration process.

SUMMARY AND FUTURE WORK

In this paper we have described and discussed a semi-automatic approach for the integration of structural Karlstad EM Schemata. In doing so, not only the automatic but also the manual tasks that are applicable in the integration process have been addressed. The research approach has been inspired by design science and the main contribution can be classified as a method.

In future work we plan to address not only mandatory and optional tasks but also the order of tasks to be performed in the schema integration process. We also plan to develop a prototype in which performance of the prototype is closely related to both the order of tasks and mandatory and optional tasks. The human computer interaction (HCI) aspects of the graphical user interface (GUI) that the domain expert interacts with in the prototype are also important to consider for future work. While addressing the HCI aspects of the prototype, we plan to use Ozlab (Pettersson and

Wik, 2013), a tool that makes it possible to test the GUI before any implementation has been conducted.

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Model Synchronization in Sociotechnical Service Systems

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ABSTRACT

Integrated product-service systems become complex sociotechnical services consisting of human and technological components. Existing management approaches are limited as they neglect changing resources and processes during the service lifecycle. The lack of proper procedures and methods going beyond the initial service engineering leads towards unsystematic and low-quality services. This contribution addresses this gap between the real service processes and the underlying service model. The paper will describe a 4-steps procedure model, which defines a framework for synchronization routines in sociotechnical service systems. The methodic approach focuses on the definition and integration of synchronization procedures in addition to standard service development. Besides the theoretical basis, we demonstrate the practicability with a case study.

Keywords: Service Systems, Service Engineering, Roundtrip Engineering, Sociotechnical Systems, Synchronization Routines, Procedures, Reverse Engineering, Active Knowledge Management

AGILE ENGINERING FOR SERVICES

Today, all spheres of the society undergo a continuing progress of technization, digitalization and servitization. This process induces to more integrated product-service systems including goods, services and ICT (Rust and Miu, 2006). These integrated products become complex sociotechnical (service) systems consisting of human and technological components (Meyer and Thieme, 2012). Existing management approaches are limited to the development of such complex service systems. There is no consideration of changing resources and processes during service delivery which is caused by missing procedures that enable an efficient and systematic change management. However, these changes are not included into the original service model due to lack of time, costs, missing awareness or missing procedures, which can lead towards unsystematic and low-quality service delivery (Thieme et al., 2013).There is a lack of proper procedures and methods going beyond the initial engineering of services that address changes of surrounding conditions in the operative phase of the service lifecycle. Missing documentation and implementation of changes in the service model significantly complicates the management of complex services and in addition leads to tacit knowledge mostly concentrated to one person on how the service is produced and delivered in reality.

This contribution addresses the presented gap between the real service processes and the underlying service model. The paper will describe an agile development method, which defines synchronization routines for the development of sociotechnical service systems. In so doing, we make use of the concept of roundtrip-engineering (RTE) and introduce it into the field of service engineering. The proposed methodic approach focuses on the definition and integration of synchronization procedures into the service concept using reverse engineering. The goal is to enable an efficient modification and update of the service model. Filling the gap of missing reverse engineering procedures enables a complete RTE-system for services and increases efficiency in service delivery and innovation. Besides the theoretical basis of the procedure model, we demonstrate the practicability and benefit of our approach with a case study in the area of ICT and knowledge management.

SERVICES AND ROUNDTRIP ENGINEERING

Engineering Service Systems

The definition of services is highly generic and needs to be clarified. Our definition follows the understanding of Böttcher (Böttcher 2009), who defines service science as follows:

> *"Service Science is the scientific discipline that is concerned with the description, explanation, design and configuration of socio-technical systems. These connect different partners through activities and the use and (ex-) change of resources in accordance to agreements between these partners with the goal of creating value for one or more partners or the whole system."*

Such an understanding defines services as socio-technical systems, where the different elements along with the subjects and objects and their resources frame the view (Chesbrough and Spohrer, 2006) (Edvardsson, 2006). In organizational development, the term sociotechnical systems describes an approach to complex organizational work design that recognizes the interaction between people and technology in workplaces. The term also refers to the interaction between society's complex infrastructures and human behavior. In our understanding, services are complex socio-technical systems consisting of human and technological components that need to be developed and engineered following a systematical approach.

This systematic development with a defined demand on quality and productivity is the central task of service engineering (Meyer and Böttcher, 2011). As a research field of service science (Schneider et al., 2006), it deals with procedures, methods and tools for the development of services. The overall aim of service engineering is the optimization of structures and processes within service systems, where e.g. productivity, quality, costs, and repeatability can be criteria. Consequently, it is strongly connected to the design of development processes for services and the search for links to other relevant research disciplines, e.g. software engineering or information engineering (Fähnrich, 1998). In service engineering, procedures and modeling frameworks are a well explored research area. Based on the work of Böttcher (Böttcher et al., 2009) (Bullinger et al., 2003) a complete services description consists of three basic models: product model, resource model, and process model. The scientific literature provides numerous procedures, methods and models covering the area of new service development as well as the management of services (Meyer, 2011). There has been no work conducted dedicated to reverse engineering procedures that cover the synchronization of the generated service model with changes over time of the implemented service. So far, the use of service models is restricted to the innovation stage of new service development projects and in many cases disregarded after implementation. As our previous research has shown, this a big obstacle in practice (Thieme et al., 2013). The lack of documentation of changes over time makes the management of processes and tasks almost impossible. Missing synchronization of service model and reality results in managing chaos, as services, in contrast to products, quickly change over time.

The Concept of Roundtrip Engineering

As presented in previous publications (Meyer et al, 2013), RTE is mainly used in the domain of software development and engineering in order to synchronize source code and UML (Knublauch and Rose, 2000) (Demeyer et al., 1999). In short, RTE is a concept to utilize the benefits of two different abstraction layers (or perspectives / views / modelling languages) and keep them synchronized.

Initially, Aßmann describes RTE as *"an instance of the method of domain transformations"* (Aßmann, 2003). Henriksson and Larsson (Henriksson and Larsson 2003) provide a general definition for the fundamental understanding of RTE. This definition describes RTE as a system of product, design and corresponding transformation procedures. Hereby, forward engineering characterizes a procedure intended for the creation of a product by a given design. Respectively, reverse engineering characterizes a procedure intended for the extraction of a design given a product. If it is possible to extract a design and based on this create an identical product (compared to the initial product used for extraction), then product, design and the transformation procedures form a RTE system (see figure 1).

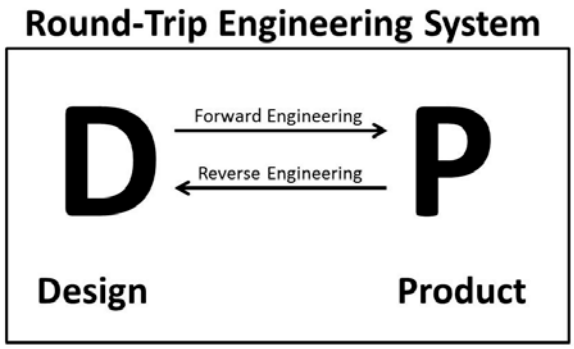

Figure 1: RTE-System (Meyer et al., 2013)

Although this definition seems intuitive, it is too strict to be useful in practice as it assumes that the source and the target are isomorphic to each other. As stated by Hettel, in most application scenarios it is not necessary and not applicable to provide transformation procedures which create the opposite view from scratch. Most of the time the synchronization of changes between the two views is sufficient or even to be preferred (Hettel et al., 2008). Hettels view is more of a practical value and fits our thoughts of the following section.

The underlying idea of RTE can be applied in other application fields. The goal of the roundtrip concept is to enable a preferably automatic synchronization of different views or levels of abstraction. In this work, we adopt the core idea of forward and reverse engineering procedures in order to update changes during service exploitation.

Application of RTE for Sociotechnical Services

Although almost all work conducted on RTE is concentrated in specific on software model transformations, the underlying idea can be applied in other application fields. Besides software modeling, first work has been conducted in the area of business process management (Barros et. al, 2007). Salvendy and Karwowski (Salvendy and Karwowski, 2010) briefly discuss the application of RTE in service engineering as a method for determining the correctness of implementation. Up till now, no further work is known to us that addresses the concept of RTE in the context of service engineering. In this chapter, we will briefly outline the application of RTE in Service Engineering based on the definition of Hettel.

In this application scenario the source model is the service model and the target model represents the executed service as an instance of the source model applied in reality. Thus the diagram from figure 1 needs to be updated as shown in figure 2. Following the understanding of RTE in software development, we define RTE-Systems for sociotechnical services as follows:

> *"RTE-systems for sociotechnical services consist of a service model, service instance and corresponding transformation procedures. Hereby, forward engineering characterizes a procedure intended for the realization of a service instance by a given service model. Respectively, reverse engineering characterizes a procedure intended for the synchronization of service model given a change in the service instance."*

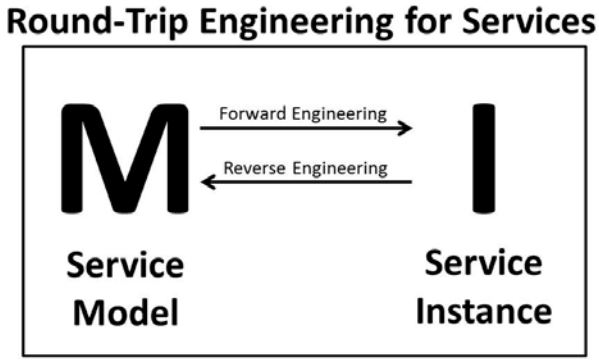

Figure 2: RTE-System for Services (Meyer et al., 2013)

In service science, service modeling, forward engineering procedures and managing services is a well explored research area (Bullinger et al., 2003) (Maglio 2006). The literature provides numerous procedures, methods and models covering the area of new service development (see (Meyer, 2011) for an overview), forward engineering procedures as well as the management of services and service instances, e.g. software-service co-design (Meyer, 2009) or service level management (Sturm et al. , 2000). So far, there has been no work conducted dedicated to reverse transformation procedures. This brief outline shows that service research provides a solid basis for the creation of RTE-systems. Nevertheless, the gap in the literature on reverse engineering procedures needs to be filled in order to be able to create complete RTE-systems for services as defined in the earlier section.

A FRAMEWORK FOR RTE SERVICE SYSTEMS

Methodical Approach

The proposed framework for the engineering of roundtrip service systems is based on the theoretical concepts of service orientation, RTE and agile development methods. We developed the framework following a 4-tasks procedure, which is described as follows:

- Task 1: Literature Review and State of the Art

The first task for the development of this framework was a literature review on service development procedures (Meyer, 2011) and RTE (briefly presented in section 2). The output of this task was used as input for step 2. The review has shown that in service science, synchronization of changes has been neglected. The concept of RTE has been successfully applied in software development in order to address this task, but so far has been not deployed in other application areas.

- Task 2: Theoretical Basis

In a second step, we integrated the existing work on service science and software development by applying the RTE concept in the area of service development and engineering. By doing so, we developed the theoretical basis for RTE Service Systems that has been presented in section 2 of this paper. The main idea of our approach is, to combine the levels of service model and service instance using forward and reverse engineering in order to enable synchronization of both levels.

- Task 3: Application in Practice

The next step was the application in a real life scenario. The aim of the case study was to test the practicability of the idea and to identify possible challenges and obstacles (presented in chapter 5). The practical experience in creating a RTE-System enabled the development of a procedure framework.

- Task 4: Definition of the Framework

Based on the developed theory (presented in section 2) and the application in a case study (presented in section 4), we defined a 4-stage procedure model as a generic framework for the development of RTE-Service Systems. This framework is presented in the next section.

RTE Procedure Framework

The aim of the presented framework is to offer a guideline for the development of RTE-Systems for services. The proposed framework consists of a four-stage procedure model.

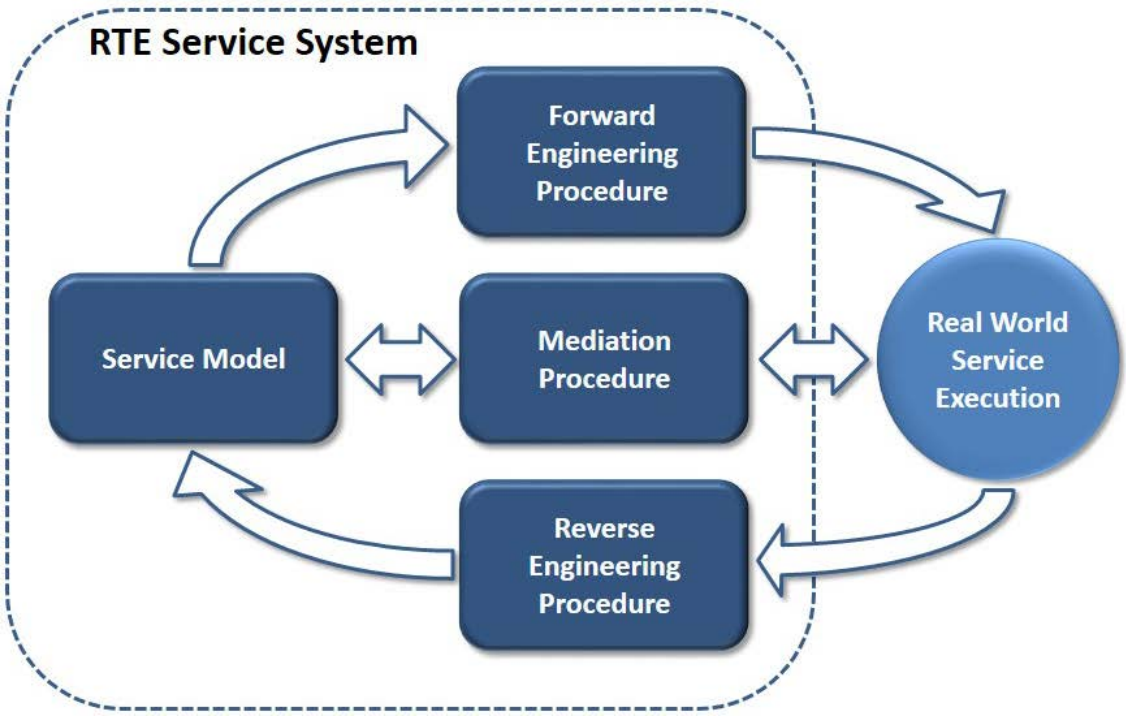

Figure 3: Visualization of the 4-steps procedure model

Although the visualization in Fig. 3 may suggest a linear process model, the procedure is intended to be run iteratively over the entire service lifecycle. Similarly to the agile software development methods like SCRUM, the aim of the proposed iterative approach is to enable an incremental and evolutionary development of the RTE System by self-organized teams and allow a regular, rapid and flexible response to change. The goal of this approach is the enabling of efficient feedback loops and adaption cycles. The stages are described as follows:

- Step 1: Generate Service Model

The initial starting point is the generation of a formal service model. Based on the work of Böttcher (Böttcher, 2009) a complete service description consists of three basic models:

1. product model – covers modularization of service components, configuration information and constraints.
2. resource model – describes all resources available and needed for the services
3. process model – contains process descriptions for the execution of the services

The generated service model contains all information regarding the realization of the service provision. It serves as a guide for the stakeholders and enables to reconstruct and comprehend the modeled service. In the beginning, it is not essential to generate a perfect model that describes the service system in every detail. As the intention is to evolve the model during several iteration loops, the model has not to be necessarily complete at the end of this step. At the first iteration loop, even a blank page of paper acting as a first resource may be sufficient in order to move on to the next step.

- Step 2: Engineer Forward Procedures

Forward engineering defines procedures intended for the realization of a service instance by a given service model. These procedures provide information generated in step 1 to the user. Users include all stakeholders involved in the service process, e.g. service costumer or staff of the service provider. The access to the information from the service model has to be presented according to the needs of each user type. Mostly, the information is provided using ICT tools. The degree of application of dedicated ICT needs to be determined by cost benefit analysis. At the end of this step, a sociotechnical system is created which allows access to all information related to the service.

- Step 3: Engineer Reverse Procedures

Reverse engineering defines procedures intended for the synchronization of the service model given a change in the service instance. The aim of the procedures is to gather variations in the real life application and enable a backflow of the identified changes and/or improvements into the service model. The service is analyzed regarding likely changes and corresponding routines to address these changes. Therefore, each service component and resource has to be assigned a responsible person that is in charge of updates and the target of corresponding information flow. The extent to which these procedure can be realized as automatic, semi-automatic or manual procedures depends on the level of ICT implementation defined in step 2.

At this stage, it is clear that not all changes can be foreseen or respectively cannot be transferred into the service model automatically. Especially semi-automatic and manual procedures may need further adjustments and consultation of upper management. This arising gap is addressed with the next step.

- Step 4: Define Mediation Procedures

The definition of mediation procedures intends to address the task of the information transfer into the service model and to enable a systematic approach to unforeseen changes and innovation ideas. The mediation model defines roles, responsibilities and procedures regarding the change management of the service. The routines should include periodic sessions, where feedback of the stakeholders is gathered and evaluated in order to access tacit knowledge that may be transferred into innovative changes.

USE CASE SCENARIO: STOCK MANAGEMENT

The following case study intends to visualize the application of the developed framework and demonstrate the practicability of the theoretical approach. In order to do so, we selected the organizational service of stock management of an institution consisting of several departments with approximately 70 employees. The service covers all activities within the institution concerning the lifecycle management of acquired goods starting with the acquisition and ending by disposal.

Generate Service Model

In this case study, we have oriented ourselves to the design paradigm of service orientation with the aim to describe the stock management services following the view of a service oriented organization structure. Hereby, we defined service components in accordance to the SOA-principles in order to ensure reusability, loose coupling and autonomy. As space in this contribution is limited, we will not present the service in every detail, but give a short overview on the service components, service instances and resources.

In our example, we have defined three service components for our service: procurement, inventory and delivery. The component procurement covers all operations concerning the acquisition of goods. It is divided into the activities purchase, withdrawal from storage and delivered by employee. This means that the good can either be newly purchased, taken from storage or taken from an employee that has the good in use. The component inventory covers the area of managing the inventory and correspondingly consists of the activities add to inventory list, update inventory list and remove from inventory list. The component delivery covers the area of handling the goods. It consists of the activities handover (to employee), storing, sell and dispose (see fig. 4).

In our use case, the service has three possible purposes: acquisition of goods, transfer of goods between departments, employees and stock or disposal of goods. In each of this scenarios activities of each service component are combined in order to generate a service instance.

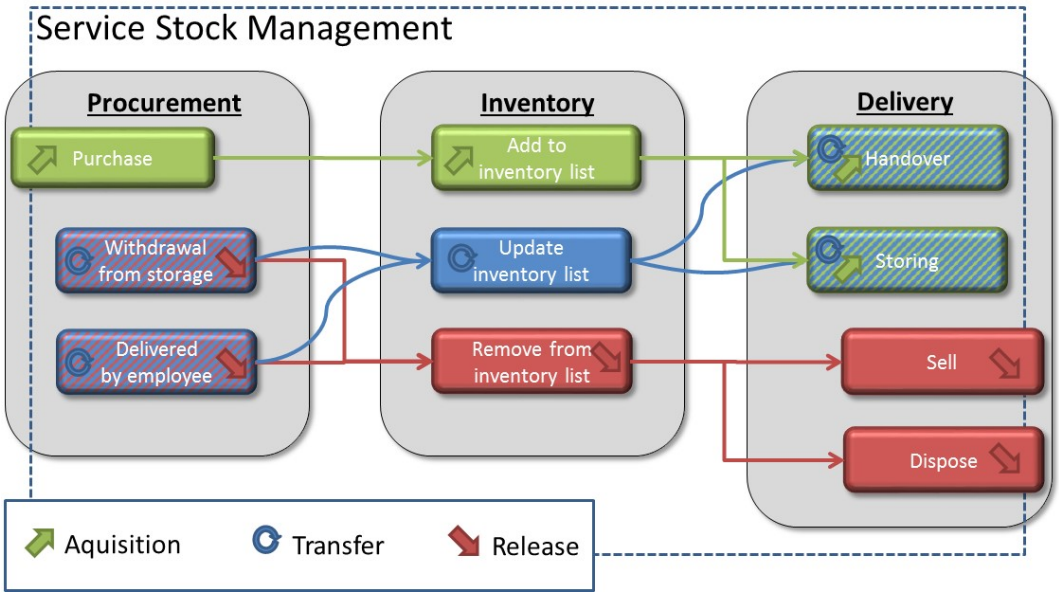

Figure 4: Visualization of the component model including service scenarios

A typical application scenario would be the purchase of a laptop by an employee. In our case, this would involve the activities purchase, add to inventory and handover to employee. Each of this activities is documented with a description and a process model including corresponding resources. Fig. 5 gives an overview on activities and resources that are needed during service delivery.

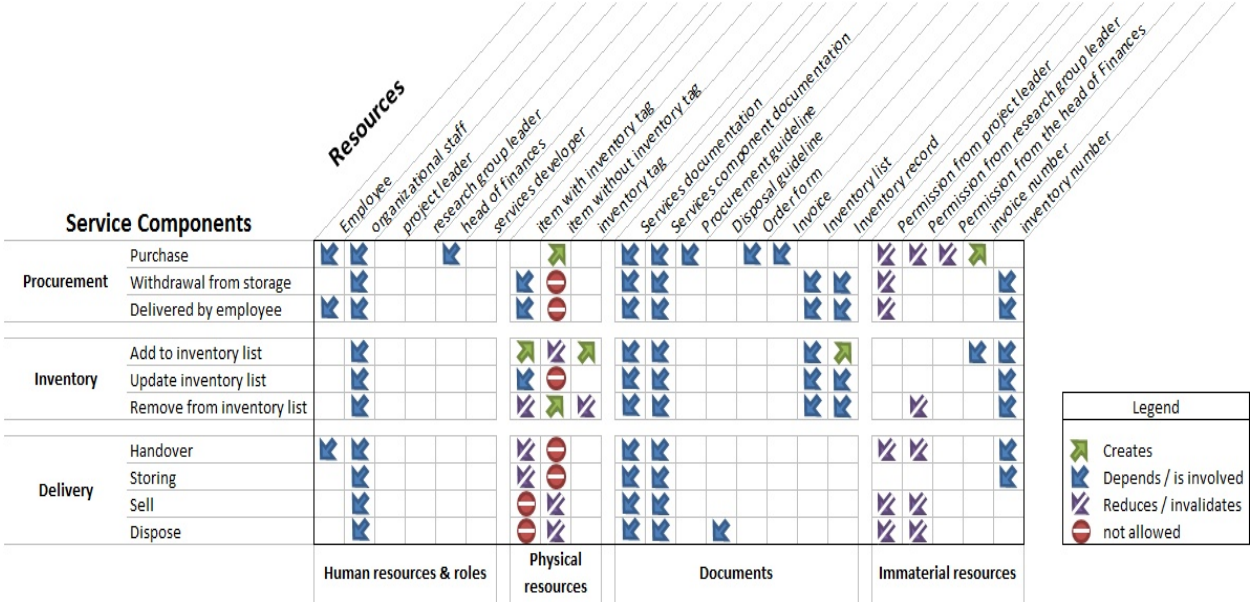

Figure 5: Visualization of the resource model with mapping to components

At the end of this step, we have generated a full service model consisting of a service description, a component model describing possible service instances, process models of all components and activates as well as a corresponding resource model. In other words a lot of information on the current state of the service that are written down as text, graphics and sheets.

Engineer Forward Procedures

The purpose of this step is to ensure, that the service model created in step 1 can be accessed by the stakeholders and that the needed information can be found as fast as possible. In our test scenario, we have decided to transfer all the informations, guidelines and hints into a knowledge management system. Involved stakeholder can enter this system via a web service and hereby get access the information about the service (see screenshot in fig. 6).

Figure 6: Representation of the service model using a knowledge management system

In this system, it is possible to generate different views on documents according to role of the user, add Q&A lists that guide the user to the right information and use a semantic search engine in order to find the right information. At the end of this step, we have a full service model that can be accessed via a standard internet browser. At this point, these informations are static and cannot be modified or updated.

Engineer Reverse Procedures

In order to ensure that the information are up to date, we make use of the feedback functionality of the system (see screenshot fig. 7) and devote it as a reverse engineering procedure. Therefore, each resource that is embedded in the knowledge management system has been assigned a responsible person. This person will receive the feedback that is send via the feedback function and is responsible to process this information according to the mediation routines defined in the next step. The feedback is sent by users that identify possible misunderstandings, missing or outdated information.

Figure 7: Feedback function used as reverse engineering procedure

Define Mediation Procedures

The mediation model defines procedures that allow to process information that is generated in step 3 and to access information that cannot be addressed with reverse engineering procedures. In our use case scenario, the model defines that an innovation workshop is carried out in regular intervals in order to address changes that cannot be foreseen and mapped with reverse engineering procedures. The workshop is organized by the person who is in charge of the service as a whole. Furthermore, the model defines that minor changes regarding service components or resources that are indicated via the feedback procedure are carried out by the assigned person. In case changes are of great moment, the person is advised to contact the person responsible for the service who in a second step can call in an innovation workshop.

CONCLUSIONS AND FUTURE WORK

The research presented in this paper can be qualified as work in progress. So far, we have developed a theoretical framework for the development of RTE service systems that will need adjustments and polishing based on further practical experience. The developed procedure model can be considered a prototype where each step will need more refinement and deeper analysis, especially the area of reverse and mediation procedures. The future will concentrate on the development of reverse engineering procedures and the display of user specific information (as part of forward engineering), what we call active knowledge management. The next step will be to analyze the usage and acceptance of our approach in the presented case study. Over time, we will add further and more complex services of this institution in order to gain more experience. As a second step, a further case study will be conducted in order to demonstrate practicability in different application areas.

Conducting this case study, we have learned that during the creation of a service model we need to determine how detailed the service descriptions and models need to be. This question is a tradeoff between accuracy, precision and correctness on the one hand, and invested effort, usability and simplicity on the other. This observation gave rise to

the idea, that the level of information depth could be determined by iteration loops following our procedure. The taught is, that starting with simple models and procedures will expose missing information, ineffective work processes etc. via reverse and mediation procedures. This deficit in systematic service development will be then addressed in a second iteration where more sophisticated determined resources and procedures are installed depending on the communicated demand. Following several iteration loops, we will achieve the information depth and procedures that are most appropriate to the given institution and task.

ACKNOWLEDGEMENT

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Storage in the Cloud: What You Need to Know and Why

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ABSTRACT

In recent years there has been huge growth in the amount of data stored on public cloud services. Much of the data stored on these services is placed there through the use of mobile apps (such as Facebook or DropBox), with little consideration given by the owners to the potential consequences of storing their data on a public service. While these services typically spell out the conditions under which user data is stored in their Terms of Service, most users don't take the time to read these and they are seldom written in a way that encourages real understanding of the terms. However, there are many issues that should be considered when choosing to store personal data in a public cloud service, both from the perspective of the user and the cloud service provider. This paper begins by explaining some key concepts of cloud storage. It then provides a list of items that should be considered when choosing a cloud service provider, explains why the issues are potentially important, and gives suggestions for actions the user might make in order to achieve their desired goals.

Keywords: Cloud, Storage

INTRODUCTION

The term "cloud" is the technical buzzword of the decade; it is used to describe a multitude of related concepts and implementations. As a result, the term itself is almost meaningless except as a high-level concept. The term "cloud storage", though still open to various interpretations, is somewhat more well-defined. In general, cloud storage refers to storing data in a remote system to which the user or application is attached by a network. While cloud computing may suggest many varied attributes, cloud storage is usually understood to include two main concepts: network access and elastic storage capacity. The term cloud storage may also suggest other, operational attributes such as object storage models and RESTful interfaces, but these are orthogonal to our discussion.

The idea of remote data storage is hardly a new one; protocols and services for storing and retrieving data remotely have existed for decades. As a technology remote storage has been available in one form or another since before the term “cloud” was coined, and before the development of the world wide web and the widespread availability of consumer internet (Sandberg *et al.*, 1985). However, several fairly recent developments have led to a profusion of low cost, easily accessible remote data storage services:

- the rapid growth in disk storage capacities combined with the plummeting cost of such storage

- the nearly ubiquitous availability of medium- to high-speed network connectivity in many parts of the world
- the explosion in the use of mobile devices

These factors have combined to fuel the growth of varied models of data storage services, from social sharing networks such as Facebook (Johnson, 2008), to file sharing sites such as Dropbox (Drago *et al.*, 2012), to data backup services such as Carbonite (Carbonite, 2014). We refer to these services generically as cloud storage services. Users may put files such as photos on social sharing sites without even thinking of them as cloud storage services; however, the considerations for storing their data "in the cloud" are no less applicable.

This paper presents some of the issues and considerations that users should be aware of when using any cloud storage service. It focuses on individuals' use of public cloud services, though many of the issues presented are equally applicable to business or other organizations, and to other remote storage models.

CONSIDERATIONS FOR USING CLOUD STORAGE SERVICES

The goal of this paper is to make users aware of some of the questions they should consider when choosing to store data in the cloud. There may be situations where a minimal set of storage service guarantees is sufficient for a user's needs, but many times it is not. Not all services are the same, and users should be aware of what they are agreeing to and what they are receiving when they use a cloud service to store their data.

Different cloud storage providers (CSPs) have different end-user cost models, but in the end the level of service a CSP can provide will depend on the cost of providing the service and the income they receive in return.. A CSP must have some way of recouping the not insignificant costs associated with providing their service (not to mention making a profit) in order to provide dependable storage services. CSP costs include capital expenditures such as processors, storage, networking equipment, and power and cooling distribution equipment; they also include operational costs such as data center premises, power, and human maintenance and administration. The quality of service (QoS) guaranteed in the CSP's terms of service will directly affect the costs associated with the service; for example, keeping more than a single copy of data increases the cost of storing that data. Users "pay for" cloud storage in various ways, whether it is by overtly paying a fee, exposing themselves to (often targeted) advertising, providing an unintended source of data that can be "monetized" by the provider, or some combination of the above. Additionally, in general users will get what they pay for. That is to say, users should not expect to receive first-class service guarantees for ostensibly free storage services.

What follows are some of the issues to consider when choosing to store data in a public cloud.

Confidentiality

Confidentiality refers to the idea that the contents of a user's data files are not visible to others. A user storing income tax returns, for instance, probably has an expectation that his or her data will not be visible to others, either other users of the service or employees of the service. Most users simply assume that the CSP takes appropriate steps to protect the confidentiality of their data. However, even if that is true, confidentiality cannot always be guaranteed in the case of a rogue employee or of a hacker's break-in to the service. There have also been egregious cases of a CSP creating confidentiality exposures, such as when Dropbox turned off user authentication for two days due to authentication server technical problems.

One solution to the problem of confidentiality is not to store data in the cloud in a form that is accessible to others; for example, for the user to encrypt the data locally then transmit only the encrypted data to the CSP. (This provides protection for the data both in transit and at rest.) While a good practice, at least for sensitive data, this leads to other challenges such as encryption key management. While software such as 1Passwd exists to assist with this task, the databases associated with such software are also a prime target for hackers.

Confidentiality may be the most difficult problem for the CSP to provide a technical solution for. A CSP may, for instance, attempt to mitigate the potential for data confidentiality breaches by storing the data in an encrypted form. However, the system must still be able to present the data back to the user in the form in which it was originally

stored, so the knowledge of how to decrypt the data is part of the system, and thus the potential for others to access the data still exists.

Privacy

Privacy is related to Confidentiality, but we use it to mean the privacy of the users of the service. This includes confidentiality not only of file data, but also metadata (that is, data about data). Obvious user metadata could include file and directory names associated with an account; iCloud apps, for instance, have visibility to all of a user's iCloud file and directory names, and could use that information to search for specific types of files or even well-known file names. Other metadata could include Google Maps navigation history or photo location metadata; this type of data becomes of concern when we realize that the NSA requires only 6 location data points to uniquely identify an individual.

Giving files and directories random or meaningless names is not likely to be a good alternative for most users, and actions such as stripping metadata from files such as photos is not always desirable. Beyond these types of actions, there is little a user can do to protect meta-information beyond being aware of the terms of use of their potential CSPs and choosing one whose terms meet the user's expectations or requirements.

Reliability

Other terms for the concept of Reliability could include Durability or Resiliency. This refers to the likelihood of being able to retrieve data at some point in the future. To some users' surprise, free cloud storage services have no liability for data loss (though this may only become apparent after a data loss event).

Durability of data in the face of system failures is a problem that can be effectively addressed by storage technology. Different approaches may be chosen depending on the storage hardware infrastructure being used and the level of reliability required. Some modern cloud systems use large numbers of low-cost disk drives, and can achieve data reliability through multiple copies of files. Others may use more sophisticated hardware and/or software, and techniques like RAID for reliability. Remote replication of data (copies of data in multiple, isolated data centers) can provide even better reliability.

However, each of these solutions requires an investment in hardware, software, and potentially administration on the part of the CSP. Multiple copies of data doubles or triples the raw storage cost of data; RAID solutions typically require more expensive hardware or software, and also increase storage utilization (though by a smaller factor than multiple full copies); remote replication not only multiplies the raw storage cost, but also requires additional data centers and a powerful networking infrastructure.

It is unlikely that a user can find a free service that will provide one of these types of reliability technologies, at least for more than a very small amount of data; the cost is simply too high. So a user must decide what their reliability requirements are and how best to meet them. One choice is to pay for a service that provides reliability guarantees. An alternative choice is to manage the reliability themselves. In some cases, keeping a local copy as well as a copy in the cloud may be sufficient; another choice could be to store copies of files in multiple CSP environments, counting on the unlikelihood that they would all lose the data. With either of these approaches, a user may want to access data periodically just to insure that their data hasn't become inaccessible for one (or more) of the copies.

Integrity

Integrity refers to the integrity of the data when it is retrieved from the cloud storage service. Spontaneous undetected data corruption is probably not a major concern in modern storage systems (though it does occasionally happen). The bigger concern is whether the CSP processes the user's data so that it is no longer what he or she originally stored. For example, both Flickr and YouTube may compress photos or videos in order to save storage space, and no photo storage system today stores “raw” photo files in their uncompressed form.

If, for example, photos and movies are uploaded to a cloud service strictly for sharing, and a lower resolution or higher level of compression is acceptable, then this is of no concern. However, if the only copy of a valued photo could be compressed or reduced unexpectedly, it may be more a more important consideration.

Availability

Availability refers to the ability to retrieve the user's data when desired. Considerations here include both agreed-to QoS constraints, such as with Amazon Glacier which has an advertised potential 4-hour retrieval lag for any data requested, as well as unforeseen events. Unforeseen events can be accidental like power and network outages, or through deliberate intervention, such as government censorship or curtailment of access to Internet services (as when Egypt experienced a shutdown of its cellular phone networks in 2011, or the more recent moves by the Turkish government to ban twitter and other social media services).

QoS constraints are presumably known beforehand, and should come as no surprise to the user. Yet it is not uncommon for a typical consumer to be unaware of the implications of such constraints for the usability of the service. Therefore, the implications of such constraints should be carefully considered before entering into an agreement.

Obviously, no one can predict the unforeseen event. However, when the only copies of data are stored in one or more cloud services, the user must always be prepared to accept the possibility of such events and the unavoidable delays they imply. If immediate access to data is of real importance, a copy that can be used without access to the CSP should be maintained. For some users, this consideration needs to be weighed against the benefit they are obtaining by treating the cloud service as a convenient and consistent data repository. This is because keeping a local copy of data stored in a cloud service requires effort to identify and maintain the latest version. The effort rapidly grows when "local" copies of the data are actually being used on multiple devices in the user's possession. This is increasingly common with the wider range of devices we use today, both to communicate and for digital media consumption.

Lifetime

Lifetime refers to how long data is expected to exist, and how it is eventually disposed of. Most users probably expect to eventually delete data when it is no longer needed, though when storage services are free of cost this may not always happen. When storage services are not free users must consider how they will manage their data if and when they decide to discontinue paying for the service, or when they decide to move to another service.

A real concern regarding lifetime is what happens when data outlives its owner. Some CSPs have policies or procedures for handling data belonging to deceased customers, while others do not. Google, for instance, gives the user the ability to set up a "dead man switch" that can define actions to be taken when the user no longer accesses the system. If users are concerned about what will happen to certain kinds of data (e.g., family photos, legal documents) after their death they should make certain that someone they trust has the credentials to access the storage as well as directions for handling the data after they are deceased. They should also be aware of the provisions, if any, regarding such an occurrence in their service agreement.

Cost, Capacity, and Provider Viability

Cost and capacity are interrelated issues. As noted earlier, users typically get what they pay for. A CSP may provide a comparatively small amount of storage for little or no cost, but may have higher rates for large amounts of data. Users should be aware of what their data storage needs are (or will be), what the CPS's storage policies and constraints are, and what the consequences of exceeding those constraints could be.

Provider or CSP viability should at least be considered when storing data on a cloud service. Providers have been known to fail or be taken offline and thereby lose massive amounts of user data, as happened with the Megaupload service (Cohn & Samuels, 2012). In a more unusual scenario, Major League Baseball (MLB) sold digital rights management (DRM) protected copies of sport videos that could only be played using software that required contact with a remote server. When the service was discontinued, the remote servers were eventually shut down; this resulted in many upset fans who felt that they had purchased videos that had unexpectedly become unplayable due to some external change outside their control for media they felt they owned. In this case, the users of this service had not considered (or possibly never realized) their dependence on a CSP.

When choosing a CSP, users should weigh the possibility of failure, service disruption, or provider continuity and viability, against the cost of the service and the importance of the data they are storing.

CONCLUSIONS

There are many issues and considerations when storing data in a public cloud. The best advice is to know what issues are important and to understand the Terms of Service that a potential CSP offers. In other words, read the service agreement, or at least ask the important questions ahead of time before choosing to store data in a public cloud.

This paper has presented some of the issues to consider when deciding to store data in a public cloud, and has attempted to give some background and guidelines to help with the decision.

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Attitudes and Use of Mobile Phones in Tweens

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ABSTRACT

As mobile phones become more and more ubiquitous, their use for various communication modes continues to increase. Ownership and use is most prevalent in young people (Baron, 2010, Cotten, 2009, Kasesniemi & Rautaninen, 2002, Ling & Yyttri, 2002, Rees & Noyes, 2007, Pew Project, 2011) and younger and younger individuals are owning and using mobile phones (Geser, 2006). Many studies have looked at mobile phone use and behaviour in 11-25 year olds but little research has been carried out with tweens (8-11 year olds). Attitudes to mobile phone use and perceptions of use towards mobile phones are investigated in tweens (8-11 year olds). 136 pupils in seven schools completed two questionnaires and 20 pupils carried out small group interviews. User behaviour with mobile phones is discussed with reference to the type of information that is communicated by voice and text. It is suggested that mobile phone use is increasing in tweens (8-11 year olds) and the way mobile phones are used are challenging traditional values and behaviours of social practice, for example, many tweens prefer to contact each other through texting rather than face to face or calling on the mobile phone.

Key words: Mobile phones, Smartphone, Text, Call, Micro-coordination, Hyper-coordination

INTRODUCTION

The mobile phone has been characterised by its ubiquitous nature since its inception and has now become an everyday tool for many people (Chantal de Gournay, 2002). Ownership and use of mobile phones is most prevalent in young people (Baron, 2010, Cotten, 2009, Fedoricz et al, 2010, Kasesniem & Rautaninen, 2002, Lin & Yttri, 2002, Pew Internet and Life Project, 2011 Rees & Noyes, 2007). Smartphone use continues to increase amongst all ages, especially by the under 25 year olds. A survey of American teens (12- 17 year olds) showed that 37% owned a smart phone (Pew Research Internet Project, 2013). This is an increase of 14% from a survey carried out the by the Pew Centre in 2011 which showed that 23% of this age group owned a smart phone.

It has been suggested that the reasons for the success of the mobile phone are due to its portability, its multipurpose use and its constant accessibility and reachability. The latter has lead to terms such as "always on" (Baron, 2008) and "perpetual contact" (Katz and Aakhaus, 2002) as a way of describing the way users interact with this technology. There is no doubt that the mobile phone has had a large impact on people's lives. Brown (2011) commenting on a behavioural study by Motorola (2008) endorses the impact mobile technology has had on people's lives of "permanently changing the way we work, live and love" (p.1). It has been claimed that mobile phones are "redefining careers, the family unit and social intercourse" (Arbitron Inc and Jacobs Media, 2011, p. 1). The mobile phone facilitates people in the organisation of their lives. Ling and Ytrri (2002) introduced the terms micro-coordination and hyper-coordination to help understand the way users organise their lives through using their mobile phone. Micro-coordination refers to the flexibility that can occur with a mobile phone when arranging meetings; it is possible to change & adapt the agreement as the need arises thus the when and where of meetings can be changed through the mobile phone. Hyper-coordination refers to micro-coordination and the expressive use of the mobile for

social & emotional communication. This connectivity from hyper-coordination refers to work, family and personal relationships.

Geser (2006) has documented the ever increasing use of the mobile phone by younger and younger users and the importance of text messaging culture. The rapid increase in mobile phone use has been discussed in many studies and also the creation of a mobile phone communication culture (Chantal de Gournay, 2002, Skog, 2002, Kaseiniemi and Rautainen, 2002). Madell and Muncer (2004) found that the most important uses for mobile phones amongst teenagers were for making and receiving calls and texting. Baron's study looked into the attitudes of users towards talking face to face, texting or calling on the mobile (Baron, 2009) and found that users preferred texting as their method of communicating with each other.

Text messaging was introduced into the domain of communication technology almost by accident. In 1982, a voice mobile telephone system that would work throughout Europe was created by a multinational European initiative known as Group Special Mobile, or GSM. This came into operation by 1992. A bit of leftover bandwidth was made available so that users could create short messages on the keypad by tapping the number keys between one and four times to produce alphabetic characters. This was SMS texting (Short message system) and very quickly became popular amongst young adults and teenagers.

One of the key factors that have been observed in many studies of mobile phone use and behaviour in adults and young people is that the very function that people enjoy from using their mobile phone is also the very function that has a negative aspect to them. For example, a major benefit of the mobile phone is the freedom offered by the ability to be able to be contacted at any time, but this constant connectivity and accessibility brings with it the problem of being "always on" (Baron, 2008) leading to a sense of dependence and in extreme cases, addiction. "Constant accessibility translates to greater efficiency and more comfort, but also increased stress" (Arbitron inc and Jacobs Media, 2011). "One may be dependent on connection and feel constant worry over accessibility, as though one were addicted to the connections the mobile phone makes possible"(Kopooma, 2001, P. 27) Such negative characteristics range from "disruptive sleep to carpel tunnel syndrome (from constant texting), distraction form the cognitive or social task at hand, or clinical addiction" (Baron, 2009).

The present study continues the exploration of this conundrum in a young age group, tweens (8-11 year olds). Drawing on studies of teenager's use of mobile phones, this is explored to find out how younger ages are using their mobile phones and also to find out what their attitudes are. Are 'the contradictory pulls' of the mobile phone experienced by adult and teenage users the same for tweens? The hypothesis that is explored is that tweens will, in fact, experience similar contradictory pulls of mobile phone use that older users do.

The study also wanted to find out if young users: tweens (8-11 year olds) own a mobile phone and what they use it for. The hypothesis that text messaging will be the most popular way of communicating is tested to see if tweens, like teenagers find texting most popular. As the mobile phone becomes more popular by younger and younger users, is face to face contact no longer the favoured means of communicating with each other?

METHOD

Participants

Participants were 136 male and female pupils in Year 4 (age 8/9), Year 5 (age 9/10) & Year 6 (age 10/11) from seven primary schools in Somerset. Interviews were then carried out with 20 male and female pupils in Year 5 (age 9/10) and Year 6 (age 10/11) from two schools. Letters were sent to parents to invite pupils to participate in the research and ethical approval for the study was given by the university.

Materials and Design

Questionnaires were presented to the pupils as A4 booklets. They were designed to find out how young people use mobile phones and their attitudes to their use of them. Four age group categories were created so that questionnaires could be adapted for the needs of different age groups. The four age groups were 8-11 year olds, 11-14 years, 14-18 years and 18-25 year olds. This paper considers the 8-11 year old group.

The motivation for the questionnaires came about as a way to gather data from a large sample of participants and to see if and how the mobile phone had impacted on participant's everyday lives. A literature survey provided the background for the questionnaires and various studies influenced the choice of questions (Baron, 2009, Van Biljon, 2006). Questions were adapted for the age of participants. The first questionnaire asked participants questions about their mobile phone use and their attitudes towards their mobile phones. The second questionnaire asked about mobile phone usage with reference to voice and text and also asked who was contacted.

Questions in the questionnaire included open ended and direct questions depending on the sort of response that was being looked for. Some questions required a direct response whereas other questions offered a choice of response on a 3 point lickert scale.

Two schools were selected to carry out interviews with Year 5 and Year 6 children. The selection for this was random. Children were interviewed in groups of three. Due to the age of the children, it was felt that the children would feel 'safe'/relaxed in a group this size. The group would be large enough to encourage dynamic interaction amongst participants but small enough for each child's voice to be heard. It was felt that interviewing individuals might feel too intense for them. Interviewing children in a group of three was a group size endorsed by Foolproof (UCD conference, November, 2012) who regularly work with children for assessing user centred design products.

Interview questions included open ended and direct questions depending on the sort of response that was elicited. The first question was open ended inviting children to tell the interviewer what they thought about mobile phones. This was followed by a question "Why do you think the mobile phone has become such an important part of everyday life?" This question was adapted from Madell and Muncer's study (2007) where a focus group of seven teenagers were asked, "Why do you use different communication media, such as the internet and mobiles phones in your social lives?" It was important to gain a broad view of how the children perceived mobile phones in their everyday lives rather than just their social lives. Asking children about their everyday lives would include their social life but not restrict their consideration of the use of their mobile phone only to their social lives. Interactions with their family could also be considered. The children were asked about whether they preferred to text or call. They were then asked, "What makes you decide to text rather than ring?" followed by "What makes you decide to call rather than text?"

Procedure

Pupils completed the questionnaires in small groups in their year groups. The setting for the questionnaires was informal and varied from a small study room or a space in the library. Children had the opportunity to ask questions. The questionnaires took about 20-30 minutes to complete.

A pilot study was carried out with ten primary school pupils. Children in each year group were asked whether or not they thought any of the questions or the language in the questions should be changed in any way. As a result, some changes were made. For example, the question, "What technological devices do you own?" was changed to "What electronic gadgets do you own?" The Year 4 children said they found this easier to understand. It was important to make sure the questionnaires were suitable for the ages of the children. Discussion with the Year 6 pupils (age 10/11) suggested that the questionnaires would be suitable for Year 5 (age 9/10) and Year 4 (age 8/9) children to fill in. The Year 6 pupils also suggested that it was easier if the questionnaires had 'boxes' for them to put their answer in so they knew where to put their responses. The questionnaires were originally on A4 paper. Year 4 pupils suggested that the questionnaires would be easier to fill in if they were in the form of a booklet.

The setting for the interviews was informal and flexible. Interviews were carried out in a small study room or space in the school. Face to face semi-structured interviews aimed to extract a rich account of personal opinions from the participants' own unprompted observations. Pupils had the opportunity to ask questions. Audio recordings of the interviews were transcribed verbatim. Interpretative phenomenological analysis (Smith and Osborn) 2003 was then used to analyse the data.

RESULTS

Some results of the questionnaires completed by 8-11 year olds and interviews carried out with 27 pupils are reported. Descriptive statistics show that 95% per cent of 8-11 year olds have access to a mobile phone whereas 66% own a mobile phone. Most of the phones owned by tweens are smart phones.

The majority hold mainly positive attitudes towards their use of mobile phones, for example, 90% of tweens believe that mobiles are fun to use.

The most popular uses

The most popular use of mobile phones is for sending and receiving texts (81%) followed very closely by making and receiving calls (80%). The most popular reason for calling (79%) and texting (77%) is to keep in touch with family. Over three quarters of pupils said they liked to play games on their phone (79%) and three quarters of pupils liked to listen to music (75%). Less than three quarters of pupils said that they used the mobile phone to access the internet (70%).

What do tweens prefer to do? Talk, Text or Face to Face

Comparing the percentages for talking face to face with each other with talking or texting on the mobile phone, tweens prefer face to face contact (51%) However, if the cumulative frequency of always and sometimes is considered together, the most popular form of contact is talking on a mobile (84%), followed closely by texting (82%) and then face to face to contact (81%).

Table 1: Which communication mode do tweens prefer?

	Talking face to face	Texting	Talking
Mostly	50.7	47.1	35.1
Sometimes	30.1	36.0	48.5
Never	19.1	16.9	16.2
Cumulative frequency of mostly & sometimes	80.9	83.1	83.8

Organising schedules and changing plans on the move

Fifty seven percent of tweens said they use their mobile to arrange when and where to meet friends. Forty two per cent used their mobile to change plans quickly. Seventy one per cent of tweens say they call or text to say where they are or check where someone else is.

When tweens were asked if they liked to be able to use a phone to keep in touch no matter where they were 80% said they did like to use their phone in this way.

Always on

Tweens were asked about whether or not they liked to have their phones on all the time. Sixty seven per cent said they did. Seventy six per cent liked to be able to be text or called at all times whereas Seventy nine per cent liked to be able to use a phone to keep in touch no matter where they were.

When tweens were asked if they liked to be able to use a phone to keep in touch no matter where they were 80% said they liked to use their phone in this way. Looking further at this desire to be able to be contacted ‘any time, any place’, tweens were asked about whether or not they kept their phone on when they went to bed. 53% slept with a phone next to their bed. 35% leave their phone on when they go to bed and 66% turn their phone off when they go to bed.

The interviews

Table 2 shows the themes identified by using interpretative phenomenological analysis (IPA).

Table 2: IPA analysis

Super ordinate themes	Emergent themes	Sub themes (codes) Used for	Phone Function
Usefulness	Useful for homework	School work	Texting Reminders Storing contacts Calculations
Relationships for perpetual (everyday) contact	Positive aspects: being able to keep in touch with family, friends and work colleagues Negative aspects: being woken up when sleeping	Micro-coordination Hyper-coordination	Texting Calling
Safety & Security	Emergency situations	Good if there is a fire	Calling
Cost	Negative aspects: go over text limit		
Entertainment			Listening to music Playing games

Some comments from the interviews are reported.

Question: What do you think about mobile phones?

"They are good for keeping in contact with people. They are important for us because we are going off to different schools".

"They are good for keeping in contact with your family. I talk to my family a lot."

"I don't use the phone much except for phoning and texting my parents"

"Good to stay in touch with your parents"

"It's good for communicating but I know people who are addicted to their phones"

"Mobile phones keep you safe"

"Good for calling if there is a fire"

Question: Why do you think mobile phones have become such an important part of everyday life?

"It's a good way to keep in touch"

"Good for communicating"

"They're useful for texting about school work"

"They keep you in touch with your family so if it's raining, for example, I can call my Mum to come and get me."

"You can use them if you're bored"

Question: Do you prefer to call or text?

More tweens prefer to text ((13) than talk (11) and three pupils said they didn't have a preference to whether they called or text on the mobile phone.

Question: What makes you decide to text rather than call?

"Calling is hard if you are doing something but if you are texting, you can carry on with what you are doing"

Texting is like a way of getting out of an argument. You wouldn't say it as a real person but by texting, it's like it protects you like a bubble, so you can say it in a text"

"What's good about texting is that you can send a photo with your text.

"I don't want to waste credit calling; I just save ringing for an emergency."

"I would text if I was angry"

"Cheaper to text"

"I would text if there is an emergency. If you text, you know the message has gone through. If you call, the person might not answer."

"It's more private to text"

"It's cheaper to text"

"And quicker, and it gives you time to think. If you're speaking on the phone, you might forget what you've said or arrange but with texting, you have it in front of you so you have time to think about what you want to say"

Question: What makes you decide to call rather than text?"

"When you talk to someone, you can give them your expression"

"When you call, you can get straight through or not at all but with texting you don't know if you have got through"

"If there was an emergency, say if your house was burning down, then I would call"

"I don't want to hurt my thumb bones by texting"

"Sometimes texting can take too much time and yeah, texting can hurt your thumbs"

"When you text, it doesn't capture the real thing like when you call and speak to someone else so I like to use a call because sometimes people don't text back. It might hurt your fingers if you text too much. It might hurt your fingers if you text too much."

"I prefer to ring to hear their voice and because it's more like face to face contact**."**

"Because I like to hear my parent's voice"

"It is comforting to hear someone's voice if you are feeling down"

"Voice is more descriptive than a text"

"You get the tone in your voice by talking."

DISCUSSION

The results from the questionnaires show that 66% of tweens in this study own a mobile phone. This is a surprisingly high number of tweens with a mobile phone, for example, compared to the Pew Survey 'Teens and Technology 2013' where it was found that 78% of teens, (12 to 17 year olds) owned a mobile phone.

Five main themes have been identified in the IPA analysis of the interviews. These are the usefulness experienced from using a mobile phone, the facilitating capacity of organising schedules, for micro-coordination and hyper-coordination with family and friends, safety in an emergency and security, cost and the use of the mobile phone for entertainment.

The 'contradictory pull' of factors participants like about mobile phones but at the same time experience a negative effect can be seen on many occasions. When asked "What do you think about mobile phones?" one participant said mobile phones:

> "are good for keeping in contact with people. Because we are going off to different schools (*referring to secondary schools)*, they are important for us"

but then referring to the cost of the phone, she said:

> "The bad thing is I go over my text limit in my contract because I text too much"

In response to the question, "What do you think about mobile phones?" another participant said:

> "I think it is quite good. I like to text, carry it around, do stuff on it"

Later on in the conversation, she said:

> "Sometimes I'm asleep and it wakes me up. It vibrates and wakes me. That's not good"

The questionnaires showed that the most popular use of mobile phones is sending and receiving texts (81%). Geser (2006) and Madell and Muncer (2004) identified the significance of texting as the most popular use of the mobile phone amongst teenagers. Calling was almost as popular as texting. 80% identified calling as a reason for using their phone. Over three quarters of pupils said they liked to play games on their phone (79%) and three quarters of pupils liked to listen to music (75%). The Pew Research Internet Project (2013) found that 74% of teens (12-17 years) access the internet on a tablet, mobile phone or other mobile device and that 25% access the internet mostly on their mobile phone. The tween's responses revealed that 70% access the internet on their mobile phone.

Comparing the percentages for talking face to face with each other with talking or texting on the mobile phone, tweens prefer face to face contact (51%) However, if the cumulative frequency of always and sometimes is considered together, the most popular form of contact is talking on a mobile (84%), followed closely by texting (82%) and then face to face to contact (81%).

The results for whether or not children decide to text rather than call or call rather than text are similar to the results found by other studies (Baron, 2009, Geser, 2004). The reasons tweens gave to the question "Why do you prefer to text rather than call?" show how users experience many benefits to texting. For example, texting information allows users time "to choose what information to include" in a text. Baron ((2009) found texting meant the message could be "kept short, and talking takes too long" (P.14) Texting meant that users wouldn't have to become entrapped in extended conversations. By texting information, they could also choose what information to include.

Other advantages that interviewees expressed are:

> "Calling is hard if you are doing something but if you are texting, you can carry on with what you are doing"

> "I don't want to waste credit calling; I just save ringing for an emergency."

> "It's cheaper to text"

> "And quicker, and it gives you time to think. If you're speaking on the phone, you might forget what you've said or arrange but with texting, you have it in front of you so you have time to think about what you want to say".

The questionnaires showed that the most popular reason for calling (79%) and texting (77%) is to keep in touch with family. Wajcman et al. (2008) showed in their study that the main purpose of mobile phone calls was to maintain continuing connection with family and friends. In the interviews, the importance of the mobile phone in family life is revealed.

> "My Dad's away a lot so I like to call him to hear his voice"

> "I like to call my Dad when he is going on his lorry"

Children with separated parents value the use of their phone to keep in touch with the other parent.

> "I have a phone because my parents are split up"

In this context, tweens prefer to call rather than text so they can hear the other parent's voice.

The results show that tweens use their mobile phones for micro-coordination in their lives. 57% arrange when and where to meet friends. 42% of tweens used their mobile to change plans quickly. 71% of tweens say they call to say where they are or check where someone else. This is backed up by the interviews:

> "My Mum got a phone so I could go up the park"

> "I go up the park"

> "They keep you in touch with your family so if it's raining, for example, I can call my Mum to come and get me."

With reference to being "always on", 67% said they liked to have their phones on all the time and 80% said they liked to be able to use a phone to keep in touch no matter where they were . 76% liked to be able to be text or called at all times. With reference to the negative quality of addiction, 53% of tweens slept with a phone next to their bed, 35% left their phone on when they went to bed whilst 66% turn their phone off when they go to bed.

Individuals make decisions on whether to text or talk depending on what information is being expressed and also what the purpose of the message is. This was also found by Baron (2009) and Ling and Yttri (2002). Although texting is the most popular means of communicating, many participants are aware of the limitations of texting:

> "Texting can be awkward. If you have an argument when you are texting, you can get a wrong impression from a text. You can get more meaning and expression in calling"

Another participant refers to the time delay in getting a response when texting:

> "I like calling because you can get more information and you know the answer straight away but with texting, you don't get the answer straight away"

In conclusion , the decision to talk or text is complex and varied. It is based on individual differences and individual perceptions and understanding of how participants perceive different functions and features on the phone. For example, one participant wants to text in an emergency because:

> "I would text if there is an emergency. If you text, you know the message has gone through. If you call, the person might not answer"

whereas another individual will call because they want to make sure they get through. It is important to them that they can express the level of the emergency by the "tone in their voice". Another participant appreciates the value of calling in an emergency:

> "If there was an emergency, say if your house was burning down, then I would call"

Participants like to hear the tone or expression in people's voice when calling:

"I like to hear people's voices. Talking makes me feel like I'm with someone".

"When you text you can't hear the tone in someone's voice, their expression"

"I prefer to ring to hear their voice and because it's more like face to face contact**."**

"It is comforting to hear someone's voice if you are feeling down"

"Voice is more descriptive than a text"

"You get the tone in your voice by talking."

This study has discussed 'the contradictory pulls' of using the mobile phone in tween's everyday lives; for example, constant accessibility creating a 'perpetual contact' culture as evidenced by tweens being woken in their sleep. Future studies could explore this further.

Some traditional ways of communicating are changing. For example, many tweens prefer to communicate by texting. This is the case for particular types of communication, for example, for micro-coordination in their lives and sometimes for avoiding face to face contact. It is easier to text. One of the advantages of texting is that it allows the user to think through what they want to communicate. They can also multitask and carry out other activities at the same time. Hyper-coordination, however, facilitates calling as the preferred means of communication because tweens like "to hear the tone or expression in people's voices". The interviews indicate that when participants want a more 'meaningful' contact, they call their family or friends. Although texting I the favoured wa of communicating by many tweens, face to face contact and the characteristics of 'real life' contact with each other are important and valued by tweens.

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Section 2

UX as a Service (UXaaS)

User Experience as Service at Social Networking

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ABSTRACT

Despite the popularity of social networks, there is a lack of a systematic way in which different social networking services can be categorized, and what users' expectations and motivations for each type of social networking services are. This paper presents a framework of social networking services. We then proceed to elaborate on how to provide best user experiences from a need-satisfaction lens for each type of social networking services.

Keywords: social networks, services, user experience, need satisfaction

INTRODUCTION

Social networking has become increasingly popular worldwide, and emerged as the most popular internet activity in recent years. As of March 2013, Facebook announced that it has 1.11 billion people using the site each month, a 23 percent growth from a year earlier. In other words, 46% of the world's 2.4 billion internet users are now on Facebook. Twitter saw over 200 million active users that send 400 million tweets per day in March 2013. Social networking now reaches 82 percent of the world's Internet population age 15 and older that accessed the Internet from a home or work computer, representing 1.2 billion users around the globe. Social network activities also top the number one spot for people's internet usage. Research by comScore(2011) reported that social networking accounted for nearly 1 in every 5 minutes spent online globally in October 2011, ranking as the most engaging online activity worldwide.

Social networks have profoundly changed how we interact with each other, as well as how we use the internet. Nowadays, people get their daily share of news by looking at stories and updates posted by friends on Facebook or from people they follow on Twitter, instead of reading news websites. We use social networks to stay in touch with friends, meet new friends, look for jobs, and play games. We share our thoughts, pictures, music and videos online with friends and comments on what our friends have posted. Although the term "social networks" covers a wide range of "web-based services that allow individuals to (1)construct a public or semi-public profile within a bounded system, (2) articulate a list of other users with whom they share a connection, and (3) view and traverse their list of connections and those made by others within the system"(Boyd & Ellison, 2008), there are considerable variations among the nature and mode of interaction of user activities performed at these websites. Some are centered around relationship maintaining and building, e.g., Facebook; while some are more geared toward content creation and sharing, e.g., Pinterest; and still others have specific goals and purposes, for example, asking and finding answers with social networking, like Quora.

Despite the many hours we spend on social networking each day, there is a lack of a systematic way in which different social networking services can be categorized, and what users' expectations and motivations for each type of social networking services are. A classification scheme of social networking services can help us organize academic discussions, understand the difference and similarities among various services, and provide more in-depth insights for social networking services. Social networks have been frequently referred to as SNS, or social networking service, reflecting the service nature of these sites. Indeed, as service is defined to be "the application of specialized competences (knowledge and skills), through deeds, processes, and performances for the benefit of another entity or the entity itself" (Vargo & Lusch, 2004), and service should correspond to the customers' expectations and satisfy their needs and requirements(Edvardsson, 1998). Social networks fit into the service definition with unique functionalities that benefit their users and satisfy users' needs by making it easier to connect, make friends, and share with each other.

With the service nature of SNS in mind, we herein present a typology of social networking services based on prior research of social networks, as well as service literature, then proceed to elaborate on how to provide best user experiences from a need-satisfaction lens for each type of social networking services..

CHRACTERISTICS OF SOCIAL NETWORKING SERVICES

Prior literature identified profile–based versus content-based as a major distinction among social networking services (Childnet International, 2008), which distinguishes SNS into two distinct groups with different purposes, nature of information, and nature of connections. Profile-based social networking services are primarily organized around members' profile pages that consist of information about an individual member, and users make connections mainly because they are interested in the user behind the profile. Facebook, Twitter, Line, Whatsapp are typical examples of profile-based social networking services. Profile-based social networking services are centered around the person that's behind the profile, so topics are more related to the person: what they do, what they like, and what they think. Typically, developing and maintaining relationships are of key concern with profile-based social networks. In content-based social networking services, however, the user's profile remains an important way of organizing connections, but plays a secondary role to the posting of content, and users make connections mainly because they like the content a certain profile provides and want to follow updates of that particular profile. Photo-sharing sites Flickr, Instagram, Pinterest and Video-sharing site Youtube are examples of this type of service. Content-based social networks are more focused on contents, and discussions and comments are based around pictures and videos, i.e. the content that are shared, with much less focus on the person per se.

Schmenner (1986) identified customization as a key element of services. Customization captures the degree to which the service is customized to satisfy an individual's particular preferences(Schmenner, 1986). In the context of social networking services, customization refers to the intended audience of the messages posted by users. There are two types of postings: one type is customized and intended for a specific person or a small group of audience, for example, leaving a comment to a friend, or posting updates to a closed circle of friends; and the other contains messages that are broadcast and are intended for everyone that is interested to read, for example, twitter accounts by the Wall Street Journal, President Obama or other celebrities. Thus, level of customization captures the differences of the intended audience. Customized messages have specific audiences, are generally exclusive (i.e., with certain level of permission setting); whereas broadcast messages are intended for the general public to view and inclusive of everyone, with no viewing permission restrictions.

A SOCIAL NETWORKING SERVICES FRAMEWORK

Using profile-based versus content-based, and customized versus broadcast as the two defining features, we create a

two-by-two matrix that categorizes the whole range of diverse social networking services into four types. Figure 1 shows a social networking services matrix and indicates some of the applications or services that fit neatly in one of the four quadrants.

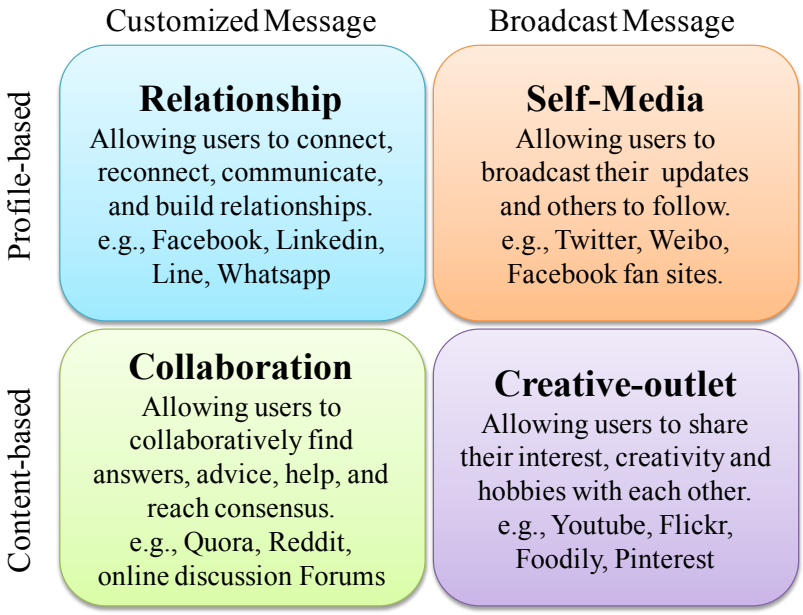

Figure 1. Social networking services matrix

Relationship

Social networking services that are profile-based and consist most of customized messages are labeled as "Relationship". It includes services such as Facebook, Linkedin, and mobile APPs such as Line and Whatsapp. These profiled-based services usually require two-way confirmation of the establishment of a connection, and enable active screening of friends and varying levels of privacy protection, and are mostly used for relationship building and maintaining. In these social networks, most connections are made by acquaintances, or at least, friends of acquaintances, and people post messages on each other's pages, leave comments on a friend's photo, or update their status to a closed circle of friends. The messages are customized for one person, or a small group of friends, and are functionally equivalent to phone calls, emails, and family Christmas letters.

Self-media

In the "self-media" type of social networking services, people connect to profile-based accounts that are established by well-known organizations, celebrities, or products. Instead of relying on traditional media channels that are owned and operated by media companies, this kind of SNS offers organizations, celebrities, and products the chance of managing a social media communication channel owned and operated by themselves. Typical examples of this type of services include Twitter, Weibo (The Chinese version of Twitter), and Facebook Fan sites. The connection requires only one-way initiation, and there's very limited screening of accounts. People can "follow", for example, president Obama and get updates whenever he posts on Twitter, or the New Agency Reuters, and get the latest breaking news before major television and website accounts are available. Similarly, brand managers can also establish fan sites of their products and broadcast the latest development of their new product and propagate promotions via self-media on Twitter or Facebook fan page.

Creative outlets

For content-based social networking services, those that offer broadcast messages to the whole audience are labeled "creative outlets". These include services that allow people to share their interest, creativity, and hobbies with each other, for example, video sharing websites Youtube, picture sharing services Instagram, Flickr, and Pinterest, and recipe sharing APP Foodily are all types of creative outlets. People post their photos, self-made funny video, or recipes online to share with people with similar interest. User can go through the website and follow whoever has the most interesting contents for updates, and exchange tips and thoughts with each other. This type of social network services connects people based on their creative outputs, and provides a meaning outlet for their creativity, while as the same time, provide entertainment and esthetic content for the followers.

Collaboration

The last type of social network services consist of sites that are content-based, yet provides messages that are customized for specific questions or topics. These sites include social question answering site Quora, that allow users to ask and answer questions via collaboration, or Reddit, where users read and rate news, and discuss hot topics. On these sites, messages are customized for a specific question or topic, usually what the previous user has commented or asked, however, people are connected mainly because of the content or what they're interested in, not that they know each other. These sites allow users to collaboratively find solutions to answers, get advice for life's difficult situations, try to reach agreement among certain topics, and find the most interesting news and content of the day. Thus, we label these sites "collaboration".

USER EXPERIENCES IN SCOIAL NETWORKING SERVICES

With the different types of social networking services that exhibit great variations in nature of services and audiences, how does each type provide unique user experiences? To answer this question, we first look at what constitutes user experiences. Although there has not been a common accepted definition of user experiences yet, scholars tend to agree that user experience is something dynamic, context-dependent, subjective, that emerges from interacting with a product, system, service, or an object(Law et al, 2009). Hassenzahl(2008) defined user experience as a momentary, primarily evaluative feeling while interacting with a product or service, and are consequence of fulfilling human needs.

Hassenzahl(2008) proposed that people perceive interactive products along two different dimensions: pragmatic quality and hedonic quality. Pragmatic quality refers to the product's perceived ability to support the achievement of tasks such as "making a telephone call" or "finding a book in an online-bookstore". Pragmatic quality calls for a focus on the product – its utility and usability in relation to potential tasks. In contrast, hedonic quality refers to the product's perceived ability to support the achievement related to human needs, such as "being competent", "being related to others", "being special". Hedonic quality calls for a focus on the self, where more general human needs beyond the instrumental come into play, such as a need for novelty and change, personal growth, self-expression and/or relatedness.

Hassenzahl(2008) further argue that the fulfillment of basic human needs, such as being autonomous, competent, related to others, stimulated, and popular through technology use is the driver of experience. When people experience fulfillment of their needs through a product, they will attach hedonic attributes to Hedonic quality, which contribute directly to the core of positive experience. In a study aimed at exploring the structure of positive experiences with technology, Hassenzahl(2008) found that experienced autonomy and competence are sources for positive experiences while using technology, while there is a lacking of this to reflect a available technologies that address relatedness in current technology usage. Hassenzahl(2008) called for future research to broaden the palette

of needs to "pleasurable stimulation," and "popularity / influence over others", to test whether these are able to produce the lacking facets of positive affect (i.e., excitement and enthusiasm).

Social networking services seem to be able to address what is found lacking in current user experiences per Hassenzahl(2008): relatedness and popularity. Beyond that, social networking services may also address other fundamental human needs, which contribute to the rich, addictive experience of using social networks.

IMPLICATIONS FOR USER EXPERIENCE DESIGN

From a user experience design perspective, each type of social networks should support the accomplishment of their main corresponding human needs. Beyond general functionalities, designers must keep the underlying human needs in mind and focus on creating seamless experience that addresses these needs via the social power that SNS offers. What specifically, then, should each type of SNS designers pay attention to? Below we offer some advice based on the need-satisfaction paradigm.

Relationship

The most important activities for relationship-oriented SNS are relationship maintaining and building, which nourish people's relatedness and self-esteem. However, people vary in their degrees of emotional expressiveness, and many people may find it difficult to express their feelings and emotions to their family and friends. Sheldon et al.(2011) reported that people that feel disconnected in their social relationship tend to resort to Facebook to feel connected. Relationship-oriented SNS can facilitate the relationship building and maintaining of its users with simple yet effective mechanism to help.

Collaboration

People go to collaboration SNS for topics they are interested in, to hear about other's opinions, and to help other people. Essentially, they're driven by the content and the interactions. To satisfy the need for autonomy, competence and self-actualization, the following aspects are important: (1) facilitating asking and helping behavior; (2) recognition of expertise and participation.

Self-media

People go to self-media SNS for influence, self-esteem, and relatedness. For celebrities and corporations, self-media such as Twitter and Weibo allow them individualized channel of influence, reaching millions of users. For followers, they get the opportunity to get the most updated news, information, and tidbits from their favorite celebrities and brands, which in turn, lead to the need satisfaction of relatedness and self-esteem.

Creative-outlet

Creative-outlet SNS features creativity from the crowd, and attract people looking for inspiration, fun, and enjoyment. Content providers find sense of competence and self-actualization, whereas viewers are entertained. To make the user experience unforgettable and satisfying, the following features might be adopted: (1) celebrating creativity; (2) encouraging exchange of thoughts.

CONCLUSIONS

Social networks are now an integral part of many people's life, however, there is a lack of a systematic approach to understand how SNS works and how to best serve SNS users. This paper tries to address this issue by first providing a typology for social networks, and then examining social networks from a need-satisfaction lens with the user experience perspective. We explore the different types of social networks, and elaborate on the needs each type of services address, and provide implications for user experience design for SNS.

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UX as a Service

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ABSTRACT

User experience design (UXD) has become an important discipline for improving the usability of service innovations. However, user interface (UI) and user experience (UX) alone normally do not define a service, nor do they become services. Recently, we have observed the rise of "Gamification as a Service", which introduce game-based mechanics to non-game services. The "fun" experiences created by gamification is therefore added onto the original experiences offered by the non-game services, and it creates extra values to the services such as customer participation and customer loyalty. Moreover, "socialization of brands" demonstrated the possibility of offering social networking experiences as a value-adding service to another service that is not related to social networking at all. A lot of business websites now include social filters, social tagging, or social feeds, so as to improve the overall service experiences. In this position paper, we discuss this emerging trend of User Experience as a Service (UXaaS), in which user experiences are offered as value-adding software services to other online services.

Keywords: User Experience, Software as a Service, Human-Computer Interactions

INTRODUCTION

With increased use of information and communication technologies (ICT) in service delivery, human-computer interaction (HCI) has become an important research topic for improving the usability of service innovations. User experience design (UXD) further extends HCI to include all aspects of a service or product perceived by users, including interfaces, graphics (UI), physical and informational interactions (Hartson and Pyla, 2012). However, user interface (UI) and user experience (UX) alone normally do not define a service, nor do they become services. The popularity of Software as a Service (Fox and Patterson, 2013) has made "Social Networking as a Service" and "Gamification as a Service" becoming a reality, where user experiences like belongings and fun are offered as value-adding services to non-social and non-game services, such as retailing, e-learning, banking and even heathcare services. In other words, user experiences as a service (UXaaS) could become valid in both service design and service business, where service companies earn their profits through creating online user experiences.

Are there other user experiences that can be packaged and offered as a software service? If we define good user experiences from an online service as satisfactions of specific user needs from the use or anticipated use of the service, then besides the direct needs to be satisfied by the functional software service itself, there are psychological needs to be satisfied by the UX services. It seems that gamification services offered satisfactions of esteem needs, while social networking services offered satisfaction of belonging needs. These UX services can be dropped from the original functional services without disabling them, meaning the UX services are pure add-ons with extra value that can be priced. The challenge is that how can we leverage ICT to create sophisticated user experiences by satisfying safety needs, understanding needs, aesthetics needs, and/or even self-actualization needs defined by physiological studies (Maslow 1993), and make money, or at least create concrete value from them? Several cases are discussed in the following.

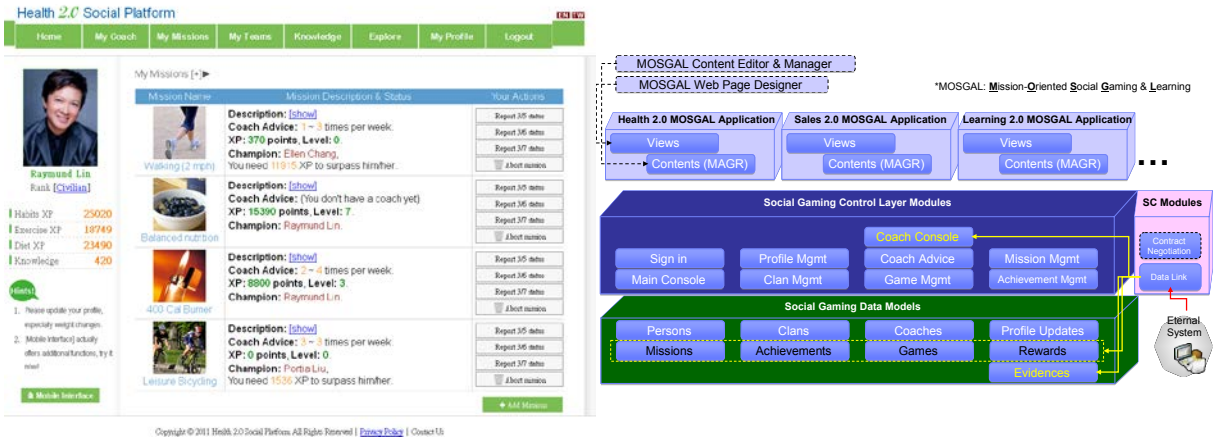
CASE STUDIES OF UXAAS

The following cases are finished or on-going studies matching our definition of UXaaS. More studies are expected to be discussed in the UXaaS conference session. The cases are analyzed with a structure of: project background, service design, impacts and implications.

Gamification as a Service for Healthcare

This is a completed study of applying Gamification as a Service to healthcare (Lin et al. 2012a, 2012b). The background of this project was an attempt to solve behavior motivation issues in healthcare. There is a unresolved issue in treating chronic diseases that medications may cure up to a limit and behavior change is expected to fully overcome the diseases. A social website was established to track participants' behavior change, and social interactions are encouraged as suggested by studies of peer-supporting groups. However, mere peer-supporting is considered not enough in resolving the issue, and some sort of goal-setting and fun experiences are devised to improve participants' motivation.

The service to bring in goal-setting and fun experiences, known as Mission-Oriented Social Learning & Gaming (MOSGAL) service, is built as an independent software service, shown in the following Figure 1(b). The social gaming control layer in Figure 1(b) offers application programming interfaces (APIs) such that the website in Figure 1(a) could retrieve goals (shown as missions) and games (shown as challenges) for participants of healthcare portal. Records of completions of missions and challenges are submitted back to the MOSGAL service for calculations of leader boards. MOSGAL also offer advanced coaching service to urge the participation of games, known as smart coaching. The only down-side of this service is that it does not offer reusable visual widgets, and therefore the original website must find its own ways of displaying the leader boards. In other words, the MOSGAL service only provides APIs to manipulate data related to the satisfaction of esteem needs, mainly leader-boards.



(a) The Gamified Healthcare Service (b) The UXaaS Behind the Curtain

Figure 1. The group purchasing interface

The impact of applying such UX service to an existing healthcare service can be measured by comparing the service with UX and the service without UX. In this case, the original online service only provides health-related information and excel documents for participants to download for the purpose of book-keeping their exercise and diet records. After the service is gamified by MOSGAL, participants can then submit the same records online while competing with others (i.e. participate the challenges offered by MOSGAL service). The two-month experiment shows that the UX add-on service does improve the participation of the healthcare service (Lin et al. 2012b), meaning that people submit exercise/diet records more often then they used to be. However we failed to justify the business value of such an UX service because the original website is non-profit.

Shopping Experience as a Service for On-line Group Purchasing

The second case study (Chin, Tsai, & Lin, 2014) is about offering group shopping experiences to online stores that do not have group purchasing capability. This is a pilot project done in universities to test how people are affected by group shopping experiences. Shopping in groups have a lot of benefits, such as bargaining power by quantify, and acknowledgement of need through peer supporting. Moreover, it brings in the joy of knowing friends are browsing the same online store as I am. This project is unique because it starts from thinking how a software service can bring in new experiences to an existing online service, instead of brining in new functionality. However, it could be difficult to separate user experiences from functions sometimes, as discussed in the following.

By focusing on UX and UX only, the service designer leveraged existing software services to provide functions of group purchasing, including an existing social networking service and a payment service. As shown in Figure 2, the UX service wants to provide group shopping experiences to a seller's website, with "shopping friends" coming from an existing social networking service, and "payment facility" coming from an online payment service. The seller's website only needs to incorporate a small piece of codes from the UX service, then visitors to the website can leave a social "tag" on the "intend-to-buy" products that their friends can see. A visitor can even start gathering a group to buy a product if he/she saw enough friends intend to buy the same product. The UX service creates an group shopping experiences to any online store such that people no longer feel that they are shopping alone.

An experiment is conducted and showed that people enjoy the new experiences brought by the UX service. In the experiment, people are given an ordinary online store for shopping in the beginning, and later an UX enhanced version of the online store is presented to them. Some shopping goals are given to the participants of the experiment, such that they could leverage group purchasing to buy more stuff if they wish to achieve the goals. The participants quickly learned the tricks of getting discounted prices from the online store by gathering a group of people with similar interests, and the group shopping experiences from real life shortens their learning curves.

(a) Design an UX Service (b) Online Store Integrating the UX Service

Figure 2. Designing an UX of Group Shopping as a Service

User Experiences of a Socially Engaged Business Process Management Environment

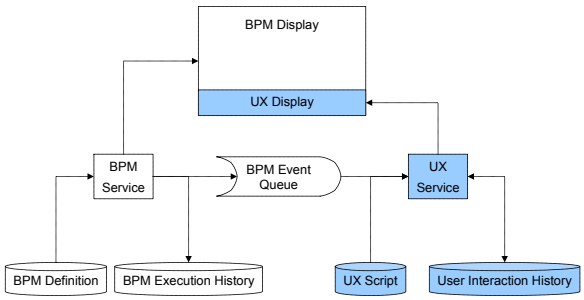
This is a pioneering project inside IBM corporation. Since Business Process Management (BPM) is a 10-year-old discipline (Chang 2005) that drives process efficiency by automating process modeling, bottle-neck analysis, and flow control of a business process. Participants of a BPM system usually concentrate on competing the tasks assigned to them without much social collaborations. However the situation is changed since more and more process tasks require peer supporting and even peer pressure to further improve the efficiency and effectiveness of completing them. The idea of a socially engaged BPM system becomes obvious. How to design a UX service that can enhance an already deployed BPM system environment is the main challenge.

The new user experiences to be added on current BPM experiences include: easy of use for first-time users, peer supporting, and peer pressures. To provide such user experiences, some functions like process guidance, process helpers, and leader-boards are expected to be implemented by the new UX service, however highly decoupled from the BPM service. In other words, the BPM service is not fully aware of the data manipulated and stored by the UX service, and the experiences created by the UX service is purely an add-on that can be dropped at any time without affecting the functions of BPM. This design allows a BPM development team to delegate almost all UX issues of BPM usage to another service team that knows human factors more than the development team.

The resulted service design, as shown in Figure 3(b), leverages event listening to decouple a BPM service and the UX service. This design requires that a BPM service makes its event queue visible to the UX service, and fortunately most BPM environments support this functionality. Therefore, whenever a UX service team wants to introduce a new user experience, they provide UX scripts triggered by specific BPM events, to facilitate a user journey. Taking Figure 3(a) as example, whenever a task is completed by a process participant, the UX service knows it from the event queue, and add a point to a regional score representing the region's participation in the process. The UX display integrated by the BPM portal will show a region leader-board to create the peer pressure experiences. The BPM service only needs to incorporate a piece of code for display, and opens their event queue to the UX service, then UX aspects of the process is delegated to the service team.

Since this is an ongoing project, no experiments are conducted yet to justify the value of a separated UX service. However, the proposed service design already created a management value that the UX design team can work independently and work in parallel with the process improvement team.

(a) Peer Supporting/Pressure as s Service



(b) Highly Decoupled Service Design

Figure 3. A Socially Engaged BPM Experience

GENERAL GUIDANCE TO UXAAS

Targeting Psychological Needs

Good user experiences are defined as satisfactions of certain psychological needs in this paper. This is true for pure

online/digital services since satisfaction of physiological needs such as food, water, breathing and homeostasis is not an option. The key challenge is to offer these "satisfactions" via an independent online/digital service with proven business value. Facebook.com did it by offering the satisfactions of belonging needs, and they prove its value by making money from advertisements. The successful stories of online social games make the concept of Gamification as a Service a new research topic to be pursued, which offers the satisfactions of esteem needs. However, in this paper, a more generic concept UXaaS is proposed to guide the design of an independent service that help other online services improve user experiences by satisfying any possible combination of psychological needs, including safety, social, esteem, growth needs and more. In the future, website owners will be asking which online services can provide peer supporting experiences to my service without knowing exactly what functions need to be implemented by them. The website incorporates a small piece of codes and turn on the service, and visitors to the site now feel "peer supported".

Capturing User Events

A UX service provider could not know whether an user satisfaction occurred without capturing corresponding user events. Events precede these satisfaction events or events causing the satisfaction will need to be carefully "listened". Therefore a piece of codes or an interact-able component must be provided to capture the events. In the group shopping case, the "Intend-to-Buy" button captures the preceding event, while the "Intend-to-Buy" friend list and "Group Buy" button fire the satisfaction event. Pushing the "Group Buy" button is never the same feeling as pushing the "Buy" button, given the satisfactions of belonging needs and safety needs. The UX service in BPM case, on the other hand, captures all user related events perfectly leveraging BPM built-in event queue service. The UX service could also be completely hidden from users of the targeted website, and offers only data APIs as in the healthcare case.

Scripting User Experiences

Once the UX services capture user events, UX scripts can be applied to lead the user journeys. In the BPM case, users are guided by a series of rewarding actions to found his/her position in the regional leader-board, and the position of his/her region in the global leader-board, satisfying esteem needs. Some educational scripts can easily help BPM users to become "masters" of their jobs, satisfying both growth needs and esteem needs. These experiences are absent in traditional BPM environments, making them less engaging. The UX script in group shopping help users of the online store website to engage in a "friendly" shopping where they see friends' intentions to buy, and they can buy goods "together", satisfying belonging and safety needs. The healthcare case has an even higher goal than previous ones to help participants achieve self-actualization through healthy life.

Presenting It as a Software Service

Since guiding users through a series of online experiences could be highly automated, the UX scripts can be presented as a software service to be customized and integrated by other online services. The immediate examples are social networking APIs and gamification APIs. More advanced UX APIs, such as the group shopping APIs and the BPM experiences APIs should be discovered and researched. Technically speaking, UX service innovators can leverage popular service technologies, such as REST, OAuth, and Cloud (Fox and Patterson, 2013), to easily devise public available independent software services. This paper also suggests a possibility of making a generic experience script engine that speeds up all UXaaS developments.

CONCLUSIONS

This position paper discusses cases of UXaaS, and presents general guidance to the design of UXaaS. The idea of a generic experience script engine is proposed but not yet realized. However, as human factors of service engineering are becoming more and more important in "experience economy". It is expected that the UXaaS phenomenon will be thoroughly studied with automation tools sophisticatedly crafted in the near future.

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Social Influence Tagging as a Service for Brand Marketing

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ABSTRACT

Oppose to the strategy of maximizing the spread of commercial advertising though/within the members of a social network, the key issue for the most firms in brand marketing should be targeting the set of individuals who may consume with higher possibility under the inevitable budget constraint. In this research we introduce a prediction framework for "precision targeting" based on the concepts of information cascades and the effects of the consumer conformity. That is, the goal of this framework is to investigate the processes to detect the influencers with higher purchasing possibility in the coming time period. Given the difficulties of data collecting and analyzing, this so called "Social Influence Tagging" can thus be as a service for all the brands for marketing strategy.

Keywords: Social Marketing, Precision Targeting, Social Influence Tagging, Information Cascades

INTRODUCTION

In recent years, with the popularization of social networking sites (SNS), such as Facebook, LinkedIn, and Twitter, a new method of communicating arises in our daily life. More than a billion people use these SNS for creating, sharing, and discussing not only various contents but also their own daily experiences by sharing text, photos, or videos to their friends or even strangers with similar interest.

From the perspective of Sociology, SNS enable the users to present themselves as well as to establish new relationships or maintain the existing ones with others within a social group in real life. On the other hand, information transferring by the interactions within the SNS users conducts a new media channel, as known as "social media". In brand marketing, users (especially the clients) on SNS have easy access to direct communication by posting their experience about specific products or services their have purchased, such that their friends (or perhaps the "potential" clients in the future) are now more easily influenced when having had read it. This powerful form of influence is known as a new sort of "word-of-mouth (WOM)", which is defined as the informal communications directed at other ones about characteristics of the products/services and/or their producers/providers. Messages by social WOM are much different from those directly by the brands who have a vested interest in selling profits, because the opinions and suggestions from the clients, especially the ones who are ours friends, are much reliable when making our own purchasing decisions (Gibs and Bruich, 2010; Hoffman and Fordor, 2010; Kietzmann et al, 2011).

The marketing effect by social WOM has been widely discussed and is now top of the agenda for many business strategies (Piskorski, 2011). There are various works from the perspective of Social Network Analysis (SNA), which focus on defining the relationships and interactions among the nodes (social members) within a network and

developing algorithms for information transferred along with the edges (Pan and Lin, 2011; Rad and Benyoucef, 2011). Moreover there has been considerable research to identifying the influential nodes, selecting an initial node set with maximum influences given different mathematical models, or constructing the underlying diffusion path by theoretical assumptions and simulation methodologies (Richardson and Domingos, 2002; Kempe et al., 2003). Nowadays, marketers as well as decision makers are still trying to identify ways in which firms can make profitable use of social WOM.

In fact, on each SNS, all the interactions between/among users (or actually the "accounts") can be stored as digital data and thus this huge stock of "behavioral data" helps us to understand the communication processes more precisely (Burgess and Bruns, 2012; Manovich, 2012). Therefore, oppose to the strategy of maximizing the spread of commercial advertising though/within the users of a SNS, the key issue for all the firms in brand marketing should be identifying the set of ones who may consume with higher possibility under the inevitable budget constraint, when the social data is available.

In this paper we introduce an analysis framework for "precision targeting" based on the concepts of information cascades and the effects of the consumer conformity. That is, the goal of this framework is to investigate the process that a firm can detect not only the influencers but also the potential consumers who may be influenced by his/her friends' information shared on the SNS, thus employ the strategies directly to the ones with higher purchasing possibility in the coming time period. This "tagging" mechanism can be a specific kind of service for brand marketing when the behavioral data described above is available.

EFFCETIVE INFORMATION AND EXPERIENCE SHARING

Information Cascade

By utilizing SNS, the advertising about products/service and even the brand image can be transferred to the users who may be the potential clients. On the other side, not only the discussions among existing clients, but also the firms can interact with them for feedbacks. Researches in different disciplines are interested in how information is spread among these users. There has been growing discussion in understanding this raising phenomenon in information transferring/diffusion and influence on the users' behaviors on SNS. However, most important of all, only the effective information transferring/diffusing, by which further consumptions may occur, is valuable when making brand marketing.

The phenomenon of effective information diffusion within a social network is known as information cascade or propagation. The modifications of purchasing decisions after reading specific information from SNS can be defined as one type of "informational social influence" discussed by Deutsch and Gerard (1955) and Bearden et al (1986). Many literatures about information cascade focus on the models to simulate information transferring and are evaluated by certain characteristics of specific measures of "spreading". For example, researches focus on the issue of "influence maximization," that is to find a small subset of nodes (SNS users), as known as influential users or opinion leaders, in the social network that could make the largest "impressions" among the social members (Valente and Davis, 1999; Kempe et al., 2003; Chen et al., 2009).

There has been growing interest in understanding the information cascades among the members on SNS, especially based from the concepts of epidemics. Consider a situation where some nodes (clients) are initially "infected" with a disease (information or advertisement), spread it to each of their neighbors (friends) and then those neighbors (friends) spread it to their own neighbors (friends of friends), and so forth. The key issues what CDC and health-related boards care about are the ones who are not only susceptible but also infected by which kind of pathogen (contents or descriptions) for such a high spread. In brand marketing, tagging such content and the ones, including infected and may-be infected, are therefore more important than just advertisement-spreading maximization. However a general evaluation mechanism for connecting information cascade and further purchasing/consumption behaviors is still lacking. That is, under the budget constraint, a brand should focus on the issue of finding out the potential clients who may purchase the products/services in some day and trigger the "consumer conformity" in a social network.

Consumer Conformity

For all the firms in brand marketing, WOM on SNS has a significant impact on the process of purchasing decision-making. It is clear that SNS plays a fundamental role as a medium for the spread of not only the information but also the influence among its users. That is, in the perspective of Social Psychology and Network Economics, individual actions and, in turn, aggregate outcomes are in large part determined by the interaction structure between heterogeneous economic agents, i.e. the individual behavior may be affected by his/her friends on SNS. This network-based social influence, noted as "embeddedness", has already been introduced by Granovetter (1985) and supported the discussions in new Economic Sociology substantially. After the raising of SNS, however, subsequent research suggests that this informational aspect of social influence may also change the others' consumption behaviors when engaging in WOM to satisfy their personal information needs when making purchasing decisions. "Consumer conformity" form SNS is thus defined as compliance with group norm, susceptibility to group influence, and behavioral changes in purchasing decisions sue to reference SNS friends/ group (Park and Feinberg, 2010).

In other words, (potential) clients may decide whether or not to purchase a specific product or service based not only on their own preference but also the previous decisions of their friends or the ones with similar interest on SNS. When effective information cascade occurs, the previous experience may cause the following conformity (purchasing behaviors) of his/her friends on SNS. Indentifying these potential customers is significant in brand marketing.

FRAMEWORK FOR SOCIAL INFLUENCE TAGGING

For every SNS as digital Internet platforms, all the "behavioral data" that firms can collect is divided into to "private data" and "public data". Take Facebook for instance, only the interactions on a Page are public (readable) when any registered users/accounts logs in. All the interactions on "the Wall" are private and can be collected only when the firm is authorized. By Graph API provided by Facebook, every firm can extract and obtain the records about the interactions as well as contents by the Facebook users, including post and reply (Like, Comment, and Share), on specific Pages. From another side of Web crawling, all the comments or discussions on the Webs can also be collected as the descriptions or opinions about the products from the point of clients' view.

The framework of social influence tagging introduced in this paper can therefore constructed as follows:

1. WOM Collection and Classification

First of all, for every product/service for promotions, a Product Feature Concept Space (PFCS) is built up to include various keywords, descriptions, or characteristics identified appropriately to reflect the "image" or "impression" of what the clients recognize about the product. Moreover, by collecting all the available data of social WOM on SNS or discussions on Web, all the text will be analyzed by phasing or syntactic analysis to match the factors illustrated in PFCS. Finally all comments or texts are segmented and then classified into "Tags" relating to how the clients evaluate this product. Figure 1 shows the process of identification and Figure 2 shows an example of tagging after comment classification from the discussions about a milk powder brand.

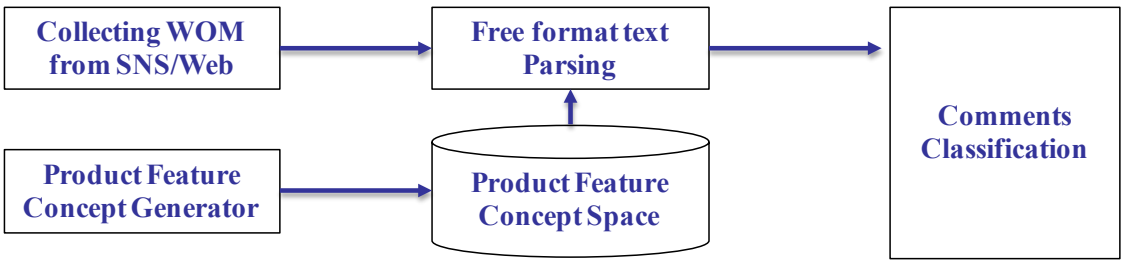

Figure 1. The Process of Comment Classification

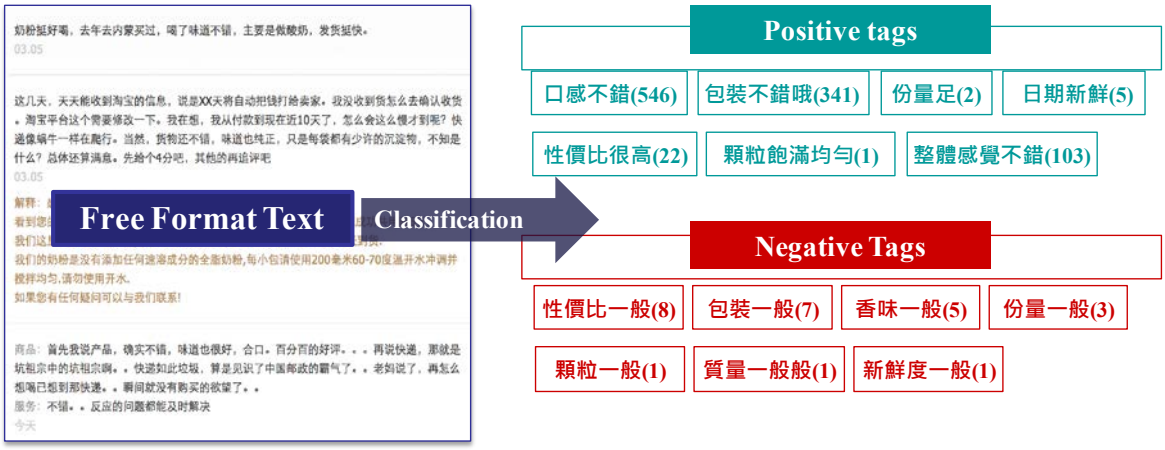

Figure 2. Tagging from Comment Classification.

2. Influencer Identification

Given the "Tags" descripted above, the users or perhaps the clients who posted or commented messages including these tags could be detected. By comparing all the (public or private) data collected from SNS, the influencers with numerous posts/comments (in public data) or his/her own friends (in private data), and of course, with higher evaluations about the product, could be identified and tagged.

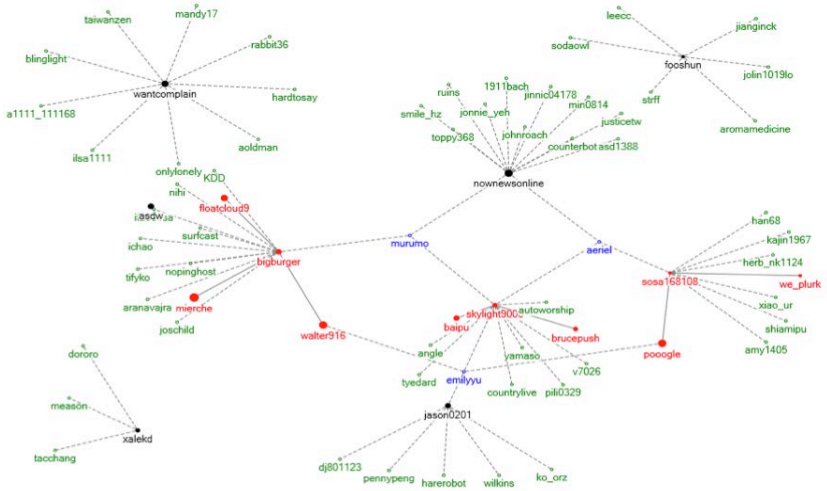

Figure 3. Influencers Tagging and Network Topology.

3. Potential Clients Detecting

Given a set of information cascade models based on the concepts of epidemic research, such as Independent Cascade Model (ICM), Linear Threshold Model (LTM), Susceptible-Infected-Recovered Model (SIR), Susceptible-Infected- Susceptible (SIS) Model, and so on, a evaluation mechanism is applied to find out the potential clients, who may have had been infected by the information posted/commented by tagged influencers. Take LTM for example, it is presumed that a user (potential client) is infected or influenced by each neighbor according to a probability. When he/she replies to multiple posts/comments, the influence effect (pathogen) is accumulated. After it exceeds the threshold, he/she would make the purchasing decision in the coming time period with high probability (i.e. he/she is indeed infected). By the estimated "level of threshold" the potential clients is determined and thus

tagged.

Take Figure 3 for example. Given the tagged influencers, the interactions of these clients with others users of specific Pages (in public data) or with his/her friends (in private data) can be illustrated. The asterisked users (or friends) may be the potential clients who have had been infected over the threshold (say three times) based on the LTM model.

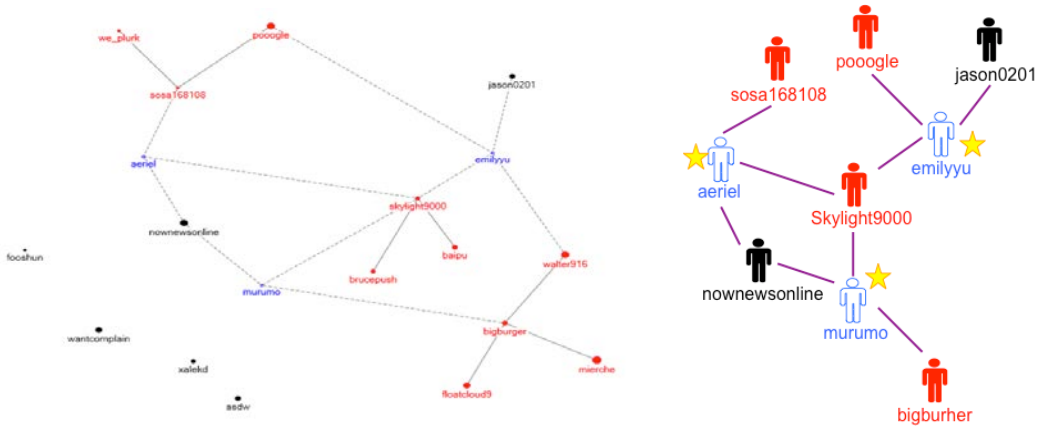

Figure 4. Potential Clients Tagging.

CONCLUSIONS

Nowadays consumers increasingly depend on the experiences, reviews, and suggestions shared on SNS, on which most of the firms believe that appropriate marketing strategies will facilitate the social WOM. In this research we introduce a framework of "social influence tagging" based on the concepts of information cascades and the effects of the consumer conformity. By tagging the comments, influencers and the potential clients on SNS sequentially, "precision targeting" is executable when the "behavioral data" are available.

However, even all the interactions could be recorded as data for further brand marketing, because there is a huge amount of Web discussions, Facebook Pages as well as SNS data, and the verifications of quantity analysis with mathematical modeling depends on significantly computing utilities, most of the firms can not directly collect all the data and thus apply to identify influencers as well as potential clients. Given the difficulties of data collecting and analyzing, this so called "Social Influence Tagging" can thus be as a service for all the brands for effective marketing strategy, by which to increase the consumption possibility of these potential clients.

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Exploring the Servicelization of Mobile User Interface Evaluation

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ABSTRACT

Publication apps, as applications of magazines, books, journals or catalogs published for mobile devices, promise to revolutionize the way we read. A feature central to the success of publication apps is the design of a satisfied interface to link interactive components to the content, which plays a pivotal role in providing readers with good memories and increasing reader satisfaction. However, today's production platform cannot directly feedback suitable mobile user interfaces for designers or editors, as well as the review processes are so lengthy that companies spend a lot of time in waiting for the results or fixing apps based on the rejection reasons. In order to improve the quality of publication apps, we propose a systematic pre-evaluation process that assists businesses to start a pleasant design and to offer consistent mobile experiences to their specific reader communities. The current study integrates association rule mining algorithm with rejection letters in order to identify possible unsatisfied user interface. We find that publishers who submit numerous publication apps save time in both development and submission, resulting from reducing the communication gap with programmers. Therefore, this approach not only enhances efficiency for mobile application development through technology-mediated service, but also effectively generates quality assured user interface meeting mobile reader needs while remaining economically competitive.

Keywords: Association Rule, DevOps, Digital Publishing, Mobile Application, User Interface

INTRODUCTION

The awareness and ownership of new media devices (also well known as tablet and smart phone) rapidly expand, spurred by marketing campaigns from Apple, Sony, or Samsung recently as well as press coverage and word-of-mouth buzz. The behavior of reading, watching, listening and surfing on the mobile devices becomes immersive and personalized. (Bringhurst, 2013) Publication apps, as applications of magazines, books, journals or catalogs published for mobile devices, thus promise to revolutionize the way we read. A feature central to the success of publication apps is the design of a satisfied interface to link interactive components to the content, which plays a pivotal role in providing readers with good memories and increasing reader satisfaction. (Benbasat and Dexter, 1985) However, today's production platform cannot directly feedback suitable mobile user interface for designers or editors (Chen et al., 2009; Schur, et al., 2013), as well as the review processes are so lengthy that companies spend a lot of time in waiting for the results or fixing apps based on the rejection reasons. (Apple Inc., 2014) Furthermore, review groups' user experiences may vary due to their different roles and purposes. (Umanath et al., 1990) Sometimes companies find it hard to stick with numerous guidelines. It's better for apps developers or designers to understand the review principle in advance so as to prevent from consuming time and labor.

In this research, we aims at improving user interface testing processes by providing automatic pre-evaluation

services within apps production platform. The current study integrates association rule mining algorithm with rejection letters in order to identify possible unsatisfied user interface. We find that publishers who submit numerous publication apps save time in both development and submission, resulting from reducing the communication gap with programmers. As a result, designers and editors can focus on their creativities to layout or to set interactive effect with abundant content in the publication apps attempting to enhance readers' satisfaction. Moreover, this approach not only enhances efficiency for mobile application development through technology-mediated service, but also effectively generates quality assured user interface meeting mobile reader needs while remaining economically competitive.

The remainder of the paper is organized as follows. State-of-the-art defines various concepts associated with servicelization, including development and operations method for digital publishing along with technology-facilitated service. Followed by the literature review, we present a methodology for designing servicelization of mobile user interface evaluation. The last section concludes the paper and illustrates the future work.

EXPLORING STATE-OF-THE-ART TO SUPPORT SYSTEMS DESIGN

DevOps

DevOps, an abbreviation for development and operations, is a software development method that stresses communication, collaboration and integration between software developers and information technology professionals. It aims to help an organization rapidly produce software products and services. (Rajiv, 2009) Companies with very frequent releases may require a DevOps awareness or orientation. DevOps is an enterprise capability for continuous software delivery that can enable organizations to seize market opportunities, respond more rapidly to customer feedback, and balance speed, cost, quality and risk. By applying lean and agile principles across the software delivery lifecycle, DevOps helps organizations deliver a differentiated and engaging customer experience, achieve quicker time to value, and gain increased capacity to innovate. (Roche, 2013)

Nowadays, more and more mobile apps companies tend to apply DevOps because they not only need to update their apps very often due to the problems of bug fixed or operating system updated, but also develop various apps as much as they can in order to get more public attention in this app economy world. This mechanism aids in release management for a company by standardizing development environments. In particular, the responsibilities for app quality assurance teams consist largely of mimicking customers' usage patterns and minimizing the discovery of unpleasant surprises. With adopting DevOps practices in quality assurance, apps review processes can be more streamlined and efficient. In this study, we regard user interface evaluation as events that can be more easily tracked as well as more flexibly managed, driving automation in detecting unsatisfied interface - without needing to enter everything manually at the command-line. The designers act as apps developers to edit their own publication apps and also act as apps operators who can test the apps from end users' point of view. Our goal is to maximize the predictability, efficiency and maintainability of operational processes in designing publication apps. This objective is very often supported by automation.

Technology-Facilitated Service

Due to the lack of professional programming skill, current publishing industry relies on expensive software packages to produce e-publications for mobile devices. (Bringhurst, 2013) This customized approach discourages small and medium publishers from publishing electronically. Therefore, an automation system to allow small publishers access to e-publishing is developed. This content production platform integrates with visual design editing and render engine automatically previews interactive applications on various mobile devices. Anyone with no programmer skill is able to produce interactive apps cost-effectively. With tools, editors and designers in publishers of any size can focus on content instead of on programming. As shown in Figure 1, the platform process for editors or designers to produce apps starts in collecting material such as text, images or videos for editing the content layout as well as previewing the designed effects to ensure the packaging results passing apps official review. We consider this platform to be a technology-facilitated service that assisting non-programmers, especially who are from small and medium publishers, to rent this automatic publishing service to spread their own publication apps. Based on this content production platform, mobile user interface evaluation mechanism can be added to enhance the service value. Users can further utilize pre-evaluation module in attempt to test whether their design are followed the review guidelines.

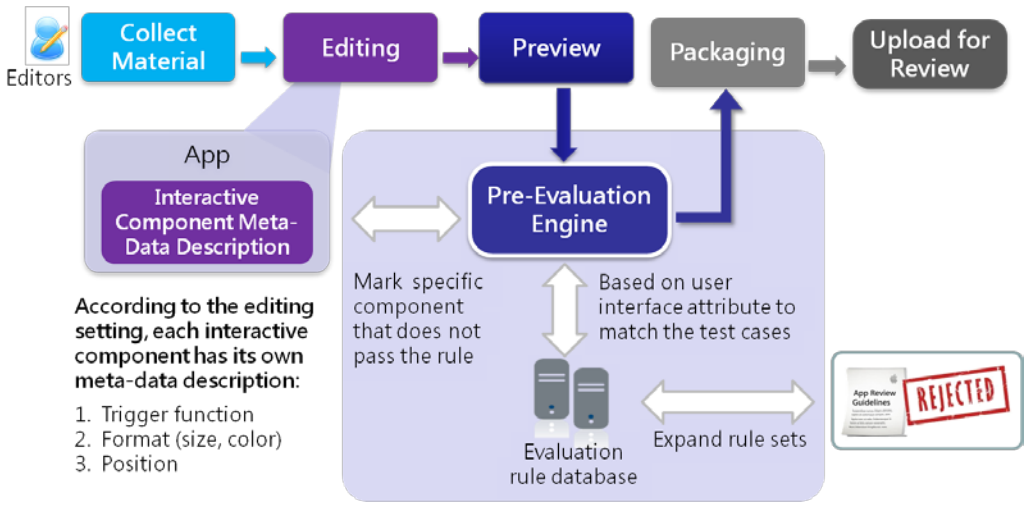

Figure 1. Service overview of mobile user interface evaluation

In this study, we propose a rule-based pre-evaluation engine within the preview process so that this evaluation can facilitate the procedure of user interface testing before wrapping the finalized content up. The engine collects rule sets from review guidelines and rejection letters to establish rule database. When users start the evaluating service by either uploading a designed folio or outputting from previous editing step, the pre-evaluation engine will match the user interface attribute to the test cases in rule database attempting to mark specific component that does not pass the rule. Each component that set from the users has its own metadata description which can be match with our predefined evaluation rules.

METHODOLOGY FOR DESIGNING THE SERVICELIZATION OF MOBILE USER INTERFACE EVALUATION

Interface design is a significant quality attribute of mobile phones and thus user interface evaluation is an essential activity for securing a highly usable mobile phone, which should be conducted during all the phases of design life cycle. Various evaluation methods have been developed and can be classified into three types: testing, inquiry, and inspection (Heo et al., 2009). Testing employs representative users on typical tasks using a system or a prototype and then evaluates how user interface supports the users to do their tasks. Typical methods include co-discovery learning, question-asking protocol and shadowing method. Inquiry method talks to users, observes how they use a system in real work settings, and let them answer questions in order to understand users' feeling about the system and their information needs. Field observation, focus groups, and questionnaire survey are typical inquiry methods. In inspection, experts examine usability-related aspects analytically. Typical methods are cognitive walkthrough and heuristic evaluation which are formed by complicated interaction among a mobile phone user interface, user and task characteristics, and other environmental factors.

In order to improve the quality of publication apps, we propose a systematic pre-evaluation process that assists businesses to start a pleasant design and to offer consistent mobile experiences to their specific user communities. The current study integrates association rule mining into *user interface rule extraction module* to alleviate problems of frequent update and numerous guidelines. Then, the key terms will be extracted from the guideline set, and the initial representation of all reviews is further enriched by using hypernyms in order to exploit the semantic relations between terms. (Chen et al., 2010) An association rule mining algorithm for texts in *rule transformation module* is employed to discover a set of highly-related frequent rules, which contain possible rejection principles for external knowledge experts to implement test codes. Finally, each page in mobile application is executed by test codes within *app page evaluation module* to find out which user interface elements are failed to pass the test cases. Every rejection letter and user feedback can be also input into *user interface rule extraction module* to expand our rule sets. See below figure.

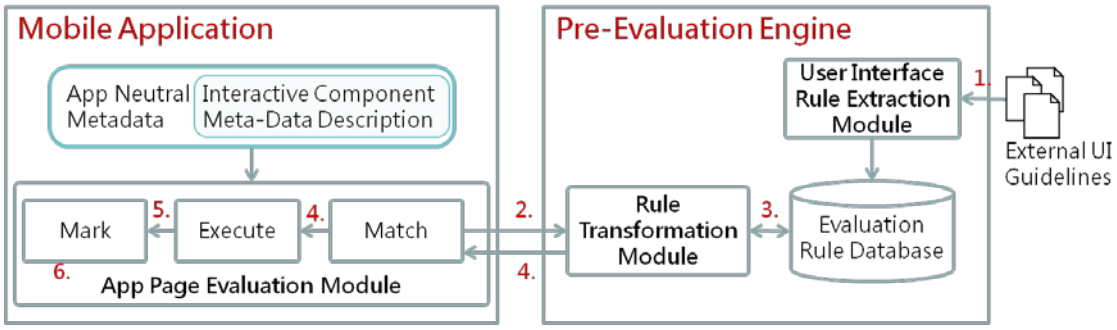

Figure 2. System modules diagram

User Interface Rule Extraction Module

In this module, when receiving a set of external documents including review guideline, human interface guideline, design guides, this module will extract and select the key term set which is equivalent to user interface attribute. There are two stages in the first module, namely Key Term Extraction and Key Term Selection, for reducing the dimensionality of the source document set. The first process for Key Term Extraction is that each guideline is broken into sentences. Then, terms in each sentence are extracted as features. In this paper, a term is regarded as the stem of a single word. Then, the terms appeared in a predefined stop word list are removed. Thirdly, remained terms are converted to their base forms by stemming. The terms with the same stem are combined for frequency counting. Finally, the frequency of each term in each document is recorded.

The second stage is Key Term Selection. We understand that terms of low frequencies are supposed as noise and useless for identifying the appropriate cluster. Thus, we apply the frequency method to choose the key terms for the document set. A term will be discarded if its weight is less than a threshold. Subsequently, this stage will base on the usage of WordNet for generating a richer document representation of the given document set. As the relationships of relevant terms have been predefined in WordNet, in this module, we intend to use the hypernyms provided by WordNet as useful features for document clustering. After key terms are extracted from the document set, they can be organized based on the hierarchical (IS–A) relationship of WordNet to construct term trees. A term tree is constructed by matching a key term in WordNet and then navigating upwards for five levels of hypernyms. Eventually, all term trees can be regarded as a term forest for the document set.

Rule Transformation Module

After the above processes, documents or review rules are converted into structured term vectors. Then, the fuzzy data mining algorithm is executed to generate fuzzy frequent item sets and output a candidate clusters set. In the following, we define the membership functions and present our fuzzy association rule mining algorithm for texts.

Firstly, each pair (term and frequency) of a document can be transformed into a fuzzy set with its frequency being represented by three fuzzy regions, namely low, middle, and high, to depict its grade of membership within corresponding documents. Each fuzzy value has a corresponding membership function to convert the key term frequency into a range value. Secondly, to generate the target cluster set for a document set, a candidate cluster set will be generated after the mining process. A candidate cluster is a two-tuple including those documents which contain all the key terms and a fuzzy frequent item set. This module generates fuzzy frequent item sets based on predefined membership functions and the minimum support value, from a large textual document set, and obtains a candidate cluster set according to the minimum confidence value. Since each discovered fuzzy frequent item set has an associated fuzzy count value, it can be regarded as the degree of importance that the item set contributes to the document set. Two confidence values of a rule pair is used to measure the strength of association among the key terms of the fuzzy frequent item sets.

App Page Evaluation Module

The objective of the last module is to assign each document to multiple clusters. For assigning documents to the target clusters, each candidate cluster with fuzzy frequent item set is considered in the clustering process. Item set will be regarded as a reference point for generating a target cluster. In order to represent the degree of importance of a document in a candidate cluster, a document-cluster matrix will be constructed to calculate the similarity of terms.

Finally, to avoid low clustering accuracy, the inter-cluster similarity between two target clusters is calculated to merge the small target cluster into the similar target cluster. In our current study, we classify the user interface elements into 13 types: activity, activity view controller, collection view, container view controller, image view, map view, page view controller, popover, scroll view, split view, table view, text view, and web view. Every type has predefined test codes written by knowledge engineers. Besides, these test rules separate the behavior in plain text and the step definition in order to facilitate the evaluation. Once the page function in the apps exists, then we only need to modify the test cases. Conversely, when the page function in the apps changes, then we only need to modify the scenarios.

DEMONSTRATION SCENARIO

In this section, we are going to introduce how the proposed service system processes in order to further demonstrate the servicelization of mobile user interface evaluation. When designers already produce an app folios from our predefined content production platform, every app page will have interactive component metadata description file which includes interaction correlation, source metadata, and position metadata. The interaction correlation specifies the relationship among components. This correlation can be touch event for image components to pop-out or scroll events for text components to display more words. As for the source metadata, it includes each component's specific information which is recorded according to user interface element attributes in the guidelines. Position metadata describes the arrangement of interactive components. These metadata files were all wrapped up in an app folio in order to be subsequently parsed for the evaluation.

As shown in below figure, the first step is transforming the guidelines and rejection letters into evaluation rules. This transformation will extract user interface related words and sentences for knowledge engineers to establish corresponding detecting codes. Followed by the content views retrieval, interactive components metadata description will match each rule to see if certain component has specific rules in the database. The aim of this action is to ensure every component is well-checked in attempt to find out possible problematic user interface components. Thirdly, when the components match certain rules, the components will be examined based on test cases to execute corresponding detecting codes. For example, in this flowchart scenario, the app page includes six button components that will be checked for size, color and position. Lastly, components that are problematic according to the rules will be marked for reminding the designers. Take the button size for instance; previous rejection letter has mentioned that the button size should be at least 44pt so that the buttons will be highlighted for being too small. To sum up, this pre-evaluation process assists the designers to preliminarily filter problematic user interface from rejection rules.

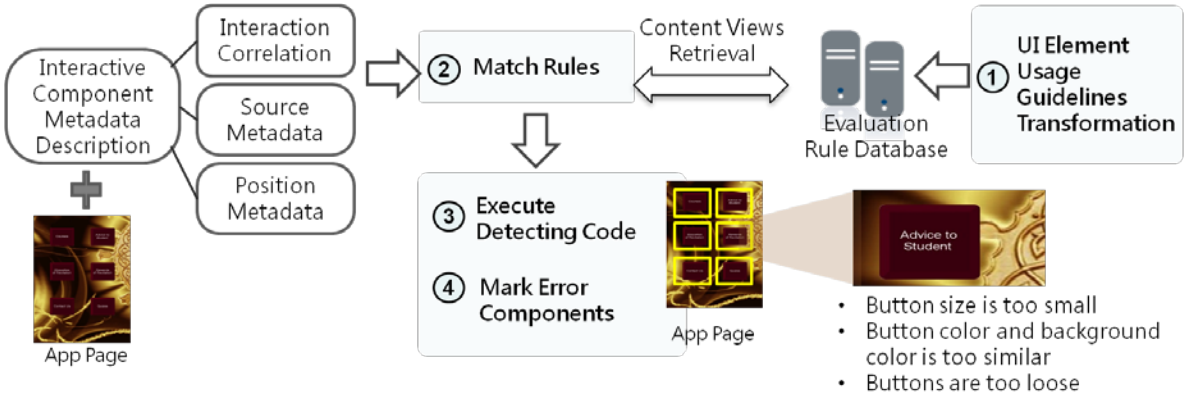

Figure 3. Flowchart of mobile application pre-evaluation

In this current study, we firstly conducted a convenience subject in order to offers a unique lens through our pre-evaluation methodology, and then in the next phase of our study we will collect more samples to evaluate the model. The samples here refer to our app folios that are uploaded to the app store for reviewing.

CONCLUSIONS

Grounded on our research, we firstly conduct a convenience subject in order to identify attitude towards using the publication apps will be more positive when the information format matches the pre-evaluation results. We find that publishers who submit numerous publication apps save time in both development and submission that resulted from reducing the communication gap with programmers. The current study provides a mechanism for editors to sketch a blueprint or a solid configuration with definite expression toward user experience knowledge. The ratings and comments from pre-evaluated publications will be further collected to guarantee the satisfied user interface. Therefore, this approach not only enhances efficiency for mobile application development through technology-mediated service, but also effectively generates quality assured user interface meeting mobile reader needs while remaining economically competitive.

ACKNOWLEDGMENT

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Shopping Experience as a Service for On-line Group Purchasing

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ABSTRACT

Group purchasing has become an important trading activity in today's e-commerce. Most of current group purchasing websites provide a platform for sellers to list products and process transactions. Consumers are attracted and gathered by bonuses or discounts provided by the websites. In such traditional group purchasing scenario, product information is listed in one specific website and consumers have to find the products which they are looking for on the specific website. The impact of social opinions and experiences on group purchasing activities are not fully utilized and studied. In this paper, we design a novel group purchasing system which can directly embed grouping service in any webpages rather than establishing a traditional web store. In addition, user experiences are collected and employed to increase the possibility of group purchasing activities. The impact of other users' preferences and purchasing activities on a buyer's purchasing choice is further studied.

Keywords: Group Purchasing, User Experience, Social Networks, Systems Engineering

INTRODUCTION

E-commerce has grown rapidly in recent years. It has dramatically changed traditional shopping scenarios and activities of consumers. People look for products on the World Wide Web (WWW) and place orders for products of their interest. The products are then delivered to the consumers by package delivery companies. Through the Web, people can find products with lower prices and read comments from other buyers of the products. Recently, people can also form groups for on-line shopping in order to get better prices or specials provided by sellers (Kauffman and Wang, 2001; Anand and Aron, 2003). The new shopping scenario of on-line group purchasing creates great opportunities to further increase sales for sellers and reduce prices for consumers. This paper develops a novel system for on-line group purchasing and investigates the impact of user preferences on consumer purchasing behaviors.

On-line group purchasing has drawn considerable attentions from people who look for better prices for products on the Internet. Current group purchasing system provides a platform on the Web for both sellers and consumers. Sellers have to list their products on the provided platform and follow the product list format of the system. Consumers have to join the group purchasing with a lot of unknown people and without customized choices. In general, people look for the products of interest and join purchasing groups based on the decisions of themselves. Other users' experiences and preferences are not shown with the product and have no impact on people's purchasing behaviors. However, users' experiences and preferences are expected to be important factors when people make the

decision to buy a product.

This paper develops an on-line group purchasing system with the flexibility to create purchasing groups in any place on the WWW. The system provides two particular services, namely 'group purchasing service', and 'user experience display service'. The services are designed as a small piece of code which can be embedded into any webpages. Registered customers who want to sell products with group purchasing functionality can plug in the code in their own webpages and users who are interested in the listed products can create purchasing groups with their own choices. The 'user experience display service' provides a mechanism for users to show their preferences on the product list and through their social networks on the Internet. The service is not only being able to create more browsing traffics, but also may improve the potential of consumers joining purchasing groups. In particular, the provided services can benefit both sellers and consumers. On the one hand, sellers can increase their sales by the browsing traffics incurred from users' social relations. User preferences shown on the product list can further attract people when purchasing a particular product. On the other hand, consumers can get even better prices through group purchasing. Consequently, the developed system is expected to have more competitiveness and sales efficiency as compared to traditional web stores or group purchasing websites.

Investigations are conducted to show the impact of the developed system on people's purchasing behaviors. Twenty-six students join the trial of the developed system. The investigation is divided into two phases. In the first phase, the developed services are turned off and the system looks like a traditional web store. In the second phase, the developed services are turn on and the students can create and join groups for purchasing products. Their preference information is also shown on the product list pages and through Facebook. Questionnaire based on the decomposed theory of planned behavior (Davis 1989; Taylor and Todd, 1995, 1995b; Lin 2008) is given to the students after the trial. The results show that the developed services have significant impacts on users' behaviors of on-line purchasing. In addition, user experience information does create positive influence on the on-line group purchasing activities.

THE GROUP PURCHASING SYSTEM DESIGN

The group purchasing system is built on the World Wide Web and integrates web services, like social connections and third-party payment, from other on-line service providers. It provides a total solution to create an on-line group purchasing page including the on-line payment, marketing through social networks, and user intention display. Two major services are developed, namely 'user preference display service' and 'group purchasing service'. Sellers may have their own on-line web stores or any webpages to list the products which they want to sell. In order to make the developed services easy for sellers to use, the developed services are designed as a short piece of embedding codes. For sellers who are interested in using our services, they only need to register their products on our group purchasing server and get the embedding codes with a specific ID for each product. Sellers just need to insert the embedding codes into appropriate locations in their own list pages and our services will be shown on the corresponding pages. The simple design brings many advantages. First, sellers do not need to re-build their web stores in order to use the services provided by our system. They can save the cost for maintaining two list pages, i.e. the original list page and the group purchasing page, for the same product in different locations. Second, it is easy for sellers to add user preference information and the group purchasing function to their own websites. Anyone who has a webpage can embed the service to create an on-line sale for a certain product. Third, it can reduce sellers' marketing efforts. The system integrates the services of on-line payment and is able to propagate users' intention for a specific product through social networks. Attention for the listed products can be drawn through users' social relations. Fourth, the system already integrates the on-line payment services. Sellers do not need to maintain their own payment system.

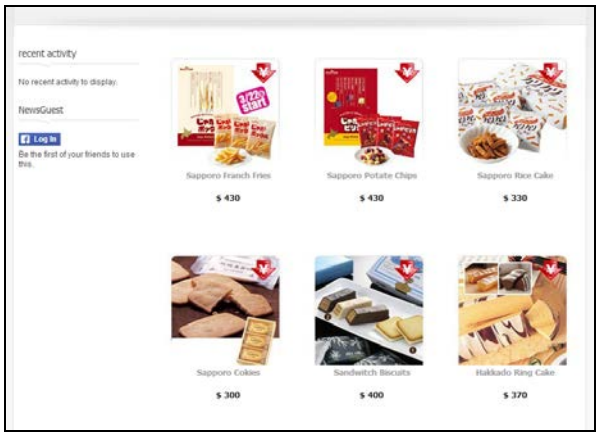
Although the above described services are provided for sellers who have their own webpages, the system also provides a web store for sellers who do not have webpages. Therefore, users can create their own web stores with the built functions of user intention display and group purchasing.

System Outlook

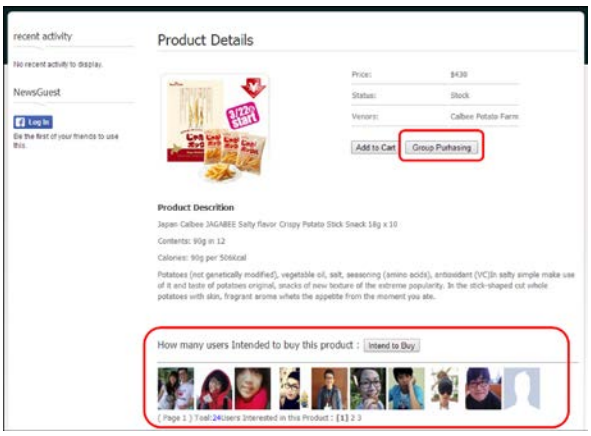
The user interface of the system is shown in Figure 1. The main portal page, shown in Figure 1(a), lists all the goods of the store. For an amateur seller, this page may look like a general homepages without any on-line business functions. Buyers can click a product and enter the page listing the product details as shown in Figure 1(b). Our user preference display service and group purchasing service are embedded in this page. The user preference display service is enclosed by the large red rectangle shown in the figure. The "Intend to Buy" button is developed by Facebook Open Graph Interface. It provides the connection to the social networks of perspective users. A user who

is interested in the product may click the button to show his/her preference of the product. Users' Facebook portraits are also shown in the bottom with user agreement. A message along with the link of the product is also posted on the user's Facebook wall at the same time. The function of this service is to collect users' interest from Internet. Through social networks, the users' friends can be attracted and brought to this product page. By collecting user preferences and propagating the preferences through social networks, general public's interest to this product may increase significantly in a short time. The increasing interest is expected to create a mood of group shopping and increase the sale of the product.

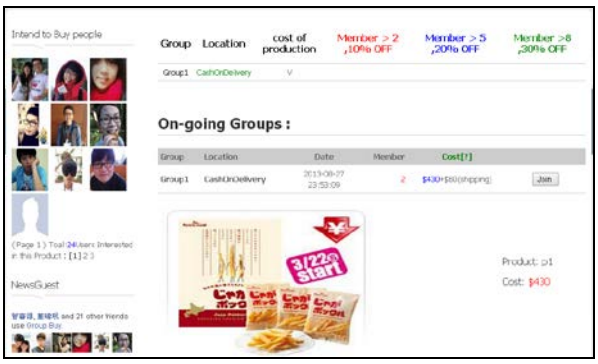
The small red rectangle shown in Figure 1(b) encloses a button for the 'group purchasing service' which provides another mechanism to improve the sales of the product from general public's interest. If a user intends to buy the product but looks for a lower price, he/she can find companion for purchasing the product together by click the 'Group Purchasing' button. In general, the sellers would be willing to reduce the price if they can sell a bunch of products at once. In particular, the more the users join a purchasing group, the lower the price may be given by the seller. When a user clicks the group purchasing button, the group purchasing page is presented as shown in Figure 1(c). The page provides two functions for the perspective buyers. One is to create a new purchasing group and the other is to join an existing group. For users who want to create a new purchasing group, the user can set the due date and time for the new group. The price given to the purchasing group will depend on the number of buyers joining the group and the rules for the price decrease are set by the seller. For example, if there are five buyers at the end of the purchasing group, the buyers can get ten percent off. If ten buyers join the group, the buyers get fifteen percent off, and so on so forth. A phenomenon can be expected is that people would choose the group with the most buyers and the group buyers' social relations may create another momentum to increase the product sale as the time approaches the due. In addition, sellers do not need to manipulate payment processes. In our implementation, PayPal is integrated into the system. For users who find appropriate group for their choice, they can just join the group.



(a) The store home



(b) The 'Intend to Buy' and 'Group Purchasing' functions



(c) The group purchasing page

Figure 1. The user interface of the group purchasing system

Finally, when the deadline of a group is reached, the server would decide the final price and execute the transactions. It will inform the seller of each buyer's address for product delivery. In particular, in Taiwan, some stores, like 7-Eleven, can help receiving packages from shipping company, which is a service for users who are not at home during daytime. Taking the advantage of this convenient service, in the system design, a buyer can set a 7-Eleven as a final delivery destination. Since all the products will be sent to the same location, sellers can reduce delivery cost and set a lower shipping fee for the group or even have free shipping for the whole group. This is also a feature for attracting people to use the group purchasing service.

System Architecture

The system is made of several components as shown in Figure 2. It includes the group purchasing server developed by the administration team, the sellers' website maintained by seller themselves, and web services provided by other third party providers, like the online payment service provided by PayPal, the social relation services provided by Facebook. The function of each component is described as follows:

- Group purchasing server: This is the major component of the System. The server has a database to maintain all the members' information including sellers and buyers. It also maintains each product's information registered by a seller and the users who click the 'intend to buy' button and are interested in a particular product. In addition, it manipulates the group purchasing activities, including creating groups, maintaining group status, and executing group purchasing transactions.
- Seller's website: Sellers may prefer to have their own website and show their products in their own styles. As a result, sellers can build a special image in users' mind. In the system architecture, sellers can have their own website composed of any general webpages. One seller just need to register his/her products to the group purchasing server and get a specific ID for each product. Then, insert the ID into a short piece of codes provided by our server and just embed the codes into webpages to plug-in the provided 'Intend to Buy' and 'Group Purchase' functions.
- On-line payment: It provides an easy and convenient way to process transactions. Currently, a transaction goes through the group purchasing server and the server manipulates the transaction between sellers and buyers. Depending on the business model, the group purchasing team can decide to charge sellers for each successful transaction or creates revenue from advertisements with free transaction for users.
- Social Networks: Utilizing users' social relations to increase purchasing interest is an important issue studied in this paper. Facebook's 'Open Graph Interface' is an easy and effective tool to employ users' social relations for our group purchasing purposes. When a user clicks the 'Intend to buy' button, this user's interest can be shown with the product and the user's Facebook. The mood of group shopping can propagate to other people who browse the corresponding webpage. The 'Intend to buy' message on Facebook can also attract people's attention to a particular product. Moreover, it is easier to create purchasing groups among friends than among strangers.

This system architecture can have several advantages. First, the system administration team does not need to maintain sellers' web stores. It can reduce the load of the system administration. Second, sellers can have better flexibility to design and control their own web product list or bulletin boards. Third, products can get exposed to more people through users' social links and need not to be listed in a centralized website.

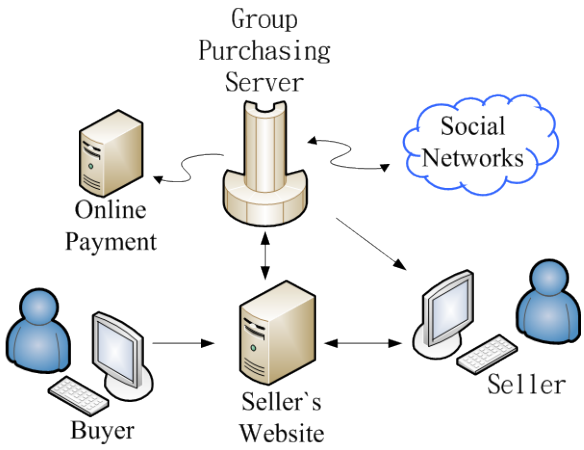


Figure 2. System Architecture

IMPACT OF THE DEVELOPED SERVICES ON GROUP PURCHASING

Trial Investigations

Trials are conducted to evaluate the effectiveness of the developed user experience display service and group purchasing service. Twenty-six students in National Taiwan University of Science and Technology are invited to try the system and provide their feedback after the trials. Some of the users have friend relationship in Facebook. The trials are performed in two phases. In the first phase, the user preference display service and group purchasing service are turned off. The trial users are given 3000 dollars for buying products in two days as on a normal online web store. The purchasing activities are just like general online shopping and performed by each individual user. In the second phase, the user preference display service and group purchasing service are turn on. The trial users are given 5000 dollars to buy products within eight days. In this phase, the trial users can show their preference of a particular product by clicking the 'Intend to buy' button. His/her friends on Facebook will see this message in the trial users' Facebook and may be attracted to the product webpage. A user can also create a purchasing group for a product and the price decreases as the number of buyers joining the group increases. The users are asked to use the system every day in our lab during the trial. All the users when using the system are recorded by a video camera and their computer screens are simultaneously recorded by a screen recording program. The videos are used to observe the users' reactions when using the system.

Evaluations and Analysis

To evaluate the effectiveness of the developed system, a questionnaire is designed and given to the users after finishing the two phase trials. Basically, the questionnaire is designed based on the decomposed theory of planned behavior (Taylor and Todd, 1995, 1995b). The Likert scale is used to measure the score from the users. The levels of evaluation are from -2 to +2 where -2 stands for the lowest score and + 2 stands for the highest score. The resulting statistics are listed in Table 1.

Due to the number of sample size being smaller than 30, this study does not intend to make statistical conclusions in this section. On the contrary, user insights are summarized from questionnaire results and user videos captured during experiments as following:

1. The major experience failure observed from user videos is in the Paypal process. Most users are concerned about the complexity and safety of online purchases in the beginning. However, after a few trials, most users got used to the system, and appeared to be relaxed from the tension of shopping alone online. In other words, they feel safe knowing that friends are going through the same shopping process, and might be able to help him/her if problems arisen. The questionnaire results somehow confirm the observation by showing low scores in question #14 (0.3 points) and #15 (0.5 points) but high scores in overall "facilitating conditions".

2. The major experience success observed from user videos is in the social networking process. Users simply take it for granted when using 'intend to buy' and 'group purchasing', not even questioning why such buttons exist on a normal online store page and how to use them. It sort of echoes our assumption that some user experiences can be "added" onto other online experiences without causing much trouble. In the questionnaire constructs of "perceived usefulness" and "perceived ease of use", the average scores are higher than other constructs. Moreover, in many responses to questions of highlighted constructs, there are no users' rating lower than zero (#2, #4, #5, #6, #8, #9).

3. Although users perceive the usefulness of group purchasing system (#1 - #5), they reported comparatively low score to question #24, #29 & #30, indicating that some of them are still hesitating in using the system frequently in the future. Our hypothesis is that people are concerning about the security of online shopping, instead of the overall shopping experiences. However, we will need to conduct more experiments to verify that.

4. Overall we found that people care most about the ease of use of new systems (#8), and whether they have full control of the system (#17). By introducing the "intend to buy" button with similar behaviors of a commonly used "like" button on social websites, people are quickly mapping their social experiences to the proposed group purchasing system, therefore speeding up the learning curve. The proposed system further demonstrated the value of providing "group shopping experience as a service" to any existing online store via Mashup-like technologies (Soylu et al. 2012).

Table 1: The questionnaire and the score statistics

Constructs	**#**	**Questions**	**Average score**
Perceived usefulness	1	I feel that the group purchasing system is useful for me.	1.3
	2	I feel that the group purchasing system can reduce the time to find enough people to form a group.	1.4
	3	I feel that the group purchasing system is helpful to increase the effectiveness of purchasing group formation.	1.3
	4	I feel that the user preference information and the on-going group information provided by the system are useful.	1.4
	5	Overall, I feel that the group purchasing system is useful.	1.3
Perceived ease of use	6	I think that the group purchasing system is easy to learn.	1.4
	7	I do not spend much time to learn the group purchasing system.	1.2
	8	I think that it is important to have an easy user interface for the group purchasing system.	1.7
	9	I think that the functions provided by the group purchasing system are easy to use.	1.4
	10	Overall, I feel that the group purchasing system is easy to use.	1.3
Self-efficacy	11	I can use the group purchasing system without assistance.	1.1
	12	I believe that I can find the information which I am looking for in the group purchasing system.	1.1
	13	I believe that I am able to learn the functions provided by the group purchasing system by myself.	1.2
	14	I believe that I am able to use the most complicated functions provided by the group purchasing system.	0.3
	15	I believe that I can have the skills to use all the functions provided by the group purchasing system.	0.5
Facilitating conditions	16	I have enough equipments to use the group purchasing system.	1.2
	17	I have full control when using the group purchasing system.	1.5
	18	I have enough time when using the group purchasing system.	1.2
	19	The technologies used by the group purchasing system are compatible with my computer.	1.2
	20	I know how to create or join a group when I want to buy a product.	1.4
	21	There are enough messages provided for me to know the sale information when I use the group purchasing system.	1.2

Attitude towards use	22	I think that it is a good idea to create purchasing groups by the group purchasing system.	1.5
	23	I think that it is a wise idea to find people and create groups for purchasing using the group purchasing system.	1.3
	24	I like to use the group purchasing system.	0.9
Perceived behavioral control	25	I think that I can use the group purchasing system without any problems based on current skills.	1.0
	26	I think that I can totally control and use the group purchasing system.	1.0
	27	I think that I have enough resource, knowledge, and ability to use the group purchasing system.	1.2
Behavioral intention to use	28	I prefer to create groups for purchasing using the group purchasing system rather than find people by myself.	1.2
	29	I will use the group purchasing system frequently in the future.	0.6
	30	I will strongly suggest other people including friends and relatives to use the group purchasing system.	0.9
	31	Overall, I have a great willingness to use the group purchasing system.	1.1

CONCLUSIONS

On-line group purchasing is one of the most popular services for shopping on today's Internet. This paper develops a novel group purchasing system and provides new on-line group purchasing experiences for both sellers and consumers. In particular, it benefits both sellers and consumers for their different requirements. Investigation results show that the developed system is easy to use and can be accepted by users without difficulties. Furthermore, the provided user experience information does show a significant impact on the purchase decisions made by consumers. It obviously builds consumers' confidence for the products and increases the willingness of users for on-line purchase. For future work, a larger scale trial and investigation is required to make statistical conclusions and to prove the usefulness of the system.

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A Journey Recommender System Using Crowd Attention Monitoring for Facilitating a Collaborative Visiting Experience

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ABSTRACT

Nowadays when people are visiting an exhibition or museum, the only available guidance is usually brochure or map, which shows location information statically. People are not able to get real-time situation of the exhibition or museum, such as which booth is currently popular. With the prevalence of mobile and social network, we can analyze people's booth visiting histories and provide valuable insights to users of a proposed journey recommender system. This presentation proposes a journey recommender system using crowd attention monitoring and dynamic route planning for facilitating a collaborative visiting experience. An exhibition case is used to demonstrate how the system works.

Keywords: Collaboration, Social, Recommendation System

INTRODUCTION

Nowadays, we can easily see recommendation functions in online systems, such as on-line shopping, article reading, or map navigation services. In our real life, we might also expect to use such a recommendation system to guide us during the tour of World Expo, theme park, museum or exhibition, instead of reading a brochure or paper map on hand. How to build up a journey recommender system using crowd attention monitoring for facilitating a collaborative visiting experience will be the essential to implement such a recommendation system. In this paper, we present a crowd-sourcing recommender system that provides dynamic recommendation to the visitors by finding similar visitors in the system based on his/her behavior/characteristics. The recommendations are generated dynamically and customized for each individual, based on his/her attention "budget" with regarding to those who (1) has the similar attention pattern (2) has the similar interests, or profile, i.e., this matching mechanism leverages dynamic and real-time trends to provide the most suitable arrangement for the visitors. Besides, we consider the congestion condition of the venues, so the attention budget could be calculated correctly. Thus, this recommender system as a service could be used to largely improve user experiences in exhibition, museum, or similar events.

This paper is organized as follows. Section II discusses some existing recommendation systems. Section III introduces the architecture of our crowd-sourcing recommender system, and Section IV gives an example utilizing such a recommender system. Finally, we conclude this paper in Section V.

RELATED WORK

Content Based Filtering

Content Based Recommendation system is a traditional recommender that provides recommendations based on its context or users' frequent behaviors. For example, if a person who goes to Amazon book store and buys some books about jogging, the content based recommender will recommend some other jogging/exercise related book to this person. If a person who usually buys the Disneyland ticket promotion in spring sale, then whenever there is a spring promotion sales for Disneyland, the recommendation system automatically provide this recommendation to him/her when the promotion starts. As mentioned in the study (Balabanoviæ, M., & Shoham, Y., 1997), the content based recommendation system has many disadvantages. Only shallow analysis of certain kinds of content can be supplied.

Collaborative Filtering

Collaborative Recommendation system provides recommendations for a user based solely on the basis of similarities between users. The collaborative recommendation system is common in our daily on-line shopping experience. For example, the system observes that most of people who buy the goggle also buy the earplug and sunscreen. Therefore, if there is a user buying goggle, the recommender will ask the user if he/she is interested in buying earplug or sunscreen. Pure collaborative recommendation addresses the shortcomings given pure content-based systems. However, this approach introduces new problems of its own. For example, if there is any new item in the database, the collaborative filtering will not have any recommendation to provide. Or if a user whose taste is unusual compared to the majority, the recommendation provided might not be useful to him/her.

Hybrid Content-Based and Collaborative Recommendation

CrowdPlanner (Su, 2013), a crowd-based route recommendation system, is a typical instance of a collaborative filtering recommendation system. It requests human workers to evaluate candidates routes recommended by different sources and methods, and determine the best route based on the feedbacks of these workers. That means, it leverages crowds' knowledge to improve the quality of recommendations. The cognition of routes of humans is quite different from computers' that human recognize routes by preferences and experiences of the real situation while computer recognizes routes from continuous time and data recorded. Thus, to provide the recommendations by evaluating the best route with user as one of the collaborative filtering is considered better. Oracle white paper (Oracle White Paper, 2011, March) endorsed such a hybrid content-based recommendation system.

ARCHITECTURE OF CROWD-SOURCING RECOMMENDER SYSTEM

In this section, we introduce the architecture of dynamic customized visiting journey recommendation system and its components. We also illustrate how the recommendation system works. **Figure 1** presents the proposed dynamic customized visiting journey recommendation system. It consists of six key components:

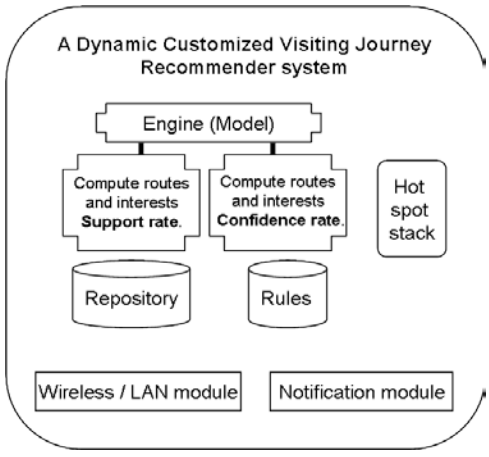

Figure 1 Components of the dynamic customized visiting journey recommendation system

Filtering Engine (Core Model)

The engine is the core component of our recommendation system. It is responsible for the following tasks:

- Pick up history records from repository and calculate each record's supporting rate.
- Pick up rules from rule repository and calculate each rule's confidence rate.
- Retrieve/store rules from/to repository.
- Compute congestion ratio of each location.
- Provide recommendation by sorting and filtering the rules according to user's preference.
- Push the recommendation to hot-spot stack when congestion occurs. Pop up recommendation when congestion situation is released.

Rules

The rules repository is designed to store the recommended rules and each rule is calculated with a confidence rate.

Repository

This repository is designed to store the locations (ex. booths) that users have visited and the attraction time of that location to the user. Each history record is saved in repository and calculated with supporting rate.

Hot Spot Stack

The hot spot stack is a repository used for store the recommendation when congestion ratio passed a threshold. If the congestion ratio of one booth is less than the threshold, system may notify user he/she can go to that booth he/she is interested in before.

Notification Module

The notification module is the module that pushes the notification messages to user's device.

Wireless / LAN Module

The Wireless/LAN module is the module handling all network connections from/to our recommendation system.

Based on the architecture, the recommendation system provides the recommendation to a visitor by finding a similar visitor in the system based on his/her behavior/characteristics. The recommendation will be generated dynamically and customized to each individual. Our system also considers the visitor's personal preference such as how much time he/she wants to spend in the trade show? What is their interested area? How many booths they plan to visit during the trade show? Figure 2 illustrates how the recommendation system works with inputs and finally provides recommendation to end users.

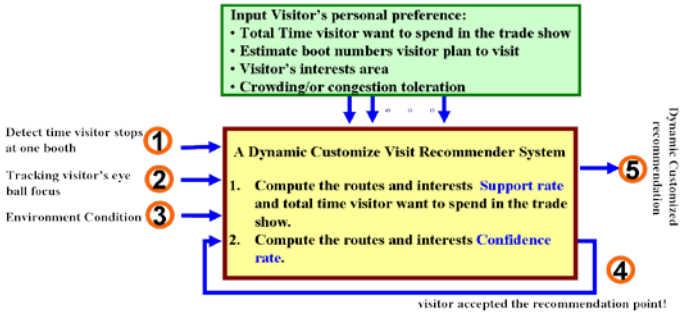

Figure 2 Input and output of the recommendation system

As we can see from **Figure 2**, the top block is the input of the visitor's personal preference which is used as criteria to our recommendation system. The input is predefined and provided by end users. The personal preference includes:

- Total time the visitor wants to spend in the trade show/exhibition/museum.
- Total number of booths the visitor plans to visit
- Visitor's interested area
- Congestion ratio tolerance.

Another input is from the real-time monitoring system which detects the following statistics:

- Time duration a visitor stops at one booth
- Visitor's eye ball focus
- Environment conditions

Utilizing inputs from personal preference and the real-time statistics, the recommendation system provides following outputs:

- The dynamically customized recommendations to the visitor by finding similar behavior/characteristic to the visitor
- Notify booth's owner when a candidate visitor is approaching or standing in front of the booth.

The recommendation system is trained by the decisions made by the user. If the user goes to the recommended booth, the data is sent back to the system and the system increase the weight of the rule (shown in **Figure 2** direction 4).

PLANNING OF EXHIBITION VISITING JOURNEY

In this section, we use exhibition as example to demonstrate the recommendation system introduced in Section III, and how people can benefit from the proposed recommendation system.

Exhibition Scenario and Notations

- In this exhibition, there are five booths named A, B, C, D, E
- The time duration (interest level) that visitor spends in a booth is classified into three levels:
  - *l*(ow): spent less than 1 minute
  - *m*(edian): spent 1 minutes to 5 minutes
  - *h*(igh): spent more than 5 minutes
- Therefore, the following notation means
  - A_m: visitor stops at booth A for 1 to 5 minutes.
  - B_l: visitor stops at booth B less than 1 minute.
  - C_h: visitor stops at booth C more than 5 minutes.
- T(x) is the total time that visitor, x, plans to spend in the exhibition.
- Supporting rate is the percentage that the same visited booth path in the repository. The more people have visited the path, the higher supporting rate this path has.
- Confidence rate is a conditional probability, which is based on user's current visited history record and come up with how high the confidence of the record has.

Assume the system is running for a while and collecting records as follows:

User 1: [A_l, B_l, C_l, D_l, E_h]
User 2: [A_h, B_h, C_h, D_h, E_h]
User 3: [A_h, B_l, C_h, D_h, E_h]
User 4: [A_h, B_l, C_l, D_h, E_h]

All records are saved as set, describing that user visited which booth and the corresponding stop time spent (interest level) there.
The average time value of different interest levels is as following and it applies to all booths data:

$t(A_l) = 0.5$ minute
$t(A_m) = 2.5$ minutes
$t(A_h) = 7.5$ minutes

User x visits the exhibition and would like to have recommended visiting plan provided by our recommendation system. User x already set his personal preference and his visiting history is tracked too.

[User x personal profile]

visit path and interest level : $[A_h, B_l]$
time plans to spend T(x) : 25 minutes
interest area : booth E

Supporting Rate of History Records and Filter Mechanism

First of all, the recommendation system engine calculates the supporting rate of each history record, shown in Table 1.

Table 1 Entries in the repository of the recommendation system

	History record (booth and corresponding level)	Total time spent	Supporting rate
1	$[A_l, B_l, C_l, D_l, E_l]$	9.5	25%
2	$[A_h, B_h, C_h, D_h, E_h]$	37.5	25%
3	$[A_h, B_l, C_h, D_h, E_h]$	30.5	25%
4	$[A_h, B_l, C_h, D_h, E_h]$	23.5	25%
5	$[A_h, C_h, D_h, E_h]$	30	50%
6	$[A_h, B_h, C_h, D_h]$	30	25%
7	$[A_h, B_l, D_h, E_l]$	23	25%
8	$[A_h, B_l, D_h, E_l]$	23	50%
9	$[A_h, D_h, E_h]$	22.5	75%
10	$[A_h, C_h, E_h]$	22.5	50%

Secondly, the recommendation system engine performs filtering steps based on user x's preference and visiting record.

1. User x already visited booth A and B and corresponding interest level is $[A_h, B_l]$. Applying finding similar behavior/characteristic algorithm to the visitor, records 1, 2, 5, 6, 9, 10 are eliminated by the recommendation list.
2. User x plans to spend 25 minutes in the exhibition. Engine eliminated the records with time longer than 25 minutes. Record 3 is deleted.
3. System knows that user x is interested in booth E. The recommendation system will take booth E as criteria. Therefore, removing record 7 which does not include booth E.
4. As a result, the recommendation system has record 4 and 8 in the list.

Confidence Rate

To provide the top recommended visiting path to user x, the recommendation system applies 'confidence rate' algorithm to record 4 and record 8 listed in Table 1. The confidence rate result is shown in Table 2.

Table 2 Records after applying confidence rate algorithm

	History record (booth and corresponding level)	Total time spent	Supporting rate	Confidence rate
1				
2				
3				
4	$[A_h, B_l, C_h, D_h, E_h]$	23.5	25%	$P([C_h, D_h, E_h] \mid [A_h, B_l]) = 50\%$
5				
6				
7				
8	$[A_h, B_l, D_h, E_l]$	23	50%	$P([D_h, E_l] \mid [A_h, B_l]) = 100\%$
9				
10				

Finally, recommendation system engine sorts records from Table 2 based on confidence rate, and then total time spent and finally by supporting rate. Based on the sorting results, the system will provide record 8 [Ah, Bl, Dh, Eh] to user x. The recommended route is the most valuable one to user x because it highly matches user's preference and crowd behavior.

Congestion Condition

There will be 'rush hours' during a trade show. During rush hour, some booths may be crowded by people, which could cause increasing time visitors spent in this booth (for example, the visitor is waiting for available salesman or the booth is too crowded for the visitor to get out that area). So we introduce congestion ratio to illustrate the congestion condition.

CR(X) Congestion ratio of booth X =

the number of visitors in a booth X / booth area of X

CR(X) = 1 means people feel comfortable around a booth (normal time)

CR(X) > 1 means people feel 'crowded' around a booth (rush hour).

Due to congestion variation during a trade show, the time visitor spends in one booth does not actually reflect visitor's interest level in this booth. So we need to normalize the time using congestion ratio.

$t'(A_{userx}) = t(A_{userx}) * (1/CR(A))$, *where*

$t(A_{userx})$ *is the actual time user x spent in booth A and*

CR(A) is congestion ratio of booth A

For example, if user x spent 10 minutes in booth A and the congestion ratio in booth A is 2. It implies that user x takes more time staying in booth A than normal time because too many people are waiting for available salesman or user x is blocked in the booth. We need to normalize visitor time spent to reflect the 'actual' interest level of user x to booth A. Applying normalization formula:

$t'(A_{userx}) = 10 * (1/2) = 5$ *minutes.*

User x may spend only 5 minutes in booth A if booth A is not so crowded. We use the normalized value inserted into system repository. The supporting rate and confidence rate algorithm uses the normalized data to come up a more accurate recommendation for user.

Hot Spot Stack

If user prefers not to go to crowded booths, we can put the recommended booth into hot spot stack, and periodically check the booth congestion ratio. If the booth congestion ratio is less than a predefined value, system will notify user he/she may go to that booth he/she is interested in.

HotSpotStack(userx).push(D)

if CR(D) is larger than a threshold (ex. 2).

HotSpotStack(userx).pop(D) and notify user x

if CR(D) is less than a value (ex. 1.2),

Take the example provided before, the final recommended path to the visitor is [Ah, Bl, Dh, Eh]. However, at that time, congestion ratio of D R(D) is 6, which means booth D is crowded. Based on visitor's preference, if the visitor prefers not going to crowded booth, our system will put booth D to visitor's stack. When R(D) is less than a value (ex. R(D)<1.2), pop up a message and notify the visitor that he/she is okay to go to booth D now.

Time Effective Weight

The data of the last two hours is much more effective and valuable than data of 1-day or 2-days ago. It's more real data which reflects current trade show situation. Our system can use different weight based on records' timestamp.

Time effective weight W(record#):

$$W(\text{record \#}) = \begin{cases} 1 & \text{if record \# is taken less 2 hours} \\ 0.5 & \text{if record \# is taken 2 hours} \sim \text{1 days} \\ 0.1 & \text{if record \# is taken more than 1 days} \end{cases}$$

Multiplying the Time effective weight to rule's confidence rate, our system can provide more realistic recommendation to user.

The overall flow of the recommendation system, starting from collecting records, calculating supporting rate and confidence rate, filtering and sorting based on user's preference and other environment conditions, and finally providing a dynamic and highly customized visiting journey recommendation to user. Figure 3 is the flow chart of the recommendation system.

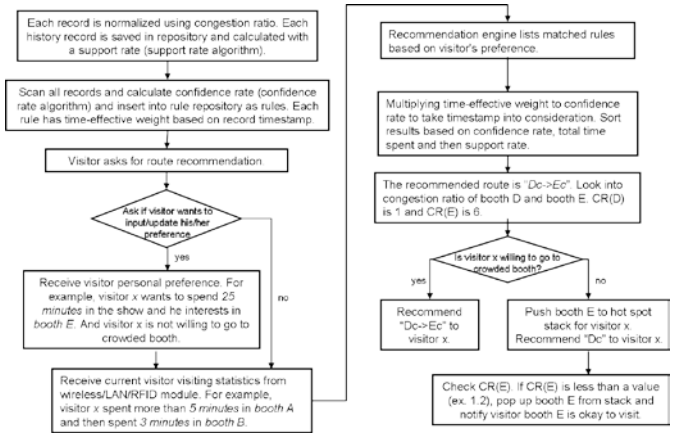

Figure 3 Overall flow of the recommendation system

CONCLUSIONS

This paper presents a location recommendation system based on historical behaviors of other visitors, leveraging the "Wisdom of Crowds". The recommendation system actively takes visitors' interests and preferences, real-time situations, such as geography, time, and other visitors' behaviors into consideration to provide accurate recommendations to visitors. It brings online recommendation experiences into real life and provide dynamic and customized recommendations. This system improves visitors' experiences and satisfaction during their visits to exhibitions or museums.

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Section 3

New Directions in Teaching and Learning Services

Group Work: Does It Work?

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ABSTRACT

Group-work plays a significant part in all undergraduate courses while working effectively as a member of a group is one of the most important generic skills that students need to develop while at university in preparation for their future working lives. Many stakeholders, however, have reservations regarding group-based assignments, in particular about whether or not individual group members are rewarded appropriately for their contribution to the overall group achievement. The success of group-work is dependent on both extrinsic factors, such as assignment design, management, assessment, etc. as well as intrinsic factors, such as the knowledge, skills, etc. of individual group members.

In this paper the challenges presented by the extrinsic factors that impact on the success of group-based assignments are considered against the background of the of formal summative assessment of group-based assignments on BSc Computing undergraduate courses in the Department of Computing at Canterbury Christ Church University in the United Kingdom. In particular the effectiveness of group-work in terms of improved learning, improved development of non-cognitive skills and assessment validity/reliability are considered.

Keywords: Group-work, assessment, fairness, coursework, self-assessment, peer-assessment, reliability

INTRODUCTION

Group-work skills are one of an important of a set of generic (common) skills that all students need to gain/develop. In the case of most courses, this is particularly important since students' future working lives (Dearing, 1997) will often be collaborative-based (Kidder, 1981). As such, group-based assessment is a highly valid form of assessment. Student performance, learning and higher level cognitive skills are all held to benefit from group-work as long as it increases student engagement with and reflection upon the subject itself. Interpersonal, leadership and organisational skills, as well as self-motivation and self-esteem are typical of the many non-cognitive areas that are held to benefit from group-work (Thorley and Gregory, 1984). Students who work in groups also tend both to be more satisfied with their course and more appreciative of the value of group-based learning (Johnson, D., Johnson, R. and Smith, 1991). Group-work, with its associated peer pressure, can sometimes encourage students, who have not previously done so, to engage with a course. Group-work also allows students to undertake larger more complex/realistic tasks than they could attempt individually, not just as a result of additional manpower but also due to the associated economies of scale and division of labour.

Governments and, of course, employers prize group-working skills. Thus, for example, the employer-led, e-skills UK organisation (licensed by the United Kingdom government as the Sector Skills Council for IT and Telecoms) introduced, amongst others, the IT Management for Business (ITMB) degree course which is currently available at twenty United Kingdom based Universities. The development of this course was funded by the United Kingdom government and was designed by leading international IT companies with a view to ensuring that ITMB

degree graduates are equipped with the skills, including group-work skills, required by industry (e-skills UK, n.d.).

Professional bodies such as the United Kingdom based British Computer Society (BCS) also recognise the need for group-working skills and as such includes "working with others" in their requirements for accreditation of University and other Higher Education Institution courses (British Computer Society, 2011).

Given the interest of the government, employers and professional bodies it is not surprising that educational establishments are often expected to expose students to group-based activities. For example, in the United Kingdom, the Quality Assurance Agency for Higher Education (QAA) honours degree computing subject benchmark statement states "[each Higher Education Institution] should be expected to be able to show that … in practical coursework there is an opportunity for students to gain experience of working … in groups [and] students will adopt a disciplined approach to their tasks [including] the related practical and transferable skills, including relevant approaches to group activity" (Quality Assurance Agency for Higher Education, 2007)

Many of the stakeholders involved in group-based assessment, however, have reservations. The most significant issue (Race, Brown and Smith, 2005) is that students, lecturers and external examiners alike all question whether individual group members are rewarded appropriately based on their individual contribution, in terms of both effort and skill, to group-work.

The success of group-work is dependent on extrinsic factors, such as assignment design, group allocation, management and assessment, as well as intrinsic factors, such as the knowledge, skills, motivation, personalities, experience, etc. of individual group members. These extrinsic factors are considered in this paper against a background of many years of formal summative assessment of group-based assignments on BSc courses in the Department of Computing at Canterbury Christ Church University located in the United Kingdom.

DESIGNING GROUP-BASED ASSIGNMENTS

As with any assignment, group-based assignments must have a well-defined task, must be perceived as an integral part of the course and must match students' skill/ability levels. Additionally, group-based assignments must also match students' group-working skill/ability levels. Furthermore, while individual students must be held accountable for their own actions, a group-based assignment must also necessitate mutual dependence between group members if learning is to be effective. In this way, individual group members feel that they succeed or otherwise as part of a group and not as individuals. The fact that the group as a whole is relying on individuals within it is strong motivationally (Kohn, 1986). Mutual dependence can be achieved, for example, by setting assignments that force group members to divide the work into mutually interdependent parts or that force group members to reach a consensus (Johnson, D., Johnson, R. and Smith, 1991).

Group-based assignments must facilitate a potentially even work load between all members of the group so that every group member has the opportunity to make an equal contribution. One way to achieve this is to design assignments that have clearly identifiable activities which can be easily distributed between group members who must then each individually make a success of their activity in order for the group, as a whole, to succeed. Unfortunately, this approach takes away part of the rationale and learning process of group-work in that the group members themselves do not break the work down into activities.

It should be noted that assignments that allow group members to compete with each other should be avoided since they tend to reduce the benefits of group-based coursework. The popular UK television show "The Apprentice" (British Broadcasting Corporation, n.d.) illustrates this graphically. The participants in this television show take part in competitive group-based activities but never fully embrace working as part of a group because all the participants are also competing against each other for the show's prize which is awarded to an individual not a group.

Finally, designing group-based assignments involves many interrelated factors. These factors are not necessarily mutually exclusive and trades-offs will often be required.

ALLOCATING STUDENTS TO GROUPS FOR GROUP-BASED ASSIGNMENTS

It must be recognised at the outset that students are often concerned about working with others with whom they are unfamiliar. Students can be randomly assigned to groups thus maximising the groups' heterogeneity (Smith, 1986). Alternatively, lecturers can choose the groups, taking into account various factors, to produce either homogenous groups or, at the other extreme, to spread the various student talents around the groups as evenly as possible (Walvoord, 1986). Some students find either of these approaches rather intimidating (Stock and Stephens, 2008). An alternative, when students are known to each other, is to let them select with whom they want to work. This approach, however, is not a good match with what students will eventually experience in their future careers where they will not normally be allowed to choose with whom they work. Walvoord (1986) suggests yet another option where students express their choice regarding potential group members but that the final allocation is left to the lecturer. The Department of Computing undergraduate course team, however, believes that such an approach could potentially result in some students being disappointed that their choice of group was ignored thus creating problems from the very outset.

In the Department of Computing, group-work on undergraduate database courses first occurs in year two (of the three year programme) by which time the majority of students are reasonably well acquainted with each other and, as such, they choose their own groups. There are, however, always those students that, for various reasons, do not find a group and in these cases lecturer intervention is inevitably required to either parachute them into an existing group or form a new group of such students. In year three the students are much better acquainted with each other, including an awareness of how their fellow students performed in group-work, and generally, during the previous academic year. The result is that students' selection of each other is more considered and consequently groups tend to be much more homogenous, happy and harmonious. For example, hard workers/high achievers will often tend to group together. This results in less, if any, need for course team intervention to form groups, less group problems, more positive student feedback and much less variation in students' perception of their team mates contribution to the group effort.

In general, groups should be neither too large nor too small. Large groups tend to reduce an individual group member's ability to participate actively and provide the opportunity for those who do not want to participate actively to free ride without being noticed. Very small groups, while presenting fewer opportunities to free ride, tend to reduce the benefits of group-based coursework. In the Department of Computing even numbered size groups are generally avoided to reduce the risk of groups being unable to achieve majority decisions in a timely manner and group size is normally set at three so that it is hard for a slacker to hide their lack of effort (Stock and Stephens, 2008).

MANAGING GROUP-BASED ASSIGNMENTS

Lecturers should formally/informally maintain regular contact with groups in order to monitor progress, provide formative feedback, check for (potential) problems and, of course, provide appropriate assistance if required. Groups should be encouraged to plan their work, including task allocation along with planned completion dates. Such planning will inevitably be crude because of student inexperience but this can, to some extent, be mitigated by help from a lecturer. Planning is critical as it allows both lecturers and groups themselves to identify timescale slippage at an early stage.

Some groups may experience problems, including difficulty in allocating tasks fairly, disparity of motivation, work ethic and ability between group members, group members who take control of their group and group members who do not contribute because of their innate quietness or their absence due to illness, etc. Most problems can normally be resolved with little more than minor lecturer intervention in the form of an individual and/or group discussion and a little direction (Stock and Stephens, 2008). The major cause of problems, however, is slackers who do not fully contribute to their group by not attending meetings, not delivering their allocated tasks on time (if at all), etc. Students must be made to realise that slacking is not an option that will go un-penalised. Walvoord (1986) suggests that after completion of a piece of group-work each student should submit a confidential report detailing their perception of the group's achievements, effectiveness and problems, along with their perception of their own and their fellow group members' individual role/contribution. This form of both self and peer assessment is employed in

the Department of Computing where each student completes a standard confidential "Individual Report" that has become known to students, for obvious reasons, as a "rat sheet"! The system generally works well and reduces a lot of intra group tension because if a group has a slacker the other members know that they have the opportunity to report this and, if substantiated, the slacker's mark, as well as their own, will be adjusted. Walvoord (1986) further suggests that such reports are also produced during the group-work. In this way group members who, by consensus, appear to be slackers realise that their behaviour has been recognised and they thus have an opportunity to change their behavior. This practice is not adopted in the Department of Computing because the course team feels that it could cause discord within groups and additionally undermine the well-recognised confidential nature of the "Individual Report".

If a group is having problems then breaking the group up and distributing its members to other groups should normally be avoided for two reasons. Firstly, the whole point of group-work is that the group succeeds or fails as a whole and dealing with problems in this way does little to foster group-working. Secondly, distributing a problem group's members to other groups may disrupt the receiving group (Walvoord, 1986). In the Department of Computing, group members are not normally distributed to other groups if problems occur. Since group-work in the department is generally short term such reallocations are often impractical since a large proportion of the assignment may well have already been completed, resulting in a less than welcoming reception for the reallocated student and problems in assessing the work of individual group members since the newcomer will normally have contributed much less. Another reason is that group-based assignments are well established in the department and, as such, if students became aware that problem groups were reallocated to other groups then there would be less incentive to make their group succeed. The approach normally taken in the department is for the lecturer to meet the problem group and attempt to resolve the problems.

SUMMATIVE ASSESSMENT OF GROUP-BASED ASSIGNMENTS

Assessment of group-based assignments is a potentially difficult issue. What exactly are we trying to assess in group-based assignments? Is it the end product, or the process by which the end product was produced, or the non-cognitive skills employed, or a combination of all three? In many courses the emphasis is normally on assessing the end product in the safe knowledge that the process by which it was created and the non-cognitive skills employed in its creation must have had an influence on the end product and as such are also being assessed albeit indirectly.

Having assessed the end product, how should marks be allocated to individual group members? The easy option, of course, is to assign all group members the same mark. This obviously promotes mutual dependence between group members and collective responsibility for the group's achievements/failures, potentially motivating students to work together as a team. Unfortunately, this approach is an open invitation for slackers to get a free ride. It is also problematic in that the performance of group members within a group can vary widely, and in such cases awarding equal marks to all members of the group is plainly unfair (Nordberg, 2008). If this approach is taken then a group assignment should have a lower weighting in the overall assessment for a course, than would otherwise be the case, in order to minimise the risk of such unfairness (Johnson, D., Johnson, R. and Smith, 1991). If, however, the weighting is too low then, students will not engage with group-based assignments because it has little effect on their overall course mark (Stock and Stephens, 2008).

On the other hand, assessing group members individually, especially if it is norm-referenced (Smith, 1986), plainly introduces an element of intra group competition in order to gain higher marks thus negating some of the benefits of group-work. One approach to assessing individual group members is to base it solely on "Individual Reports". Generally group members are better placed than their lecturers to know what actually happened within a group and also to assess the process by which the deliverables were produced, although student produced diaries, meeting minutes, etc. can make this less opaque to the lecturer. On this basis, it is generally considered worthwhile and acceptable to make use of peer assessment in group-based assignments (Fry, 1990). With such an approach, however, there is no check, apart from possible unanimity of group members' views, on the reliability of group members' perception, honesty, judgement, lack of bias and the absence of reciprocation (Magin, 2001). It is The Department of Computing undergraduate course team's experience that individual group members often have difficulty quantifying individual contributions and often base their assessment on just one element when a basket of different elements (for example, effort, achievement, leadership, team spirit, helping others, etc.) would perhaps be

more appropriate, and as a consequence students sometimes need guidance in this area.

In the Department of Computing the end product is assessed and each group is awarded a group mark that becomes each individual group member's mark. Individual group member's marks can, however, be increased/decreased depending on the contents of "Individual Reports" in which, amongst other things, students specify what percentage of the total group mark they believe should be allocated to each group member, including themselves, and whether they would like a group and/or individual viva voce examination (viva). If all group members specify an equal allocation of marks then all group members are always awarded the same mark on the basis that the group has plainly taken collective responsibility for its work, the group has probably worked well together and that group members' individual efforts have probably been mutually appreciated which are together a highly desirable outcome for a group-based assignment. If group members don't specify an equal allocation of marks but that allocation is not significantly different and is consistent between all group members then an adjustment is made to individual group members marks. If group members don't specify an equal allocation of marks and that allocation is significantly different and/or is inconsistent between group members (such variability being an indication of lack of reliability in peer assessment) then a viva of the group and each individual group member always takes place where an equitable distribution of marks is thrashed out. Vivas can be very successful because while students are often unrealistic or even lie in their "Individual Reports" they very rarely do so to a lecturer in front of their fellow group members (Stock and Stephens, 2008). Once the percentage of the total group mark for each group member is established then, the widely used approach (University of Melbourne Graduate School of Education Centre for the Study of Higher Education, 2002) where, arithmetically, the product of the group mark and the number of group members weighted by the percentage of the total group mark for a specific group member gives their individual mark, can be employed. Thus for example, for a three member group who achieved a group mark of 50% and whose members, it is established, contributed 50%, 30% and 20% of the total group mark then they would be awarded individual marks of 75%, 45% and 30% respectively. Such an approach is not without its problems. It is The Department of Computing undergraduate course team's experience that group members often have difficulty quantifying individual contributions as detailed above, often basing their assessment on just one factor when a basket of different factors (for example, as previously, effort, achievement, leadership, team spirit, helping others, etc.) would perhaps be more appropriate while individual group members are often surprised that, what they consider, a small change in their percentage contribution can have a large effect on their individual mark. Note, given the simple algorithm above, that it is possible to achieve an individual mark of more than 100%! For example, consider a three member group who achieved a group mark of 50% and whose members, it is established, contributed 70%, 20% and 10% of the total group mark then one group member would be awarded individual mark of 105%! Plainly there is a need for marks to be capped and/or the employment of a more sophisticated (non-linear) algorithm. The simple nature of the algorithm above also raises issues of possible over generousness and meanness in the allocation of marks between group members. For example, consider a three member group who achieved a group mark of 50% and whose members, it is established, contributed 60%, 30% and 10% of the total group mark, then they would be awarded individual marks of 90%, 45% and 15% respectively. Such a scenario raises a few issues. Does one group member really deserve an individual mark of 90% for an assignment that only achieved a group mark of 50%? Consider the case of a student submitting an individual assignment that was assessed at 50% and who subsequently argued that they should get 90% because they spent much more time than normal on the assignment. Would we accept this argument? Of course not! Does one group member really deserve an individual mark of just 15%? If we are being generous to one group member then by the arithmetic nature of the algorithm we must be being mean to the other/s. Again, plainly there is a need for marks to be capped and/or the employment of a more sophisticated (non-linear) algorithm.

Data[1] is collected yearly in the Department of Computing for all course-work for both summative and analysis purposes.

Analysing the year two data it is noticeable that the spread of marks for individual assignments is much greater than that for group-based assignments as shown by the percentage relative standard deviation (%RSD) of 47% and 25%

[1] The "data" discussed here is the most recent available, at the time of writing, being for the 78 students who completed the 2011-12 year two BSc Database Systems I course and those who, a year later, followed this up with the 2012-13 year three BSc Database Systems II course. It could be argued that data collected over a much longer period would be more reliable but changes in assessment practice (e.g. the number of assignments and their overall course weighting, etc.) vary from year to year, particularly after revalidation of courses every five years, making any aggregation potentially problematic. Similar analysis of other cohorts has, however, always yielded broadly similar patterns. Note that the raw data has been scrubbed, for example, students who did not complete all the assessments in a specific year have been omitted. Finally, note that marks refer to those awarded to individual students *after* consideration of students' "Individual Reports".

respectively. Statistically, the cause can be seen very clearly by a detailed analysis of individual student marks. If students' individual marks are taken as a reasonably accurate measure of their ability, then it can be seen that for students who are above average on this basis their group-work mark is generally lower and for students who are below average on this basis their group-work mark is generally higher than their individual mark. In practice, the course team believes that the cause is partly because a high proportion of groups decide that all members of their group should receive equal marks thus masking the full variability of actual individual performance. In addition, the correlation coefficient (r) between individual and group-based assignment marks, at 0.4, is at best medium. Is assessment failing to discriminate accurately between individual students within group-based assignments? This is a difficult question to answer and the simplistic statistical analysis above gives little help. Firstly, it must be pointed out that individual and group-based assignments are not assessing the same thing, the latter is assessing students' ability to deliver as part of a group, which involves a different skill set, and as such, perhaps a high correlation between the two should not be expected. Secondly, by allowing groups to award the same mark to all group members will also reduce the level of positive correlation, again because the true level of individual performance within groups is masked. Finally, there is the possibility that group-based assessment is to some extent unreliable given the potential variability of students' individual performance within group-based assignments. Further analysis plainly needs to be carried out in this area.

Analysing the year three data, the difference between the %RSD for individual and group-based assignment marks at 30% and 27% respectively is not marked while the r between individual and group-based assignment marks, at 0.6, is high. This is perhaps surprising since a much larger proportion of groups in year three decide that all members of their group should receive equal marks. This should, ceteris paribus, result in a larger difference in the %RSD and a lower r between the year three individual and group-based assignment marks than those for year two, if the masking effect detailed above for the year two data is correct. In fact, the exact opposite has occurred. Something more significant has plainly changed between the two years. The course team believes that the major difference is that the year three groups are much more homogenous than those in year two. It is believed that less thought goes into group selection in year two. In year three, however, students are much more careful in that, for example, the more able and/or motivated students tend to group together. This results in both a lower difference in the %RSD and a higher r between the year three individual and group-based assignment marks than that for year two because, in terms of ability, the groups are more homogenous and as a result the masking effect, previously described, is less pronounced. It is also, of course, possible that collaborative working (even to an unacceptable level) on individual assignments rises in year three as a result of closer friendships and improved student ability at hiding such collaboration from the course team thus blurring the difference between group-based and, supposedly, individual-based (but in reality collaborative) coursework. Finally, it could be a combination of all of these factors. Again, further analysis plainly needs to be carried out in this area.

Finally, given the doubt over the fairness, and even the reliability, of assessing group-based assignments, they should never be a major weighting in the overall assessment of any course.

CONCLUSIONS

In the Department of Computing student feedback from standard course review and evaluation procedures, contained within "Individual Reports" and that received, less formally shows that while a few students have poor experiences of group-based assessment for most it is very positive. It is also worth noting that there has only ever been one formal appeal against a mark awarded to an individual for a group-based assignment which was not upheld because the appellant mistakenly thought that they had been awarded a mark lower than that of their group whereas in fact the opposite was true! The department's approach to group-based assignments has evolved over the many years, not just to improve the teaching, learning and assessment process itself, but also to meet changing student skills, motivations and expectations as well as internal/external regulatory requirements.

Finally, there is every indication that group-based assessment is worthwhile in terms of both improved learning and the development of non-cognitive skills, but there is nevertheless also a significant risk in terms of assessment fairness. There is plainly a trade-off between the two and course teams must strike a balance while also minimising the risk of unfairness in assessment by careful assignment design, group allocation, management and assessment.

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Meeting Service Needs of the Changing Profile of Student Customers

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ABSTRACT

The objective of this paper is to investigate how Higher Education Institutes (HEIs) in the United Kingdom (UK) can redefine education services to meet the needs of student customers. The student demographics extracted from the UK's Higher Education Statistics Agency (HESA), Key Information Sets (KIS) and an example HEI, University of Greenwich, UK, are explored and analysed. Additionally, the National Statistics Survey (NSS) on student satisfaction is also examined. Statistical analysis alone is insufficient to form a contextual view of the general student customers' profile. The changing demographics and the current student customers' prolific use of technology highlighted the fact that the past understanding of student profiles and their education needs no longer apply in the current context. A new method of student customer profiling is suggested. Service procurement in HEIs and the Service Consumption Life Cycle of student customers are discussed in the context of service needs and iterative interactions with specific service delivery focal areas within the HEI. A recommendation is made for periodic risk regulation assessments using new student customer profiles against areas of service needs to ensure a set of quality service delivery to meet the needs of these new students.

Keywords: Student Demographics, Higher Education Statistics Agency (HESA), Key Information Sets (KIS), Student Customer profiling, IT Literacy, IT Skills, Service Blueprinting, Risk Regulation, Service Procurement, Service Consumption Life Cycle

INTRODUCTION

Student demographics have evolved to be more cosmopolitan over the years as a result of both local and global students' aspirations for better quality Higher Education in the United Kingdom (UK). An assessment of demographics available at national and institutional levels found that while it presents a generic view through categorisation, the information is still rather "basic". Student customer profiling is discussed as an extension to the demographics data and an essential tool to help Higher Education Institutions (HEIs) to establish better services to meet the needs of the changing profiles of student customers. The student customers' need and use of service is discussed in the context of their service consumption life cycle where they interact with focal areas within the HEI that offer them services.

THE CHANGING STUDENT PROFILES

Many student customers are increasingly seen using mobile technology but there are still some who are lagging behind. They proficiently read and reply to emails from their smart phones in quick succession like how they do texting of messages. So what kind of IT literate and skilled student profiles do these students fit into? All HEIs who follow the UK government mandate, submit a compilation of their student customer demographic data to the Higher Education Statistics Agency (HESA). The currently available resources are those found at national and institution level demographics.

Demographics

The different types of national demographic data and surveys collected on students over the years form a generalised view. The statistics compiled by HESA show data compiled over the last five years. This is useful for considering changing trends in student population, rankings in specific categories and increase or decrease in numbers. Some of the demographic classifications include a collection of HEIs by geographical regions, students' domicile by geographic regions or countries, etc. The full-time or part-time mode of study is also tabulated. Other student specific information include the distribution of the student population by different categories for example gender, ethnicity, domicile and age but this is not enough to understand the distinctive characteristics of the student (see Tables 1, 2 and 3).

As a result of the rise in tuition fees for UK local students, there was a significant drop in student numbers in the academic year 2012/13, especially in part-time student numbers (see Table 1). It can be noted that there is a peak in number during 2011/12 because many students decided not to take the "gap year" study break to take advantage of the tuition fee freeze. This spread of information is useful for senior management in setting HEI level goals and making high level strategic decisions that may have sweeping impacts for the HEIs. Even though it is useful to be able to review in further detail the student distribution in both categories by country, it is not enough to build a student profile that the HEI can use to understand and support student learning.

Table 1: An extract of all student enrolments on HE courses by mode of study and domicile 2008/09 to 2012/13 (© Higher Education Statistics Agency Limited 2014)

All levels	2008/09	2009/10	2010/11	2011/12	2012/13
Full-time					
UK	1234150	1292460	1312295	1344810	1307840
Other EU	91970	100275	106250	110745	106060
Non-EU	213915	239425	258795	265845	268245
Total full-time	**1540035**	**1632160**	**1677345**	**1721400**	**1682145**
Part-time					
UK	792935	795160	760775	716600	607175
Other EU	25690	24765	23870	21805	19230
Non-EU	37395	41335	39310	36840	31730
Total part-time	**856020**	**861260**	**823955**	**775240**	**658130**
All modes					
UK	2027085	2087615	2073070	2061410	1915015
Other EU	117660	125045	130120	132550	125290
Non-EU	251310	280760	298110	302680	299970
Total	**2396055**	**2493420**	**2501295**	**2496645**	**2340275**

Table 2: Top ten other EU countries of domicile in 2012/13 for student enrolments on HE courses by location of HE institution and country of domicile 2008/09 to 2012/13 (© Higher Education Statistics Agency Limited 2014)

All UK HEIs	2008/09	2009/10	2010/11	2011/12	2012/13
Germany	14130	15425	16265	15985	14520
Ireland	15360	16595	16855	15075	12620
France	13090	13780	13325	12835	11725
Greece	12035	11785	11630	11790	10910
Cyprus (European Union)(#5)	10370	11160	11320	11620	10840
Italy	6040	6550	7100	8010	8320
Romania	2160	3190	4625	5915	6460
Bulgaria	2185	3395	4615	5705	6060
Spain	5690	5720	5795	5935	5995
Poland	9145	8415	7330	6295	5280
All other	27460	29020	31265	33385	32565
Total all UK HEIs	**117660**	**125045**	**130120**	**132550**	**125290**

Table 3: Top ten non-EU countries of domicile in 2012/13 for student enrolments on HE courses by location of HE institution and country of domicile 2008/09 to 2012/13 (© Higher Education Statistics Agency Limited 2014Author: HESA)

All UK HEIs	2008/09	2009/10	2010/11	2011/12	2012/13
China	47035	56990	67325	78715	83790
India	34065	38500	39090	29900	22385
Nigeria	14380	16680	17585	17620	17395
United States	14345	15060	15555	16335	16235
Malaysia	12695	14060	13900	14545	15015
Hong Kong (Special Administrative	9600	9945	10440	11335	13065
Saudi Arabia	5205	8340	10270	9860	9440
Pakistan	9610	9815	10185	8820	7185
Canada	5350	5575	5905	6115	6190
Thailand	4675	5505	5945	6235	6180
All other	94355	100290	101915	103205	103100
Total all UK HEIs	**251310**	**280760**	**298110**	**302680**	**299970**

Table 4: University of Greenwich student population by ethnicity 2012 - 2013 (University of Greenwich, Planning and Statistics (2014))

Ethnicity of Students	Total
Asian other	1,594
Bangladeshi	1,125
Black African	3,301
Black Caribbean	970
Black Other	281
Chinese	792
Indian	1,629
Mixed	1,040
Pakistani	722
White	11,329
Other	531
Not Given	442
Unknown	1
Total	23,757

Individual HEIs compile their own students' demographics at institutional, faculty and departmental level for their own internal analysis on student recruitment, retention, withdrawals, completion, etc as well as for external statistical returns to HESA. Demographics compiled by the Planning and Statistics department of University of Greenwich for example, provided similar breakdown classifications (see Tables 4 and 5). The figures are used by senior management for projection purposes and strategically plan recruitment goals for example. This demonstrates that even at institution level, it is still not possible to establish distinctive student characteristics for the purpose of supporting student customers in the teaching and learning environment which is where service is largely consumed.

Table 5: University of Greenwich student population by domicile 2012 - 2013 (University of Greenwich, Planning and Statistics (2014))

Domicile Region of Students	Total
UK	19,156
EU	1,123
Overseas	3,478
Total	23,757

Student Customer Profiling

Additional demographics currently available at the national and HEI levels are only sufficient for understanding entry level student customer classifications. Entry level in this instance refers to first year student entry into HEIs. The HEI sector in the UK has the annual National Student Survey (NSS) managed by Ipsos MORI (an independent research agency) where HEI students are encouraged to participate to provide feedback on student satisfaction (NSS, 2014). This annual survey is commissioned by the Higher Education Funding Council for England (HEFCE) on behalf of various bodies. Data comparison tables showing satisfactions and dissatisfactions on various metrics are then made available in the Key Information Sets (KIS) and Unistats (the official resource for comparing UK Higher Education courses). While the NSS provides prospective students with information to assist in their decision making in the choice of HEIs for further education, HEIs also use the data as a feedback and measure for their institutional guide on service improvements at a general level (see Table 6).

Table 6: Extract of Key Information Set (KIS) on the NSS derived information (Author: Unknown)

Information items for publication in the KIS	Source of this information	For the September 2013 KIS, this information relates to:
Results from the following NSS questions: • Staff are good at explaining things • Staff have made the subject interesting • Overall, I am satisfied with the quality of my course • I have received sufficient advice and support with my studies • Feedback on my work has been prompt • Feedback on my work has helped me clarify things I did not understand • The library resources are good enough for my needs • I have been able to access general IT resources when I needed to • I am satisfied with the Students' Union (Association or Guild)	National Student Survey (NSS)	2013 NSS results

Further to this, at HEI level (for example at the University of Greenwich) the Business Faculty independently implemented course or module level student customer surveys on student satisfaction. Towards the end of the course or module run, the student customers are encouraged to respond to the surveys electronically (see Table 7). Although the survey questions draw on more specific areas related to the course or module delivery experience, they

are mapped quite closely in line with the NSS survey questions. The data collected is also not sufficient to help establish student customer profiling requirements. Besides, it is difficult at the operations level to target service areas and levels required for a better customer satisfaction rating. The nature of the service contract and service consumption require student customers to be constantly engaged and interacting with the service systems and providers within the HEIs to achieve their learning goals for contractual completion. Contractual completion refers to the student meeting the learning outcomes and passing the assessments set within each of the courses. Based on the above demographic and survey data available both at national and institutional levels, it can be concluded that it is necessary for HEIs to establish a method of data collection of student profiles. This new extended data collected can be used to better understand student customers and their needs, help in establishing better service delivery and therefore better student customer retention rates.

Table 7: Faculty level sample survey questions focused at course/module delivery (Author: Business Faculty, University of Greenwich)

Please complete the evaluation survey at the end of your course.
• How would you rate the value of this course overall?
• How would you rate the quality of lectures on this course?
• How would you rate the quality of the tutorials on this course?
• How would you rate the quality of the learning materials on this course? (e.g. Recommended books, Moodle site, Handouts, etc.)?
• How would you rate the operational efficiency and effectiveness on this course? (e.g. Timetable, clarity of general organisation, marking completed within indicated timeframes).
• Please add any additional comments which will help to clarify how you have answered any of the questions above.

The successful use of customer profiling in many industry sectors have ensured its continuous use in many different ways to bring about organisational empowerment to engage more effectively with their customers. According to Forsythe (2012), customer profiling provides a "systematic means of understanding customers better". Meanwhile Forsythe (2012), Schofield (2006) and Kippenberger (2000) found its usefulness in corporate strategy for managing customer satisfaction in a better way and improving rates of customer retentions. Customer profiling has also helped organisations to increase their customer base (Moberg, 1996). Gary-Bobo (2008) extended the idea that profiling benefits both the student customer and the HEI. This means that HEIs can use customer profiling for better empowerment and service delivery resulting in improved customer satisfactions and student customers in turn benefit from getting what they want.

The student customer population at each HEI in the UK comprise of undergraduate and postgraduate students who enter Higher Education at different entry levels. Since HEIs are increasingly harnessing the power of IT to deliver services to student customers especially in the teaching and learning focal area. When profiling student customers, it is crucial to include IT literacy and skill sets assessments and consider the following points on student customer types and distribution within a specific HEI at macro level:

- The largest cohorts are mostly from the UK domiciled students with the next largest cohort from non European Union member countries (non-EU) and the smallest cohorts from European Union member countries (see Table 1 and 5). From the IT adoption and cultural perspectives, each of these countries where the student customers come from, has different levels of technology infrastructural accessibility and use to facilitate teaching and learning. As a result, the student customers have varied IT literacy and skill sets.

- The demographic data on student domiciles show that there is a high level of mobility in the student population (see Tables 2, 3 and 5). In the global context, the population in many countries including the UK has become more cosmopolitan. This is evident in the spread of ethnicity of student customers for example in the University of Greenwich as seen in Table 4. Typically, many different ethnic groups of student customers come from families whose parents or grandparents are migrants. Some of these student customers are either born locally in the UK or they themselves are children migrants. The student customers' records might reflect one particular domicile origin but in the last 10 years of their lives, they might have lived in another country and therefore experienced a different level of IT adoption and cultural perspectives.

- Undergraduate First year entry cohorts no longer comprised of the usual entry level age group. For various reasons, there are now more mature student customers in Higher Education. Similarly from the IT adoption and cultural perspectives, each of these student customers has different levels of past technology use and therefore have varied IT literacy and skill sets

- It has also been observed that many local undergraduate (UK) students used their first year experience in HEIs as a "taster year" unlike foreign students who are more "restricted" due to their visa restrictions and various other legislative controls. This means that if they are not happy with the education service they procured, they will transfer from their first HEI to their next available choice HEI. Such transfers can occur either at the end of their half term or at the end of their full term of the first academic year. These in-coming student customers will not have the same HEI IT adoption and cultural experience so their IT literacy and skill sets will defer from the existing student cohorts.

- As a result of inter-HEI (between UK HEIs and HEIs from different non-EU countries) contractual service level agreements, many of the UK HEIs have large groups of 2nd and 3rd Year Direct Entry cohorts joining their existing cohorts of student customers. IT adoption and cultural perspectives in HEIs from each of these countries are vastly different in terms of the levels of technology use to facilitate teaching and learning. Many of these student customers who do not have English as their first language struggled to cope in their learning on top of having varied IT literacy and skill sets.

- Special short term in-coming ERASMUS exchange student customers from HEIs from 33 participating European Union countries and various cohorts of student customers from other Higher Education student exchange programmes are another category of student customers (British Council and ERASMUS, 2014). Due to their backgrounds, short half term (otherwise also referred to as a logical half of the UK's one academic year) contracts and stay, many of them will benefit from this profiling.

- Students returning to resume their academic studies from interruptions as a result of work placements which are part of their contracts as well as those who interrupted their studies for various personal reasons need particular support to continue with their service consumption. They are the ones who will find that their familiar peer groups are somewhat different from their previous experience. New or revised service systems that they need to interact with that are either in the face-to-face or online contexts might have been implemented in their absence.

- A particular small group of student customers with special needs include all students with disabilities such as visual, auditory and/or speech impairment and mobility impairment (Gov.UK). Many service providers do not necessarily know how to support these student customers. It has been found that this group of student customers found implementing assistive technology help with their learning. The "special needs" for each disabled student customer is unique. The UK government supports these "special needs" individuals financially.

- Lastly, the individual student customer's social, cultural and financial factors (in terms of affordability) also account for IT adoption, IT literacy and skill sets. The student customers' family's and friends' IT adoption and use have an influence on them. Financial factors will also determine affordances at different stages of the student customers' lives in terms of when and what type of technology they can afford.

Framing the Student Profile

With the increasing use of technology in teaching and learning, student customer profiling on their IT literacy and skill sets is evidently relevant for better learning experience. Various independent small scale studies in different HEIs documented a wide range of technology enhanced learning experiences implemented (Self, 2009; De Cocco and Kenedy, 2012). So it helps service providers in the HEI to better understand and prepare for supporting learning needs that can be facilitated through the use of technology. The collective data from the student customers profiling can provide a holistic view and be used to feed into the re-engineering processes by way of re-evaluation, re-define, re-design, re-package, stream-lining, and re-implementations of service delivery.

The HEI at its organisational level must initiate a directive to establish generic student profiles periodically to be used across faculties for profiling to work effectively. This profile should include IT literacy and IT related skills. It will form a framework for better understanding of the HEI student customers, providing (face-to-face or online) support and development of students' learning needs, working towards satisfactory service consumption. A

potentially useful mechanism for extracting relevant data is to identify key indicators required for framing the student profile:

- Formal and mandatory assessment of IT literacy and IT related skills to inform both parties, i.e. the student customer and the service provider (such as the lecturers and academic administrators).
- Scope of IT literacy and IT related skills should be faculty specific to ensure assessment and capture of more relevant information that fits the skills requirements needed for the specific programme of study under the faculty. Specific tests and questionnaires should be used to capture the student customer profiles.
- Feedback from student customers should be collated as feeds into recommended face-to-face or online learning support to ensure the appropriate level and relevant skills development is received by the student customer.
- Every student customer should be assessed at the beginning of their entry into the learning contract at least once a year. This includes all returning students who have been "absent" for various reasons. Specific feedback from this exercise will facilitate and allow customization of IT support service for each individual.
- Collation of student profile data at faculty and HEI levels for collective assessments and reviews to establish best practices in terms of student customer support and development.
- Provide relevant access and supporting information to service providers so that they are empowered to perform their service provisions.

SERVICE PROCUREMENT IN HIGHER EDUCATION

When student customers register with the HEI, the student enters into a contract both with the HEI and the faculty within the HEI. Teaching and learning development is the service that student customers consume while they learn and work towards the final goal. In this instance, the goal refers to the student customers achieving their required passes and credits that demonstrated they have met their learning goals or outcomes defined by the HEI. Since the learning process in HEIs is facilitated through the use of technology, student customers must have a reasonable level of IT literacy or IT skills to be able to facilitate and manage their own learning independently.

Service Contract

The student receives the definitions and specifications of the degree procured in the form of programme and course or module levels handbooks. The programme level handbooks details include the list of courses or modules covered over a specific timeframe, the lecturers, the contacts, the credits accumulated, etc. The course or module level handbooks define in more detail, the teaching topics and plans, obligatory learning commitments in terms of hours, the length of the course, the assessment details, etc. This might include pre-requisite student capabilities or academic qualifications. Additionally, learning outcomes at programme level and more specific details at course level define the contractual obligations between the student customer and service provider. This service contract generally adequately covers the general expectations and understanding between the student customer and service providers. The service provider in this instance refers to the lecturer or tutor. It also includes the administration services provided by the faculty but details are not elaborated here. With the HEIs increasingly higher adoption rate of technology in their service delivery, the service contract however, does not usually cover any other areas such as IT related skills (assuming that the course is not a technical one).

Service Consumption Life Cycle

Typically in the HEI, each academic year runs on a fix number of terms, so it is easy to associate each year to service consumption life cycle (see Figure 1). The number of the service consumption life cycles depends very much on the student customers' programme of study, otherwise translated as service contracts procured by the student customers. The contact time between the student customers and service deliverers depends on whether the contract is for a full-time or part-time degree. A full-time undergraduate degree for example, takes between three to four

years to completion while the full-time postgraduate degree takes between one and a half to two years to completion. Part time degrees take double the length of time to completion. This is based on the assumption that there are no periods of study interruptions.

The longer the tenure of the service contract, the more familiar the student customers are with the service consumption process and the use of technology tools to facilitate access. Where student customers failed to pass their course or courses, they failed to meet their learning outcomes or goals. These failed cohorts who have to be re-assessed go through a slightly extended service consumption life cycle that is slightly different from the other main cohorts of student customers. This extended version is classed as an "Exception Minor Subset" service consumption life cycle (see Figure 1). The number of such exceptions allowed for each student customer depends on the policy of the faculty. In identifying this, it is possible for the HEI to classify and define appropriate service support in this area. If they pass this re-assessment, their progression will be reviewed and determined by the HEI academic panel. For those student customers who failed their re-assessments, they will be required to go through the full course specific learning cycle in the following academic year. But this group of student customers will be assigned to the normal cohort of students' service consumption group.

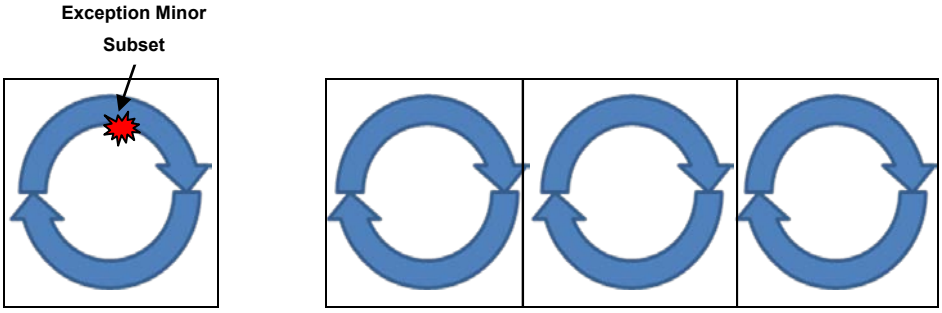

Figure 1. A Full-Time Single Service Consumption Life Cycle equals to an academic year (on the left) and a Full-Time 3-Service Consumption Life Cycles for the 3-year Undergraduate Student Customer (on the right) (Author's)

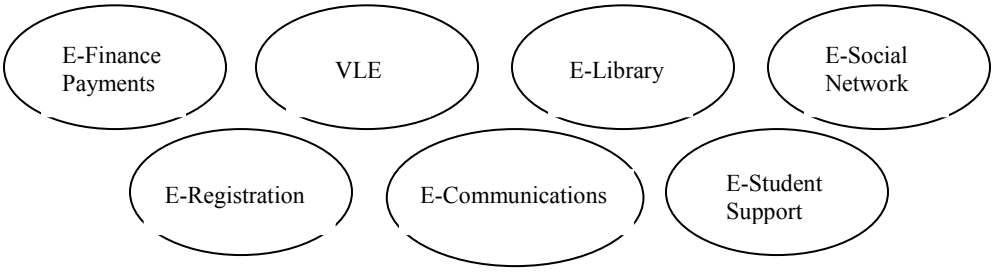

Figure 2. Focal areas used by student customers during Service Consumption Life Cycle (Author's)

During the period of the service consumption life cycle, the student customers will interact with some key functional focal areas of services (see Figure 2). The focal areas largely exists as independent silos but over time, there has been attempts at building bridges between them to simplify student customers' access to these service areas such as using a single login through web access. The use of service blue printing technique when mapped against the student customer profiles help to plot the overall service processes, perspectives, activities and evidence (Shostack, 1984). Staged periodic HEI level audits across these focal areas of services will produce results that identify frequency of usage in key service interaction points, service gaps and issues for service re-engineering to rectify and improve

services in the HEI.

Inductions and briefings are run bi-annually at faculty level for the different cohorts of new entry level student customers. The major event occurs during the Inductions or "Freshers' Week" before the start of the service consumption life cycle while the second one occurs before the start of the second half of the next term. There are still some student customers who are found to have missed these sessions for various reasons, some of which are due to external influences. Faculties have to determine how to address these gaps and develop an exception process that can handle this issue and close service gaps. The following describe the focal areas of student customers' interactions via the use of technology:

- The main source of learning is through interacting with the Virtual Learning Environment (VLE) which hosts the learning contents, course or module related communications, and facilitates electronic assessments and re-assessments submissions and feedback. This is the most important focal area because it is the primary service providing source for student customers with the highest frequency of interactions. Specific functional development of the course or module website is implemented to encourage students to interact with the system for learning engagement and deep learning.
    - While the faculty might dictate a general management instruction on the provision of this service system, there is still disparity in the level of the detail development. A validation process is needed to improve standardisation, recommend and streamline services for each course or module.
    - There are short term service contract student customers (found in the different groups of student customer types and distribution) who do not know how to use the VLE so they need to be briefed.
    - Applications and appeals for extenuating circumstances that may impact the student customers' assessments submission are also managed through this channel.
    - IT access and related network problems lie in a separate domain under the HEI's Network and ICT department. From the service prospective, when accessibility problem occurs with this particular service system, student customers are channeled to the ICT Help Desk for assistance. It must be noted that when there is accessibility problems with the HEI's network, the VLE is also not accessible.
- The E-Library resource methods of access for academic content, self-help book check-outs and returns, e-fines, etc require specialised briefing on how to access the resource. Some student customers who missed these briefings for various reasons including some short term service contract student customers need to have similar sessions organised. Student customers use this resource regularly for access to additional learning contents for their learning and assessments preparations.
- E-Registration and self management of student customers' private and course related information. There are two specific peak times in access to this resource which usually occur before the start of the academic terms. So this means both at the beginning and at the mid-point of the service consumption life cycle.
- E-Finance related payments, disbursements, access and procedures are very often not clearly understood by student customers. Problems such as delayed payments results in access to learning resources being denied which often resulted in confusion for students because information is not available or unclear.
- E-Communications relate to HEI and faculty related channels for marketing information, publication and emails. Although this is largely intuitive, there are other areas such as sources of contacts which still confused student customers. This is also another high frequency access focal area.
- E-Student support covers disability assessments, counseling, language support, etc. Although this is very important for the minority of student customers, this focal area is still largely a "mystery" to even other service providers within the HEI.
- E-Social Network refers to the Student Union and Clubs access which promotes active social interactions. This is a frequently used resource by students for communications, publicity, information access and distributions.

Following service reviews and process reengineering for each focal area leading up to implementing better services to meet the service needs of the new profile of student customers, HEIs can still consider taking their service delivery to another level. Raban (2011) suggests the use of risk regulation where reviews and assessments are part of the corporate governance requirement for HEIs. While this justifies a means for improvement, Crouchley (2004) argues that performance measurements used as indicators of HEI performance are flawed due to specific limitations in "tick box exercises". In this instance, the continuing use of updated student customer profiles to map against the focal areas discussed above will result in a more accurate holistic view of the HEI service delivery. It is even possible to analyse specific service details within each focal area to determine the frequency of use, re-distribution of support levels required, cost reductions and cost effective operations. Service gaps found can be rectified by repeating the re-engineering service processes using service blueprinting techniques to iteratively test and re-test before implementations to ensure efficiency and effectiveness in service delivery.

CONCLUSIONS

An exploration of the potential use of student customer demographics and NSS data for understanding the changing student customer profiles is made. It is found that both sets of data do not fully conclude with a clear student customer profile. More student customers are now expected to engage in the use of technology in HEIs for their learning environment, administrative functions and Higher Education Social purposes. Student customer profiling is suggested through the analysis of cohort compositions and categorizations including their IT literacy and skills. The collective data from the profiling exercise will then be used for training and updating of cohorts of student customers' IT literacy and skill sets.

The student customers' service consumption life cycle is discussed in the context of their need to interact with various focal areas for their service consumption. Even though HEIs have progressively updated their silos of online systems in their service focal areas with some attempts on building bridges to inter-connect these systems, they are still not functioning as cohesively as in an ideal scenario. These service focal areas functionally exist autonomously and as specialised service centres, they need to form and function cohesively for better service delivery. The use of student customer profiles should also greatly improve accessibility because the service focal areas will have a better defined expectation of how best to deliver services. Additionally, the student customer profile including students' view of what a good learning experience affordance mean should ultimately translate to better student retention.

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Evaluating Digital Library's Service Concept and Pre-Launch Implementation

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ABSTRACT

The paper presents a challenging online service concept for culture and science, namely the public interface of the Finnish Digital Library, known as Finna. Its most distinctive features originate from the fact that practically all Finnish libraries, archives, and museums are prospective partners through Finna. From the viewpoint of human-computer interaction (HCI), Finna's greatest challenges are 1) to design and implement user experience for a heterogeneous target population, and 2) to design and implement a service that merges differing information structures and conventions on the use of libraries', archives', and museums' materials. The paper focuses on four independent usability studies that evaluated the test version of Finna. The studies were planned to cover the most relevant questions and to reveal existing usability problems. Following the current principles of work organization, Finna's research collaboration partners provided the resources for conducting the studies. The studies' findings concerned the validity of Finna's service concept and its implementation. The results indicate that the service may be accepted by its end-users if three issues are resolved: the coverage of content, the representation of materials, and the identity of the service. This will require collaboration between all project partners and Finna's designers.

Keywords: User Experience Design; Implementation; Evaluation; Usability; Digital Library; Service design

INTRODUCTION

Background

The world of public services is changing rapidly. Society requires productivity, and citizens require attractive services for their taxes. Consequently, libraries, archives, and museums (LAMs) are adjusting their functions to this economic, environmental and social transformation. These organizations have noticed that they share values and customers, which makes it desirable to cooperate across sectors in the delivery of their services.

For more than a decade, digitalization has generated forward-looking cooperation among LAMs. They consider it important to coordinate efforts on all fronts, in order to remain competitive in the evolving environment of online services (e.g., Covey, 2002). These organizations are sharing their expertise and joining forces to develop new types of information-facilitation services for citizens. 'Digital library' has become a common term for a range of infrastructures that support and preserve cultural contexts and research (Candela, 2010), regardless of the type of organization providing the content.

This paper presents the concept and implementation of a digital library, which has been developed in nation-wide cross-sector cooperation between libraries, archives, and museums in Finland.

Finna – the public interface of the Finnish Digital Library

Finna is part of the Finnish Digital Library (FDL) project, which is funded by the Finnish Ministry of Education and Culture. Its strong mandate ensures that the service can be developed with keen commitment and with consideration for all stakeholders.

Finna brings together the collections of Finnish libraries, archives, and museums. The National Library of Finland is responsible for the development and maintenance of the service. Representatives from participating organizations and stakeholders are involved in devising national digital library strategies, as well as in the operational work. (Hormia-Poutanen et al., 2013.)

Participating organizations can join Finna in two ways. They can publish their material in Finna's National View, which provides online access to all restriction-free material within Finna's metadata index. Or they can utilize the Finna software and build their own version of Finna's interface, also called Organization View (see Image 1). Individual organizations' own views can display all material within Finna, or just a limited set. So end-users can access Finna's content via several interfaces available on the Internet.

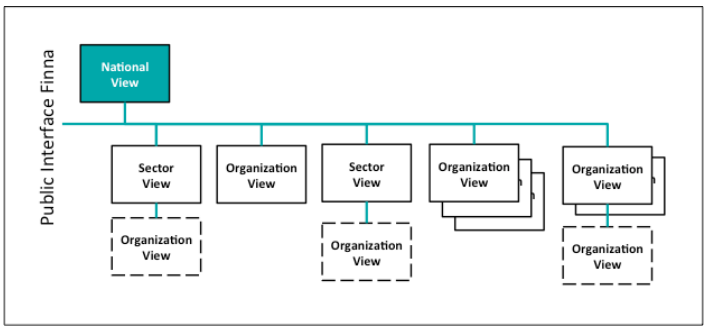

Image 1: The family of Finna Views

Finna accomodates all sorts of material and various kinds of metadata formats approved in the FDL Standard Portfolio (*The National Digital Library – Enterprise Architecture*, 2010). Participants will still maintain their own back-end systems, but Finna will gradually replace their current online services. External services enhancing the user experience, such as ontologies or online payment, will also be integrated into Finna (see Image 2). The final spectrum of Finna's services will be very wide.

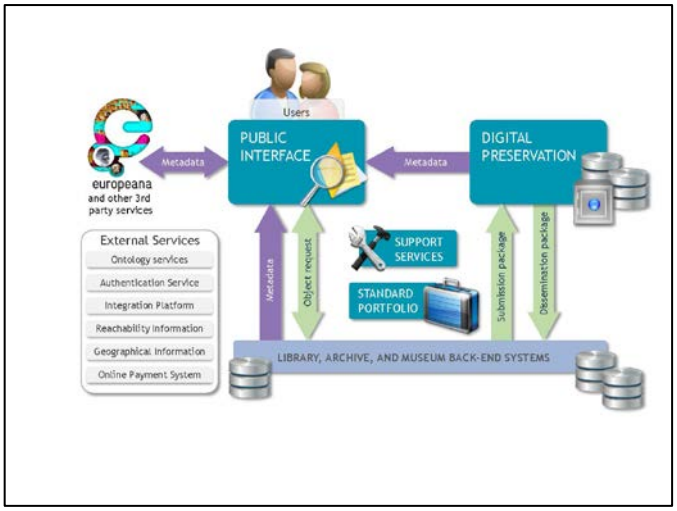

Image 2: Finnish Digital Library enterprise architecture

Implementation of Finna

The Finnish Digital Library project begun in 2008. The first years were used for planning, i.e. defining the requirements, establishing the governance model and development methods, and finding the suitable software for the Finna public interface. Following the common policy for LAM sectors, the most prominent library and discovery system vendors were invited to tender. The arduous procurement process was completed, and a choice was made. After the pilot testing phase was extended three times, it became obvious that the chosen software could not meet the requirements. The contract was cancelled and another approach was taken. In January 2012 our in-house team at the National Library of Finland began to develop the public interface software.

We at the National Library have been building the Finna service on open source software (OSS) solutions. We are contributing to the OSS community by further developing the core interface module VuFind (see vufind.org/about.php), and by publishing in-house-developed Finna-specific modules. We are managing the work using agile software development methodology. We consider that these approaches enhance flexibility and provide opportunities for customer-driven innovation (Hormia-Poutanen et al., 2013). These elements also increase the complexity of the work and its outcome.

We published the first running test version of Finna in December 2012, and the first production version in October 2013. This paper discusses the status and actions taken during the 10 months of the test version phase.

Challenges from the viewpoint of HCI

Finna, as a project as well as a service, is unique in many ways. The most distinctive features originate from the fact that practically all Finnish libraries, archives, and museums are prospective partners through Finna. The customer base of these organizations ranges from scholars in all academic disciplines, through the general public, to minority groups with special needs and requirements. Furthermore, Finna's content includes digital materials accessible online, but also reference information for the physical collections of archives, libraries and museums.

Although LAMs have similar values, and preserve and distribute similar materials, there are significant differences in the way they serve their customers. Due to historical development, they have divergent methods and practices of collection management, metadata generation, material description, and even service objectives. These practices and policies influence the opportunities for cross-sector collaboration (Zorich et al., 2008). They also influence the experience of a visitor to their premises or online sites.

As collaboration actors LAMs also form a heterogeneous group of resources and knowledge. The central agents in each sector can contribute to a challenging collaboration project on a wider scale than, e.g., a municipal one-man organization managing its' collections with a spreadsheet application. Collaboration cannot function on good will alone, it needs resources (Zorich et al., 2008). The same is true for collaboration in usability. Some LAM organizations are well-accomplished in the user-centered design and implementation of their online services, but others have no resources to invest in these activities.

From the viewpoint of Human-Computer Interaction (HCI) research, public services may seem less attractive, because governments and public-funding organizations can seldom pioneer ITC development. However, Buie and Murray (2012, xxxv) claim that government systems are an important area for usability and user experience research, because these systems affect the everyday life of tremendous numbers of government employees, not to mention citizens. For various reasons (as described in Buie & Murray, 2012), the usability of public systems is not as good as it should be. Further, the public sector is an important area for usability and user experience research, because it can provide insight into profoundly complex systems and services, as well as divergent ways of organizing systems' design and implementation.

This paper focuses on characteristics of Finna that were distinctive during the short period of development between December 2012 and October 2013. These characteristics can be of interest to the wider community of HCI practitioners and researchers in terms of the following:

- Design and implementation of user experience for a heterogeneous target population.
- Design and implementation of a service that merges differing information structures and conventions on the use of libraries', archives', and museums' materials.

Although Finna will primarily serve users from its partner organizations, it should later attract new users, too. Finna should finally serve, in principle, every citizen in Finland who has access to the Internet. This means approximately 90% of citizens between the ages of 16 and 74 (*Official Statistics of Finland*, 2010), with their personal interests and contexts of use. It is acknowledged that designing multiuser systems or services for large populations requires a special approach (Krippendorff, 2006; Meroni and Sangiori, 2011).

Although organizations can build their own Finna interface, the core of all interfaces is a fusion of the underlying information structures, metadata, conventions of use, and expectations of partners participating in the development. In terms of knowledge engineering (Sowa, 2000), Finna unites several domain models for one purpose.

This report is part of my longitudinal case research that focuses on the organization of usability work in the development of a digital library. My aim is to examine the change that has occurred in organizational settings, and for this purpose I use Cultural-Historical Activity Theory (see, e.g., Kaptelinin & Nardi, 2006). Following the principles of action research, I aim to study the existing reality at the same time as fostering change in it. My role as the manager and leader of usability activities at the National Library enables this. I hope that the documentation of phases and actions will provide applicable information, firstly for actors involved in the case of Finna, and secondly for others facing similar challenges.

Questions and hypothesis

Usability has been one of Finna's essential development tracks. We have applied user-centered design methods and conducted studies on Finna's usability from the beginning of the project (Hirvonen and Kautonen, 2011; Kautonen, 2013.) The new approach to build the software in-house at the National Library, using open source software components, raised the level of usability challenges. Instead of relying on software vendor's efforts concerning, e.g., good interface usability, we at the National Library had to solve all problems by ourselves. Organizations taking part in Finna were also facing new challenges, because we involve our partners strongly in the development, including usability activities.

Between the publications of the test version and the first production version, we needed to study the validity of design and implementation decisions. Our central questions were as follows:

How do users perceive Finna as a service? Do they find that it answers to their needs and interests? How should the service be further developed?

The designers and developers at the National Library did not find it easy to define Finna's service concept. Therefore we assumed that it was confusing for users, too. The implementation surely had some faults and usability issues, but the core idea of uniting material from Finnish LAMs to meet user's needs was viable. We expected that the evaluations would provide proof of user satisfaction sufficient to further develop the service, and that they would point out the areas of conflicting user expectations.

Related research and services

The challenge of heterogeneous audiences has long been recognized in the field of HCI. The principles of universal design have emphasized the importance of designing services for everybody, "services that can be used by people of all abilities, to the greatest extent possible, without adaptations" (Erlandson 2008, 5). The market potential of special audiences, e.g. elderly customers, has increased the attention on universal design as a desirable approach (e.g. Gassmann and Reepmeyer, 2011). Specific user groups can be considered through processes of globalization, internationalization, and localization (Marcus and Gould, 2012).

There is ongoing interest in the field of HCI research into systems and services of high complexity. The reasons for complexity can arise from the system itself, its audiences, or the situation in which system is being used. When the system is complex, the needs of different user groups must be acknowledged independently (Albers, 2011a). Generally, the aim is to reduce systems' undue psychological complexity, and simplify users' interaction with technology (Thomas & Richards, 2012). e-Research is one of the areas where large-scale, distributed, multidisciplinary, and multi-institutional – i.e. complex – user environments are being studied (Flor et al., 2010).

Users' perception in the context of digital libraries have been actively investigated (Chowdhury, 2010). Many reports describe interesting cases, and point out challenges for digital library design.

There is good evidence and some unanimity concerning effective user experience design and evaluation practices in the context of modern digital libraries and equivalent services. For example, Agosti et al. (2009) have argued for using a combination of implicitly and explicitly collected data for studying digital library users. Fagan et al. (2012) indicate similarities between the usability of discovery tools and digital libraries. As well, the subject of new viewpoints and methodologies has been raised. Khoo et al. (2012) have compared users' and evaluators' perceptions of usability, and their implications for usability evaluation. Recently, Kostkova and Madle (2013) have presented a framework for digital library impact evaluation. This discourse about digital libraries is founded on advancements within the HCI discipline.

When compared to other digital libraries, the closest to Finna is the European digital library Europeana (available at europeana.eu), which brings together the collections from European archives, libraries, museums, and galleries. Another service uniting all types of a nation's organizations is the Digital Public Library of America (DPLA, available at dp.la). However, both of these include only digital collections, whereas Finna also covers the reference information about physical collections.

Experiences from such projects and services have provided valuable information for the development of Finna. Europeana has published studies on its usability activities (Chowdhury, 2010; Dobrewa and Chowdhury, 2010) that are a relevant reference for practitioners in the field. Developers of DPLA are also sharing their everyday experiences of converging digital LAM initiatives in the USA (e.g., Marx & Frick, 2012). Nonetheless, little research has addressed the particular challenges this paper deals with, in the context of digital libraries or similar public services.

METHOD

Four evaluation studies in the spring of 2013

The usability of Finna was evaluated in four individual qualitative studies during the spring of 2013. The following sums up the basic facts of these evaluations, including the 5 dimensions of usability tests according to Dumas and Fox (2012): the purpose of the test, scope of the product tested, location of sessions, presence of test moderator, and level of functionality of the product. The common features describing the conducting of these evaluations are described first, and the evaluation-dependent facts later. In addition, the reasons behind the decisions are described in order to help in assessing the reliability and validity of these evaluations.

The studies focused on the most relevant questions for service development, and on revealing the existing usability problems. The researchers decided on their methods and the conducting their study independently from others. We at the National Library only provided background information and helped in contacting appropriate test persons.

By combining the results from the evaluation studies I aimed at deepening our understanding of relevant issues in the development of Finna. Each evaluator concentrated on the questions of his/her study, but in this paper I seek answers to the central questions.

The four actors conducting the studies

The resources allocated for usability activities determined the execution of evaluations in 2013. We had to outsource all evaluations, and could purchase only one of them from a commercial procurement partner. One of the principles of the new approach has been the establishment of a strong collaboration network with different stakeholders. As a consequence, two Finnish universities hosting research in usability showed interest in Finna in 2013. Contracting students into Finna's usability evaluation significantly reduced our expenses. We also valued the viewpoints and paradigm of their affiliation universities. Respectively, we took into account that the risks of the timing and quality of the students' work might not equal that of professionals.

Two of the evaluations inspected the Finna's National View, and two focused on the first running Organization View, namely the view of the Jyväskylä University Library (JYU View). Both views were tested online, by accessing the test versions available on the Internet. There were no other operational views at that time. The tested views had three major differences. Firstly, the JYU View contained material only from the Jyväskylä University Library (JYU), whereas the National View displayed all released material. Secondly, the licensed electronic publications and databases of the JYU were integrated into their own view, not the National View. Thirdly, the appearance of each view was distinctive, although they both had the same basic layout and features.

We thought it was important to study both views. The National View was the root of all other views, and therefore examining it provided relevant information concerning the usability of all other views (see Image 3). On the other hand, the target users of the JYU View were the students, researchers and staff of the university. Together they represent one of the main target groups of the Finna service. Therefore it was interesting to find out their expectations and experiences.

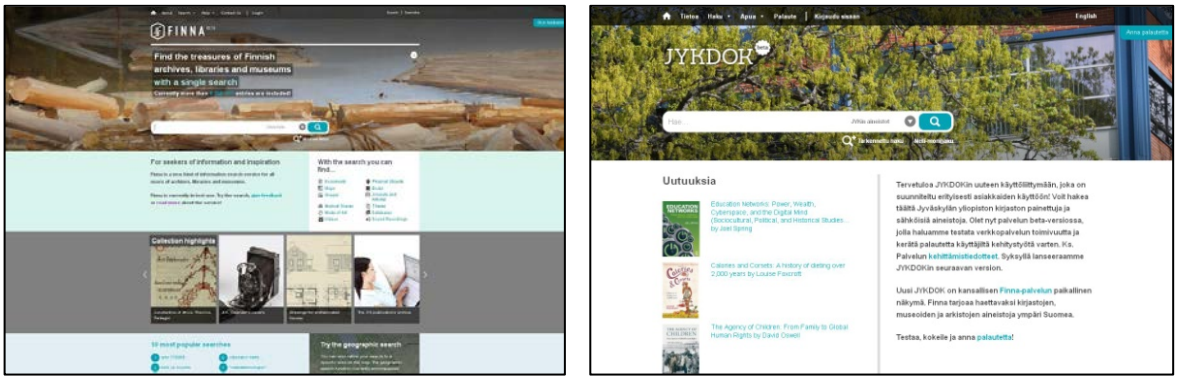

Image 3: The home page of Finna's National View (left) and the Jyväskylä University Library View (right)

Depending on the acquisition methods used, each evaluation was based on different kinds of data. The source material varied from interview scripts and notes to video recordings and screen shots. The researchers analyzed their data and used appropriate methods according to their own judgment. Only a fraction of the original field data was delivered to the developers at the National Library. Each study report included a list of findings, and suggestions for overcoming the expressed usability problems. The fourth study also provided some exemplary source code for correcting user interface discrepancies.

Only two of the evaluation reports have been published (Heinänen, 2013; Kuuskoski, 2013), but all essential facts can be found in Table 1. Hereafter, I refer to each study with an identification code indicated in the table. The following chapters give an overview of each study and its research settings.

Evaluation 1: Usability test of Finna's National View

The first test was conducted to evaluate the overall usability of the test version of the Finna's National View. The study included all available functionalities on the interface. The evaluation was conducted by the experienced usability company Adage Ltd., which provides user-centered design and usability research services to its clients in business and the public sector. Adage is a permanent service supplier for the National Library.

The evaluation was a conventional usability test, which included interviews and user tests. The tests were carried out at the premises of Adage and monitored by usability experts from the company and the commissioner. The test consisted of roughly formulated tasks that followed participants' individual interests, and tested the basic functionalities: search, narrowing the search, viewing the results, and saving the search results.

The participants were recruited by Adage. The National Library defined the criteria for the target group, and took part in planning the test and the relevant tasks. There were 6 participants of both genders, who represented elderly non-academic history researchers, e.g. family history hobbyists. None of them knew about Finna before the test.

Evaluation 2: User test of the JYU View

The second evaluation was conducted to evaluate the first running Organization View of Finna, namely the test version of the JYU View. The aim was to find existing usability issues in the natural context of JYU View users. The study was planned and conducted by a graduate student from the University of Tampere. The data were collected in interviews and the user tests were conducted on the premises of the Jyväskylä University Library. The library helped in recruiting participants from among the University's students and researchers.

Altogether 7 persons participated from three different disciplines of the university. All were experienced users of online library services, but they had no previous experience with Finna.

The participants were asked to complete the test following their own study or research interests. The assignments covered the natural flow of information retrieval, and explored the use of information. The test included interviews and discussions during the assignments, which gave the researcher more insight into the subjects' thinking.

Evaluation 3: Heuristic evaluation of the JYU View

The third evaluation was conducted to complement the other evaluation on the test version of the JYU View. The aim was to focus on the user interface and find all potential usability problems. Searching for licensed electronic publications was excluded from the evaluation. The evaluation was conducted as an expert evaluation. The evaluator was a graduate student from the University of Tampere, who had enough experience in informatics and online service development, as well as library informatics, to be considered an expert.

The evaluator used four sets of heuristics: three general online service heuristics and one designed for online public libraries. The reason for using this many was to test all features and detect all problems in the Finna interface.

Evaluation 4: Accessibility test of Finna's National View

The last evaluation was conducted to assess the accessibility and usability of Finna's National View for visually impaired users using a screen reader. The evaluation was conducted by a group of graduate students at Aalto University as part of their studies. The Finnish Library for the Visually Impaired helped in recruiting the participants. Altogether 7 persons took part in either one or two user tests during the study. The tests were conducted in the users' own environment, using their own devices to access Finna.

The user tests were complemented with a heuristic evaluation, background interviews, and questionnaires investigating the user experience and validity of the test results. The evaluators also made a software model to evaluate the validity of their findings. The model was a valuable source of information for Finna's developers.

Table 1: The facts of the four usability evaluation studies on Finna carried out in spring 2013

ID	Time when conducted	Affiliation	Target	User group involved	Location of sessions	Applied data acquisition methods	T	I	C
E1	March 2013	Adage Ltd.	The National View	Elderly hobbyist researchers	Usability laboratory	User test, interviews	6	36 (11)	12
E2	April 2013	University of Tampere	JYU View	Students and researchers from the University of Jyväskylä	Library premises	User test, interviews	7	19 (0)	10
E3	April–May 2013	University of Tampere	JYU View	--	--	Heuristic evaluation	--	53 (11)	--
E4	April–May 2013	Aalto University	The National View	Visually impaired persons using screen readers	Users' own environment	Contextual inquiries, interviews, heuristic evaluation, questionnaires, user tests	9	79 (11)	6

RESULTS

Overview

The results of the evaluation studies were reported to the developers at the National Library and to Finna's Usability Working Group.

The number of identified usability issues from all evaluations was nearly 200. However, many of these overlapped, and some were mentioned in all four reports. Each study indicated the severity of the findings, pointing to issues in need of prompt attention. The number of distinct individual issues of a 'severe' or a 'critical' nature was 31.

The three evaluations involving end-users (E1, E2, E4) included interviews or questions that inspired the test subjects to comment openly. The number of individual comments was 28. The comments provided important information about users' thinking.

The heuristic evaluation of the JYU view (E3) revealed issues mostly concerning the user interface implementation. The descriptions included either suggestions or direct recommendations about how these issues could be resolved. As well, the three other studies indicated interface-related issues, and remedies.

Relevant findings

The results from all four evaluation studies showed that the service concept is not clear to users. Several findings indicated that the way the search was targeted, or the way the search results could be filtered, was not intuitive enough (E1, E2, E3, E4). On the other hand, users familiar with online library systems were very effective in information retrieval and could easily comprehend and even appreciate the basic functionality of Finna (E2). However, the expert evaluator expressed confusion in a case where the external service, i.e. the licensed material database search, functioned differently from Finna (E3).

The users' prior knowledge influenced the way they used, or did not use the functionalities provided (E2). There were also some pleasant surprises (E4). On some occasions the evaluations revealed expectations that, in fact, were not dependent on Finna or its implementation. Such expectations concerned storing favorites (E1), searching the background database (E2, E3), or external services (E2). Results from evaluations of the JYU View (E2, E3) strongly suggested a need for effective use. The evaluators complained when quick and effective use was compromised because of some interface feature or functionality.

The results indicated that features originating from the back-end systems, integrated services or restricted materials influence users' experience of Finna (E1, E3). These features are not part of or caused by Finna's software, but rather users experience them as part of it. Also the look and feel of Finna was compared to the current systems. Some users expressed that the appearance of the interface related to a feeling of trustworthiness and reliability – or the opposite (E2).

The last evaluation pointed out that the usable accessibility of the system was dependent on users' skills in the auxiliary technology, i.e. the screen reader (E4). One particular finding from the fourth evaluation (E4) was that the interface code, which was more accessible with screen readers, was considered altogether better for sighted users as well.

All results contained indications of poor interface terminology. Some of these terms were user interface terminology (E1, E2, E3); others were abbreviations, keywords or other metadata originating from the back-end systems (E1, E4). Users found some field titles confusing. They found unexpected or even erroneous metadata in a particular type of field (E1, E4). There were also complaints that the available metadata was in discrepancy with a particular context of use (E1, E3). The quality of the metadata was considered as a meaningful element for use.

The findings included several notes concerning access to the material, in other words, Finna's content. The users testing the National View (E1) expressed enthusiastic first impressions, but this changed when they discovered that the service included only a fraction of the material in Finnish libraries, archives, and museums. Users expected to get direct and easy access to the material that was relevant to them (E1). The users testing the JYU View (E2, E3) indicated wanting to see the collections from other libraries, if the desired publication was not accessible in their home library. The JYU View provided access only to the material of the Jyväskylä University Library. The users testing the National View indicated dissatisfaction when they found that all of the material was not available online

(E1). However, users testing the JYU View did not indicate such a need and were satisfied with the reference information they found (E2).

CONCLUSIONS

Concerning the method and conducting the evaluation studies

In the development team at the National Library of Finland we assumed that Finna's service concept was confusing for its users. Four independent usability evaluation studies were conducted in order to validate the service concept and its implementation. These studies approached the usability of the Finna service from different viewpoints and used a variety of data acquisition and evaluation methods. The developers and designers at the National Library appreciated the results and quickly used them to improve the interface and other system features. Thus, the evaluation studies succeeded in showing further development options for the service.

We at the National Library had little control over how studies were conducted, because they were outsourced to our partners. This caused a degree of variation and discontinuity, and therefore their results were not comparable. None of the evaluations could look deep into the users' needs and interests. These tests merely evaluated the access to the information, not its usefulness in real situations or for longer period of time. As Albers (2011a) argues, information salience is one of the necessary elements of an effective system.

Due to the long timespan of the project, as well as unforeseen changes of direction, limited resources, and changes in organization, there has been no opportunity to apply the fully controlled approaches. The user experience design, implementation, and evaluation practices of Finna may not be systematic, but similarities with the ecological approach defined by Still (2011) can be seen.

From the viewpoint of the usability activities' management, I consider the results of the test phase to be satisfactory. Instead of a single evaluation we can benefit from the findings of four studies. The studies provided enough material to answer the central questions, and the users' perceptions of Finna were mainly positive.

Concerning the challenge of a heterogeneous population

One of the most important tasks in an innovative public service project, such as Finna, is expectations management. This requires constant dialogue with stakeholders, of whom the end-users should be among the first.

There will be different expectations about Finna as a service. Some users will only browse available contents, whereas others will demand a specialized tool for professional use. Interestingly, Chowdhury (2010) has noted that the same information in a digital library may be accessed, understood and used differently by users in different contexts. Albers (2011b) emphasizes that the various needs of user groups should not be overlooked, and that the design should not be simplified to the lowest information need.

The evaluation studies reported in this paper were addressed to potential users with different backgrounds and different needs. The results showed that the test version of Finna was not entirely what these people expected. Features familiar from existing systems were considered easy and quite usable, but there were also expressions of dissatisfaction. A negative experience may discourage further use of a new service. These conclusions are consistent with studies on Europeana and The European Library (Dobreva and Chowdhury, 2010; Agosti et al., 2010). A good impression of a service can be enhanced with refined implementation, but it is essentially an issue of design.

Concerning most parts – or elements, as Garrett (2011) says – user experience is created on a designer's desktop. The evaluation of Finna's accessibility for visually impaired users also showed the importance of implementation. Furthermore, the results implied that a service well implemented, in this case, produced with correct application code, serves all user groups better.

Independent of the context of use, it seems that people consider a digital library to be as good as its contents. The evaluation studies on Finna revealed many indications supporting this assumption. Dobreva and Chowdhury (2010) have also argued, that it is essential to resolve content issues alongside the usability issues. Thus, the ***coverage of content*** within Finna seems a crucial requirement for the success of the service.

Concerning the challenge of merged services

The service concept of Finna is a combination of current library, archive, and museum use scenarios. Finna's partner organizations know their patrons well, and therefore Finna relies on their specifications about information structures and conventions. However, the results of our evaluation studies proved, that the new interface revealed the shortcomings of these presumptions. It seems obvious, that something has to be changed in the way the metadata, the interface terminology, and other conventions are represented.

LAMs in Finland apply different metadata standards that are described in the NDL Standards Portfolio (*The National Digital Library – Enterprise Architecture*, 2010). Although harvesting the diverse metadata and mapping them to the system requires resources, it is feasible. But it will require much effort before the material from LAMs can be displayed via one interface in a usable manner.

The results of Finna's evaluation studies also indicated a need to reconsider the terminology and expressions displayed to users. It is a challenge for interaction designers to abandon the conventions inherited from established organizations and existing systems. According to Krippendorff (2006), it is a designer's fundamental duty and right to adjust the design thinking towards users' actual and future contexts of use.

New policies and the transformation of entire work processes are required in order to change the ***representation of material***. The current cooperation through the Finna consortium provides solid ground for such change. According to Buxton (2007), a cooperative approach could be desirable in design work. This suggests partners being involved in activities that are now the sole responsibility of the development team at the National Library. To cover all aspects of representation, Finna should also involve proprietary software partners in collective design problem-solving.

These findings could be used as an argument against the original idea of Finna, i.e. merging services from divergent application domains into one interface. However, the option to implement an Organization View and modify it to local needs actually enables such an aspiration. Library professionals in America have expressed similar concerns about hybrid services for academic and public use, addressing the case of the Digital Public Library of America (Rothman, 2011; Sydell, 2013). A user-centered approach, however, criticizes hasty conclusions. If there are users who desire primary material from different content providers, they should have an opportunity to access the material using some kind of a single search (Palmer et al., 2009; Perescott & Erway, 2011). Too often, users must face the different representation models and conventions, and adjust their actions accordingly. Once Finna has been launched, the users' actual behavior together with this challenge will be studied further.

Finally, one more aspect concerning merged services was indicated in the evaluation studies. The participants did not necessarily see, which feature or functionality was part of Finna. They did not identify the boundaries of the Finna service. This concern is related to the reliability of the service, which was also indicated in the evaluation results. The users' trust in libraries, archives, and museums must not be lost. According to Kuniavsky (2003), personality and attraction are one of the central aspects of creating a good user experience. On the basis of this assertion, the ***identity of the*** Finna ***service*** should be further designed and defined.

Future work

The four evaluation studies revealed findings pertaining to the validity of Finna's service concept and its implementation. Most of the issues concerning the implementation that the findings raised were rather straightforward, and could be resolved before the launch of the first production version. However, there were also findings that pointed out more fundamental issues in the information design and service concept of a cross-sector digital library.

The results indicate that the service may be accepted by its end-users, if the following three issues are resolved:

- Coverage of content,
- Representation of materials, and
- Identity of the service.

It is important to recognize that none of these challenges will be overcome only with better design and implementation, i.e., the work done at the National Library of Finland. They require the involvement of LAM organizations taking part in Finna, other partners, and stakeholders. Sandford and Doulton (2012) state that improving users' expe-

rience of government services requires a profound transformation of delivery processes. The same will be required from services provided by other public organizations, such as LAMs. Shifting the focus from organizations' cultures to users' cultures can ultimately change the policymaking and lead to a deeper digital convergence of LAMs.

This paper was limited to a short period of the Finna project, focusing on two challenges. Along with the progress made, more work and studies will be done, and other user groups will become involved. We will focus on Finna's actual use once the service has been launched for the public. We also intend to review the process of how user experience design and an agile software development method have been intertwined. The development of Finna continues until 2016, and so does the work on its usability.

My research on organizational settings will hopefully also reveal other kinds of transformations. By paying attention to the case of Finna, its actors, activities, distribution of work, and other elements of the activity framework, I hope to introduce the available opportunities to developers of public services in their challenging circumstances.

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Effects of Social Promotion for Customer Choice in the High Mobility of Mobile Phone Market

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ABSTRACT

Current mobile phone markets have becoming high mobility of mobile-phone users by standardizing the mobile phone devices. In Japan, before introducing MNP (mobile number portability), the Japanese market was saturated in between three international companies named NTT DoCoMo, KDDI au and Softbank with their specified mobile phones. The competitive condition around the mobile phone market to switch from specific to standardized mobile phones is becoming severe. However, in Japan, the current main strategy has been price competition still because the devices are well developed and the traditional mobile phone market has a low mobility of mobile-phone users. Conversely, in Pakistan, to be undertaking social promotions based on high mobility of mobile phone users. In this case, how can we develop and balance individual/social promotion in the high mobility of mobile-phone users? Mobile-carriers should understand customer preference for mobile phones and services rather than increasing their market shares. Customer retention and loyalty are important goals for mobile carrier companies. We found the equilibrium of individual/social promotion effect based on numerical simulation. Marketers can better cultivate relationships with existing customers instead of attracting new customers. We will design an optimal customer selection, formulating a distinct marketing mix and modifying the marketing organization.

Keywords: Social promotion, Individual promotion, Brand switching, Customer retention

INTRODUCTION

The mobile phone industry is one of the fastest growing industries in the world and increasing very fast as developing countries emerge (Keithy Conly, 2010). Mobile phones industries have gone through major changes and are constantly progressing to meet consumer expectations (A.T.Kearney 2013). Worldwide mobile phone industry is well defined by whole market share and price based upon product type. The mobile phone industry can further categorized into three different divisions: low-price, middle, and high-price. In the global mobile phone industry, scale and market share are the major goals (Keithy Conly, 2010). The ability to grow globally is critical as development in markets increased and new potential customers come forward. However, it is still possible to be profitable in the market without expanding rapidly against severe competition by stabilizing their position. Currently mobile phone market has becoming high mobility of mobile-phone users by standardizing the mobile phone devices.

Almost half of the population of the earth is now using mobile communications and a billion mobile phone subscribers added in the last 4 years (A.T.Kearney 2013). Still countless adults and young people would grow the social and economic benefits of mobile technology. Moreover, emphasizing on a huge opportunity for future evolution and a challenge to all players in the industry ecosystem to expand the range of products and services to

overcome this demand.

The main objective of this research is to support the social promotions in the field of telecommunications in Japan. In addition, we are adopting social promotion strategy, which provided by the Pakistani telecommunication industries for their whole community. We are not saying individual promotions are not use full but we are finding a balancing point using some models and numerical simulations. In this paper, we use the terms; switching brands, social promotions, individual promotions, customer's loyalty, customer satisfaction, and ultimately customer retention. The research questions are how to stop switching brands, how to promote social promotions in the society and discuss the advantages of social promotions in short, and long run.

Currently in Japan, there are three major companies, which saturated enough. In addition, the focus of all companies is to attract the new customers or poach customers from the other telecom carriers. For this purpose, these companies are making many promotions for only those who want to switch their carrier (individual promotion) and sometimes companies ignore the demands of their old customers. But this paper is highlighting the efficient promotion strategy which is not only for new customers or for those who are switching from other carriers but this strategy is also for old customers, this research is to introduce social promotions in telecom industry to achieve customer loyalty for customer retention and also to attract new customers. As maintaining customers is an important thing for marketers because the cost of marketing activities issued by the service providers to attract new customers is much greater than the costs incurred to maintain existing customers (Kotler and Keller, 2009).

This paper divided into 6 sections. Section 1.1 presents a background of telecommunication industry worldwide and especially in japan. Sub-Section 1.2 explains the research questions and purposes of study. Sub-Section 1.3 is about research approach. There are some related works discussed in section 2. Section 3 reviews the making of models for social promotions. Section 4 is about main results and numerical simulations. Section 5 is implications and finally the discussion section concludes the paper in section 6.

BACKGROUND

Telecommunication companies in Japan

In Japan**,** before introducing MNP (mobile number portability), Japanese market was saturated in between three international companies named NTT DoCoMo, KDDI au and Softbank with their specified mobile phones. Meanwhile there was no such competition of mobile phone because every mobile phone carrier has its own specific mobile phones different from one another. Soon 3G technologies introduced and mobile phone demand increased tremendously and everyone desires to get latest mobile phone so after specified mobile all mobile companies shifted to Standard mobile like I-Phone and Android phone.

Japanese consumers tend to use mobile phones more as a device to connect to the Internet in order to download various contents, such as games, (currently social games are attracting the interest of the younger generation). Also mobile digital TV, movies, and music as well as using value-added services, such as shopping at convenience stores and making train and airplane reservations (Funk, 2005, for example). Small handsets can now even view homepages built for PC access and have come to be devices for mobile computing. Because of this critical situation, many people start switching their carriers to take benefits. In Japan, every mobile carrier's aim has become to get new customers. Every company introduces many exciting offers for those who want to change their networks only and somehow they failed to meet the requirements of the old customers. Due to lack of attention, many companies lose their old customer. All attention was on individual promotion not for the whole members or social promotions. Using the social value of user community is one solution for the differentiation factors in the future. As the competitive condition around the mobile phone, market to switch from specific to standardized mobile phones is becoming severe.

Telecommunication companies in Pakistan

In contrast, Pakistan to be undertaking social promotions based on the high mobility of mobile phone users. In this region of the world, telecommunication industry is growing rapidly (Saeed, R.. Nisar, F., Lodhi, R. N., Ahmad,M., Arshad. M. 2013). Since 2004, after the deregulation, cellular market in Pakistan observed incredible development rates of over 170% and the trend is continuing to the present (Pakistan Telecommunication Authority, 2011-2012). Many companies became a part of this sector in the last decade and competing fiercely for the market share. The

total number of cellular subscribers is above 108.99 million at the end of the year 2012. The telecom industries are trying their level best to attract and retain the customers through several marketing skills.

In Pakistan there are five main telecom operators Zong, Warid, Ufone, Telenor and Mobilink which are offering GSM (Global System of Mobile services) and all of them are successfully obtaining their goals in their particular ways (Saeed, R.. Nisar, F., Lodhi, R. N., Ahmad,M., Arshad. M. 2013). In order to compete successfully in this situation, the mobile carrier companies have developed social promotion strategies that include the low fees in the air time rates, free friends and family calls, free SMS (Short Message Service), free credit and small top ups. Some time on different national or religious occasions like in December 25, many mobile carrier companies provide a free internet facility for all their users. There are so many examples of social promotions in Pakistan. The goal of such strategies is to not only beat the competition and retain the customers; it also attracts the new customers by offering the attractive packages.

Brand Switching

For developing the mobile phone industry well, it is difficult to make differentiation by promotions for individual. However, in Japan, currently the main strategy is price competition still because the device is well developed; traditional mobile phone market was low mobility of mobile-phone user. 'Switching Brands' has been widely used in the field of economics, psychology. This concept further implemented in marketing as well. By incorporating the influence of governmental economic policy, this work provides an integrated framework to analyze the experiences and significances of switching brands (Genesh et al., 2000: 65). Meanwhile, with the rapid growth of mobile phone market globally, consumer's switching brands should understand to compose an inclusive marketing strategy for players in the market.

There are numerous Models to investigate about the behavior of people. The convenient one described by (Dick and Basu, 1994; Sheeran and Abraham, 2003). Experience counted to be a way in order to make decision. The customer as its existing product but many companies has unsuccessful in understanding the market mix strategy. Numeral studies have investigated the advantage of customer-focused brand switching and their potential to achieve super results (Oliver, 1999; Russell-Bennett et al., 2007). Theoretically, it is important to investigate the building blocks of customer satisfaction and brand switching. As a substitute, the practical implementation helps to enhance the experience of customer in term of brand switching. This study particularly focuses on the importance of customer satisfaction with determinants on brand switching because the core objective of strategic marketing is the resultant of customer satisfaction (Jaworski and Kohli, 1991; Luo and Seyedian, 2003; Webb et al., 2000).

As there is positive impact of customer satisfaction on sustainability of brand (Howell, 2004), meanwhile, brand switching occur due to the decrease and increase in the satisfaction level and the willingness of the customer to purchase other brands is some time decrease and increase. Also supported by Trivedi and Morgan (1996) as well as Klein (2001) stated many examples where many loyal customers switched towards other. Motivation through Extrinsic and intrinsic factors may affect the brand switching. The major roles in intrinsic motivation are through choices and varieties (McAlister and Pessemier, 1982) or attribute satiation (Zuckermann, 1979). Also consequential behavior can also be the effect by curiosity (Sheth and Raju, 1974). If the goal of purchasing not achieved many consumers shift towards other brand (Van Trijp et al., 1996). Young adults easily switched towards other brands if they have limited income (Ness et al., 2002; Dick et al., 1996).Researches trigger out many crucial factors affecting the behavior such as price, variety and packaging (Ness et al., 2002; Dick et al., 1996; Veloutosou et al., 2004) involvement (Baltas, 1997; Shukla, 2004), and dissatisfaction (Abendoth, 2001; Shukla, 2004).

Social promotion

There is no doubt that the ultimate objective of every company is to create the certain level of sales and deliver such promotions that may create profit to continue the business activities. Every business develops the sales evaluation and develops the strategies to accomplish it, especially in the service industry. This is the serious link between the social promotion and customer loyalty. The social promotion and sales battle has created the need of continuously retaining the older customers and creating fascination for the perspective customers. The national and multinational companies are spending millions of the dollars to give a boost to the social promotions in the short time. The researchers of social sciences have a long debate on the influence of social promotion on the behavior of customers. The overall observation in social promotion is to motivate all consumers to act positively towards offering of company. The customers are satisfied and they will keep on purchasing the products even on the normal price.

Contrary to this, Dodson & Taybout, (2001) found that social promotion acts as an external incentive and there is less possibility that the customers will repurchase the products after the campaign is over.

Individual Promotion

The individual promotion is certainly very important. It may change the customer approach to purchase the product on the normal price. Price discounts may also encourage low-probability purchasers to try. Individual promotion is the strategy of a company to get new customers or when they observe one customer's last purchase history then they provide some discount and some promotions to those customers. Individual promotions are for short term and although at that time after getting exciting offer that customer will be satisfy but in business point of view marketers have to think for whole community not for only one (Gedenk, K., Neslin. 1999). There will be a negative impact on the brands worth if that customers still move to other company due to more exciting offer because price used as a measure of excellence for many service consumers.

Characteristics of Individual and Social Promotions

We summarized the characteristics of individual and social promotions (see Table 1).

Table 1: Characteristics of Individual and Social Promotions

No.	Factors	Company (X) Individual Promotion	Company (Y) Social Promotion
1	Target	Customers of (Y)	Customers of (X) and (Y)
2	Relationship	Short term	Long term
3	Method	On demand	Automatic
4	Effectiveness	Short term high, Long term low	Short term low, Long term high
5	Community size	Low	High
6	Customer satisfaction	Short term	Long term
7	Customer loyalty	Low	High
8	Customer retention	Low	High
9	Switching brand	High	Low
10	Risk	High	Low
11	Promotion	Only (Y)	Every one (X),(Y)

Research Questions and Purposes

This research collected to answer many questions as; Firstly, how can we develop balance of individual/social promotion in the high mobility of mobile-phone user? Secondly, what would be the impact when balance of individual/social will developed? Thirdly, mobile-carrier companies should understand customer preference for mobile phones and services rather than increasing the market share with the purpose to show that customer retention, satisfaction and loyalty are important goals for mobile carrier companies.

In today's low growth and highly competitive marketplace, customers are getting an important area of analysis and planning. It is very useful for the mobile carrier companies to recognize how their sales and social promotions campaigns stimulate the customer's behavior and the grade of the effectiveness of their activities in a specific way. It also conveys the importance for the policy makers and regulating bodies to make an understanding of the role of sales and social promotions in varying the behavior of the customer in this vibrant industry. It may provide support to the academic researchers to recognize the customer's behavior of the telecom industry by filling the gap in the literature by exploring the connection between sales and social promotions as well as customer's retention and customer's loyalty.

The main purpose of the study is to find how can we built a brand loyalty in the mind of customer in order to find that we are studying the dimensions of customer satisfaction which help us to find brand switching in services. This study based on how we can make customers satisfy by providing them social promotions in telecommunication industry. If customer is satisfied with the product or services then he or she will remain loyal to the product or brand.

Approach

We propose a model to compare the effects of two different promotions. The two different promotions are the individual promotion and social promotion. We apply the "Customer Poaching and Brand Switching"(Fudenberg and Tirole, 2000) to the individual promotion. Next, we extend the individual promotion model for competition of individual and social promotion effects. We focus on the welfare assistant promotion as one of a social promotion effects.

RELATED WORKS

Hotelling model (Hotelling, 1929) can express customers' behavior on location and product characteristics.

Fudenberg (2010) extended hotelling model for customer poaching. Definition of Customer poaching is “Attracting customers of their competitor by offering them price discrimination”. In this model, duopoly poaching under both short-term and long-term contracts assuming either that each consumer's brand preferences are fixed over time. Fudenberg mentioned, "Changing preference.” However, this setting of model is required more assuming for model.

Zhang (2011) is applying Fudenberg (2010) to "behavior-based personalization" by customers' purchase histories. She constructed a two-period duopoly model about personalization. Consumers have heterogeneous tastes and uniformly distributed on a hotelling line.

MAKING MODELS FOR SOCIAL PROMOTIONS

In this section, we construct models for representing effects of social promotion and individual promotion. First, we prepare the benchmark model using Hotelling Model (Hotelling, 1929). Second, we represent an individual promotion as a “customer poaching” by Fudenberg (Fudenberg and Tirole, 2000). Finally, we construct an individual plus social promotion model based on these basic models. The targeted social promotion is a welfare assistant promotion. We consider the promotion strategies how do manage customers within a variety of social structure. The point of the social promotion model is that we divide customers to three types: Low-income, Middle-income and High-income.

We believe that the next idea of a mobile-phone market in Japan is social promotions. Because of price competition is prevalent in current Japanese situation. Thus, we focus and propose the model considering social promotion effects. Naturally, we require the empirical research for the validation of the proposed model in the further research.

A Benchmark Model by Hotelling Model

We set two firms and n-period model based on the Hotelling Model (Hotelling, 1929) (see Figure 1). We prepare the condition of firm’s side and customer’s side. After we calculate the equilibrium by using neutral customer that they are not discriminate two firms. Finally, we get the position of the neutral customers.

In firm’s side, we set the Firm A and Firm B. Firm A provides service a. Firm B provide service b. These services are non-durable. The value of services is v. These prices of service are P. Service a and service b is constant, that is, they are not changed by time. The marginal cost of services normalized to Zero. Two firms act simultaneously.

In customer’s side, customer preference is represented by a line in [0, 1] on the x-axis (see Figure 1). The customers are bounded to use either service a or b on the every period. There are neutral-customers that are not discriminate service a and b. The preference of neutral-customers is x*. We use a uniformly distribution as a customer distribution function. That is, f(x) = 1 on the z-axis. Utility functions for firm A and B are,

$$u_A = v - t(x-a)^2 - P,$$
$$u_B = v - t(x+a-1)^2 - P. \quad (1)$$

Utility function represented by u_A and u_B. Parameter t is a transportation cost. Variable x is represented customers preference position on the preference interval [0, 1].

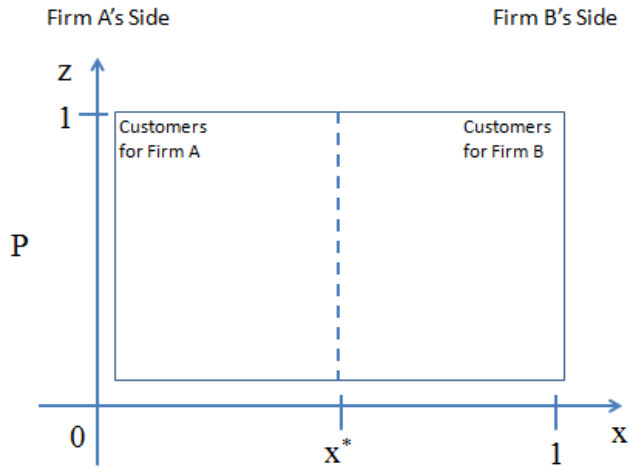

Figure 1. Concept of Hotelling Model. (Hotelling, 1988)

We focus on the neutral-customers x*. Neutral-customers are not discriminate service a and b, that is, each of utility function is same by x*. Therefore, with a – b is not zero,

$$v - t(x^* - a)^2 - P = v - t(x^* - b)^2 - P$$
$$x^* = (a+b)/2. \quad (2)$$

Next step, we calculate the profits of firm A and B. Profit π_A and π_B of firm A and B are, with the distribution function f(x) = 1,

$$\pi_A = P\int_0^{(a+b)/2} f(x)dx = P\frac{a+b}{2},$$
$$\pi_B = P\int_{(a+b)/2}^1 f(x)dx = P - P\frac{a+b}{2}. \quad (3)$$

Profit π_A and π_B are linear functions of a or b. By profit maximization, the value of a is maximum point in the closed interval. In equilibrium, both profit of firm A and B is same. That is,

$$\pi_A = \pi_B$$
$$x^* = 1/2. \quad (4)$$

We got x* is 1/2 and service a is close to 1/2 from 0 to 1/2 on the x-axis.

A Model for Individual Promotion

In this subsection, we consider an individual promotion by using "customer poaching" (Fudenberg and Tirole, 2000) extended from Hotelling model (Hotelling, 1929). Firm A and B conduct a price discrimination strategy for rival's customers (see Figure 2). The discount prices are P_A for customers in firm B's side and P_B for customers in firm A's side. Service a is close to 1/2 from the previous subsection. We add two utility functions to previous one,

$$
\begin{aligned}
u_{A1} &= v - t(x-a)^2 - P, \\
u_{A2} &= v - t(x-a)^2 - P_A, \\
u_{B1} &= v - t(x+a-1)^2 - P, \\
u_{B2} &= v - t(x+a-1)^2 - P_B.
\end{aligned} \tag{5}
$$

We focus neutral-customers from there as well. In firm B's side, neutral-customers is x_B^*. In firm A's side, neutral-customers is x_A^*. Therefore,

$$
\begin{aligned}
& v - t(x_A^* - a)^2 - P_A = v - t(x_A^* + a - 1)^2 - P \\
& x_A^* = \frac{P - P_A + t(1-2a)}{2t(1-2a)}, \\
& v - t(x_B^* - a)^2 - P = v - t(x_B^* + a - 1)^2 - P_B \\
& x_B^* = \frac{P_B - P + t(1-2a)}{2t(1-2a)}.
\end{aligned} \tag{6}
$$

Profit π_A and π_B of firm A and B are, with the distribution function f(x) = 1,

$$
\begin{aligned}
\pi_A &= P\int_0^{x_B^*} f(x)dx + P_A\int_{1/2}^{x_A^*} f(x)dx \\
&= \frac{-P_A^2 + PP_A + P(P_B - P + t(1-2a))}{2t(1-2a)}, \\
\pi_B &= P_B\int_{x_B^*}^{1/2} f(x)dx + P\int_{x_A^*}^{1} f(x)dx \\
&= \frac{-P_B^2 + PP_B + P(P_A - P + t(1-2a))}{2t(1-2a)}.
\end{aligned} \tag{7}
$$

We calculate the discount prices P_A and P_B by profit maximization,

$$
\begin{aligned}
& \pi_A'(P_A) = -2P_A + P \\
& \pi_A''(P_A) = -2 \\
& \therefore P_A = \frac{P}{2}.
\end{aligned} \tag{8}
$$

In the same way, the discount price P_B is P/2.

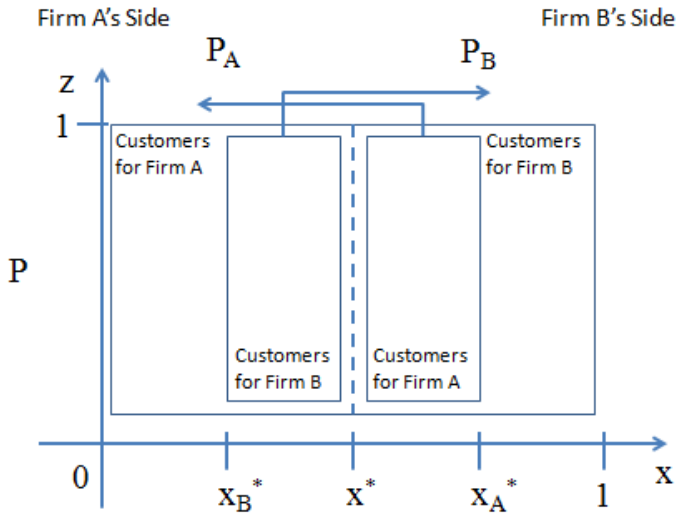

Figure 2. Concept of a Customer Poaching Model. (Fudenberg and Tirole, 2000)

A Model for Individual and Social Promotion

We proposed an extended model for representing effects of the individual and social promotion based on the previous sections. Here, we focus on the welfare assistant promotion as a social promotion. There are many social promotions. We believe that it is very important to discuss the welfare assistant promotion considering current economic situation all over the world.

We divide customer type as High-income, Middle-income and Low-income (see Figure 3). z_1 and z_2 represents the difference between customers, on the z-axis. Firms provide high value v_+ by Price P_+ to High-income customers. Firms provide normal value v by Price P to Middle-income customers. Firms provide low value v_- by Price P_- to Low-income customers. In addition, we add the social value V_S for representing the effects of social promotion to the previous discussion. C_s represents the cost of conducting the social promotion. The utility functions are, with $v_- - P_- = v - P = v_+ - P_+$,

$$\begin{aligned}
u_{A11} &= v_- - t(x-a)^2 - P_- + v_s^{(A)}, \\
u_{A12} &= v - t(x-a)^2 - P + v_s^{(A)}, \\
u_{A13} &= v_+ - t(x-a)^2 - P_+ + v_s^{(A)}, \\
u_{A2} &= v - t(x-a)^2 - P_A + v_s^{(A)}, \\
u_{B11} &= v_- - t(x+a-1)^2 - P_- + v_s^{(B)}, \\
u_{B12} &= v - t(x+a-1)^2 - P + v_s^{(B)}, \\
u_{B13} &= v_+ - t(x+a-1)^2 - P_+ + v_s^{(B)}, \\
u_{B2} &= v - t(x+a-1)^2 - P_B + v_s^{(B)}.
\end{aligned} \tag{9}$$

We calculate the profit based on previous subsections,

$$\begin{aligned}
\pi_A &= P_- \int_0^{x_B^*} z_1 dx + P \int_0^{x_B^*} (z_2 - z_1) dx + P_+ \int_0^{x_B^*} (1 - z_2) dx + \frac{P}{2} \int_{1/2}^{x_A^*} f(x) dx - C_S \int_0^{x_B^*} dx \\
&= (P_- z_1 + P z_2 - p z_1 + P_+ - P_+ z_2) x_B^* + \frac{P}{2} (x_A^* - \frac{1}{2}) - C_S x_B^*
\end{aligned} \tag{10}$$

.

Here, we set $P_{-}\, z_1 + P\,(z_2\text{-}z_1) + P_{+}\,(1\text{-}z_2) = P + C$ for cancelling the social promotion cost C_s. Therefore, neutral-customers x_A^* is,

$$
\begin{aligned}
& v - t(x_A^* - a)^2 - \frac{P}{2} + v_s^{(A)} = v - t(x_A^* + a - 1)^2 - P + v_s^{(B)} \\
& x_A^* = \frac{\frac{P}{2} + v_s^{(A)} - v_s^{(B)} + t(1-2a)}{2t(1-2a)}, \\
& v - t(x_B^* - a)^2 - P = v - t(x_B^* + a - 1)^2 - \frac{P}{2} \\
& x_B^* = \frac{-\frac{P}{2} + v_s^{(A)} - v_s^{(B)} + t(1-2a)}{2t(1-2a)}.
\end{aligned}
\tag{11}
$$

Profits of these firms are,

$$
\begin{aligned}
\pi_A &= P\int_0^{x_B^*} f(x)dx + \frac{P}{2}\int_{1/2}^{x_A^*} f(x)dx, \\
&= \frac{-\frac{P^2}{2} + 3P(v_s^{(A)} - v_s^{(B)}) + 2Pt(1-2a)}{4t(1-2a)}, \\
\pi_B &= \frac{P}{2}\int_{x_B^*}^{1/2} f(x)dx + P\int_{x_A^*}^{1} f(x)dx \\
&= \frac{-\frac{P^2}{2} - 3P(v_s^{(A)} - v_s^{(B)}) + 2Pt(1-2a)}{4t(1-2a)}, \\
\therefore \pi_A - \pi_B &= \frac{6P(v_s^{(A)} - v_s^{(B)})}{4t(1-2a)}.
\end{aligned}
\tag{12}
$$

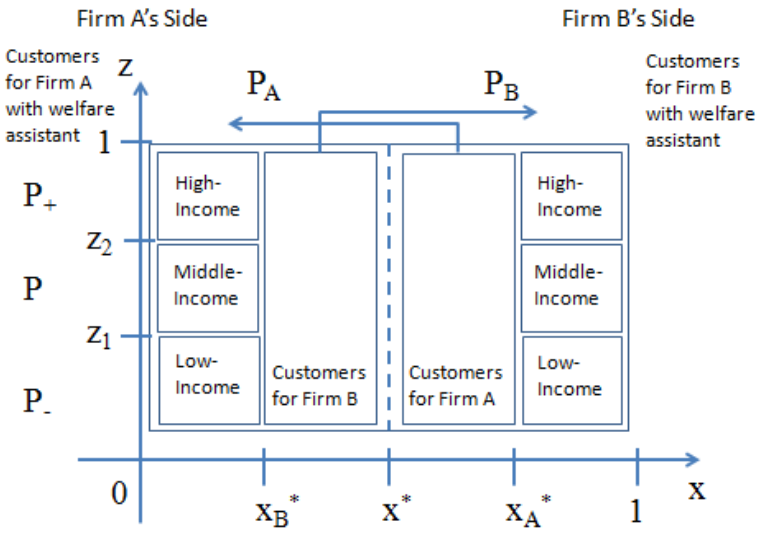

Figure 3. Concept of a Welfare assistant promotion

There are two different logics. The two logics are independent. First is "Customer poaching" which discussed previously in subsection. Second is "Welfare assistant Promotion" as concrete one of the social promotion cases. I divide existing customers of each firm to three types: High-income, Middle-income and Low-income customers. We think that the social values v_S is functions of time. We set the simplest forms for the social value v_S as following, a and b are parameters, t is a time,

$$v_S(t) = ct + d. \tag{13}$$

NUMERICAL SIMULATION FOR THE MODELS

Introduction

In this section, we aim to simulate the proposed model with focusing the change of social value $v_s(t)$. We set the actual number for the formula. First, we prepare the customer-poaching model as a benchmark. Second, we check the aspect of proposed individual and social promotion model.

As an output from this section, we got the matrix of change the parameter, t and appreciation rate c. The parameter c is increasing rate of social value $v_s(t)$. Naturally, we need to check by empirical researches. However, it is important to understand the mechanism of model for getting the results from real investigation.

In addition, we need to understand of social promotion effects. How do we evaluate the social value is the issue in current economy of all over the world. Our approach is one of them that how do we evaluate the social value.

A Model for Individual Promotion: No Social Promotion Effect

We check the difference between profits of Firm A and Firm B based on the section 3.2 (see Figure 4). Here, we set that P is 1, and a is 0.49, that is b is 0.51. We check the five periods.

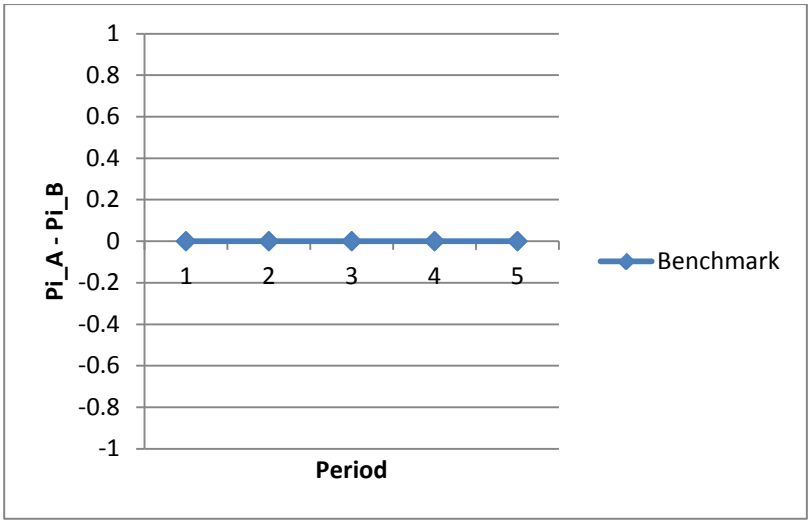

Figure 4. Benchmark: No Social Promotion Effect

There is no change in relation to the difference of profits. The reason is that the condition is equilibrium.

A Model for individual and Social Promotion

In this subsection, we add the social value based on section 3.3(see Figure 5). The parameter setting is the following: P =1, t =15, a=0.49, d=-0.5 and c = {0.01, 0, -0.01}. In Figure 5, A11 represents the both appreciation rate is 0.01. A21 represents the appreciation rate of firm A is 0 and one of firm B is 0.01. A31 represents the appreciation rate of firm A is -0.01 and one of firm B is 0.01 and so on.

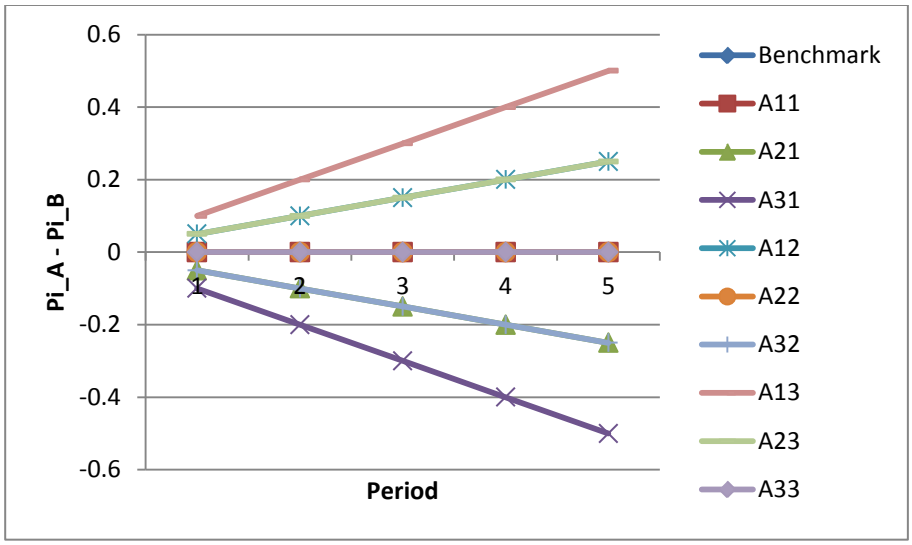

Figure 5. Simulation of Individual and Social Promotion Model

We got the nine (9) patterns of the results (see Table 2). In Table 2, "positive" means that the appreciation rate c is 0.01; "constant" means that one is 0 and "negative" means that one is -0.01

Note: The graph for numerical simulation show the difference of Firm A's profit and Firm B's one each parameter c. The c means appreciation rate of social value Vs.

Social Promotion Effect

		Firm B		
		Positive	Constant	Negative
Firm A	Positive	0	+	++
	Constant	-	0	+
	Negative	--	-	0

Table 2: 9 Patterns of Social Promotion Effect by Proposed Model

IMPLICATION

We find the equilibrium of individual/social promotion effect based on numerical simulation by which we provided some important insights, such as the dissatisfaction, felt by consumers has positively influenced the brand switching decision. Therefore, the company needs to review all factors that can increase customer satisfaction both in terms of product quality improvement, quality of service as well as in providing them promotions with no hidden elements. Marketers also need to communicate the quality of product and quality customer service to existing and prospective new customers. Due to the social promotions consumers, who are satisfied, tend to keep using the same brand and even invite other customers to use the same brand of product.

Marketers need to do new developments in their offered product, thus they can meet the consumers' needs and desires. We also find that social promotions affect the consumers' brand switching decision. It means that marketers need to know in certain forms how social promotion influence consumers' brand switching decision. Marketers must be able to influence consumer-purchasing patterns by conducting more attractive promotions programs for the whole community of members, such as bonuses, incentives, discounts and others.

CONCLUSIONS

We hypothesize that social promotions have long-term effects for the communities in relation to the service. Here, we showed the long-term effect of some social promotion strategy, a welfare assistant promotion, with dividing

three types based on a "positive," "constant" and "negative" effect. We believe that actual behaviors of long-term effects of social promotion are non-linear. Thus, we need to fit the behaviors of long-term effects based on empirical researches. This paper modifies the framework and tries to produce referential findings from the study of mobile phone market in terms of experiences and significances of switching carrier in Japan. These numerical results expected that this research would develop enhancement in understanding of switching brands or carriers for researchers.

Particularly in Japan there is less work done in the service sector like telecommunication. Thus, this study aims to cover the empirical gap in literature. Generally, our empirical findings have supported prior studies. The study finds consumer dissatisfaction affects positively on brand switching decision, which it means that dissatisfied consumers will try to find information on other products they consider and perceive have the added-value and in line with their expectations, and they may stop buying a product or influence others not to buy. We also find that social promotions positively related to branding switching decision. Meanwhile, the need of the variety seeking moderates the relationship between customer dissatisfaction and brand switching decision, which the presence of low level of need to seek the variation has weakened this relationship.

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Bringing Empathy in Service Network

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ABSTRACT

In this paper we present recent cases where human-centered designers apply empathic design approaches for public service development. The public service development nowadays involves a complex network in which multiple organizations from different sector need to collaborate in order to provide more holistic and effective solutions for citizens. Collaboration in this complex network, however, is yet very challenging. In this paper, we explore the mindset and tools of empathic design as a potential approach to overcome this challenge. Based on two pilot projects carried out with a large municipality in Finland, we shed light on opportunities of empathic design in three aspects: firstly, in helping service developers see a holistic picture of the complex service structure and at the same time view it from individual actors' perspectives; secondly, in engaging various actors in face-to-face dialogues and achieving a mutual understanding; lastly, in envisioning new ways of working in organizations through the small-scale experiments. These findings indicate new roles of empathic design for creating collaborative relationships in service networks. Discussions in this paper also include challenges of doing empathic design in public organizations.

Keywords: Service Design, Public Service, Service Network, Empathic Design, Organizational Change

INTRODUCTION

We see more and more cases in which public organizations apply design thinking and service design in public service innovation. Design has been indeed recognized as a potential discipline to enhance citizen's experiences with public service offerings and at the same time to ensure cost-efficiency of service development. Although both concepts being somewhat blurry, the core of design thinking and service design lie in human-centeredness, a holistic perspective to problem and an iterative process (for example, see Brown, 2009; Lockwood, 2010; Kimbell, 2011; Meroni and Sangiorgi 2011).

The situation, however, is not easy. Despite public organizations' interests, design is not recognized in a strategic level, and thus the impact remains in a small scale. In addition, human-centred and co-creation approaches of design are not easily embedded in existing practices in public organizations (Bason, 2010). At the same time, designers are also lack of competences needed to work with public sector (TEM, 2013). Nowadays the public service development involves a complex network that constitutes of various organizations and individuals, including experts in various functional departments, partners from different sectors and citizens. The object of service design is extending from customers' experiences at service encounters to a collaborative platform and service system where various actors could co-create new service concepts (Meroni and Sangiorgi, 2011; Patricio et al., 2011). Designer's challenges in this situation are then to understand a complexity of a service network, identify relationships of various actors and supporting their mutual understanding, and create a collaborative platform for the that is effective and citizen-oriented.

In this paper, we explore potentials of 'empathic design' for dealing with the abovementioned challenges. Empathic design was originally developed to enhance designer's understanding of users in user-centered design, especially with the notion of 'design for experiences' in early 2000s (Fulton Suri, 2003b; Koskinen et al., 2003; Leonard and Rayport, 1997). Designers unfold the empathic design process where users could reflect on and express their personal experiences through visual, narrative and creative tools. Designers closely follow this process, in order to get access to how users feel and make sense of the world. In this paper, we introduce two cases where the empathic design approach was applied for public service development in Finland, expanding their role into bringing empathic understanding in a complex service network, beyond a dyadic relationship between users and designers. We will firstly review key principles and tools of empathic design that have original roots in design for experiences. Then we will look into current challenges of public service development in its complex network reported from earlier studies. The case studies will follow to illustrate how various empathic design tools can be applied to collaborative settings of public service development. We then discuss opportunities and challenges of doing empathic design in public service network based on the follow-up interviews with the project participants.

EMPATHIC DESIGN

In late 90s, people's emotions, subjective experiences and dreams and their links to design were addressed as key design topics (for example, Fulton Suri, 2003a; Jordan, 2000; Sanders and Dandavate, 1999). These human qualities are challenging to capture or pin down, and strongly bounded in contexts that are heterogeneous and dynamically changing. The cognitive, rational approach to users provides little support for that: A more holistic, embodied, social and interpretive approach was required. Empathic design emerged from this need, foregrounding human's empathic ability to understand another person's feelings and experiences as central for design. In contrast to 'scientism' and a cognitive approach in user-centered design, empathic design builds on an interpretive approach for making sense of how other human beings experience the world, with their bodies (not just the mind) situated in their own socio-cultural context (Koskinen and Battarbee, 2003).

One of the early writings on empathic design comes from the field of marketing. Leonard and Rayport (1997) framed empathic design as gathering ideas through observing users in situ. Very recently, Edvardsson et al.'s (2012) provided a good review on methods for customer integration in the service development, describing users as "a potential goldmine of information for service development, not only in the idea generation phase but throughout the development process (p.439)." While emphasizing the importance of customer integration, their view on empathic design is yet narrow in comparison to the contemporary empathic design practice and mindset. Although observation has been one of the key methods for understanding users in context, the array of methods is wide and collaborative approaches with empathic twist are gaining ground.

Having a shared ground with ethnography, empathic design goes beyond that. The empathic design mindset and activities are design-oriented, aiming to envision 'what is possible' in the future based on the understanding of 'what it is now'. Tools used in empathic design thus often involve visual, tactile and creative components that help users project their experiences, imagine 'what if' questions, and envision the desired future. A core belief is that human experiences and emotions are not something that can be 'mined' and represented as bullet-point lists of user specification. Instead, they can be reflected through the process of visual, narrative or tangible creations (Sanders and Dandavate, 1999). Designers closely follow users' creation process and build iterative dialogues with users to interpret their creations and responses together. The method of empathic probes, for example, unfolds a continuous dialogic process between designers and users: designers create tangible probe kits and deliver them to users, and users respond to them in a self-documenting manner (Mattelmäki and Battarbee, 2002). The process often continues with designers and users meeting again and interpreting the probe returns together. In so doing, designers accept their subjective position as human beings and balance their subjective interpretations of users with the objective reasoning (Koskinen et al., 2003). This helps to reduce the scientific gap between users and designers and to avoid the risk of user abstraction (Gaver et al., 1999; Gaver et al., 2003).

As co-design becomes popular in many business and organizations (Mattelmäki and Sleeswijk Visser, 2011; Sanders and Stappers, 2008; Steen et al., 2011), empathic design has also evolved towards co-design, providing tools and mindsets for diverse experts, beyond and in addition to users, to come together and collaborate creatively. While there are many variations of co-design (Mattelmäki and Sleeswijk Visser, 2011), the core belief is that people with no design training must contribute to design activities, be they users or stakeholders. Co-design processes support people with no design training to have empathic understanding of the existing situation and create ideas for the

future – i.e. to become empathic designers on their own-, and the task of professional designers is to facilitate this process (Mattelmäki et al., 2014).

Co-design built heavily on collaborative workshops that brought together many kinds of stakeholders in different stages of the processes. This shift from users to a wider set of stakeholders and partners beyond product development context broadened the array of research topics from products to systems, to organizations, and to networks behind organizations. One of the main research programmes has been in exploring how to achieve a shared understanding among different stakeholders in networks and how could tools and mindsets of empathic design be found useful and applied in co-design and it applications. For example empathic design also explored design games (for example, Vaajakallio, 2012) and designerly approaches in the public sector (for example, Keinonen et al., 2013).

RECENT CHALLENGES IN PUBLIC SERVICE NETWORK

Recently public organizations are recognizing that the bureaucracy is no longer a steering wheel that can solve complex problems in a current society (Winhall, 2011). They seek alternative approaches that can provide a solution-oriented platform for multi-disciplinary professions' collaboration and place everyday people's experiences at the center. Design is recognized as a potential discipline to meet these needs. Public organizations increasingly collaborate with design consultancies or universities to incorporate design thinking and service design in their internal systems and processes (for example, Bason, 2010; World Design Capital Helsinki, 2012; European Commission's Innovation Policy).

Service development in a municipal context is characterized by multiple actors from different departments, and constraints and drivers that are political and organizational (Hakio and Mattelmäki, 2011). Coordinating their collaboration and making sense of such complexity are important. However, public organizations often have isolated departments ('silos'), in which employees tend to focus on only a part of the service or an internal process (Steen et al., 2011). Different departments of a public body are used to function within their own silos rather than contribute to cross-functional collaboration projects. Furthermore, service systems are typically constructed with a number of organizations and individuals in a network, from various public service providers to private and third sector ones, from the ones who make decisions on service offerings to frontline staff members and end-users. The end-users can be regarded as a group of several people, such as a family with members having different needs. This isolated organizational practice and complexity of the service network make it very challenging to achieve an effective collaboration.

In this situation, we see empathy as a potential element to tackle these challenges for following reasons:

Firstly, the empathic tools could bring end-users' experiences to service developers and providers, for example, policy makers and various experts in organizations. As Wright and McCarthy (2008) explain, this can be achieved in two ways: a dialogue-based approach and a narrative approach. How these two approaches are taken can be explained with an example of different settings of co-design workshop. In a dialogue approach, empathic designers organize co-design gatherings, typically in a form of workshop, where service developers, partners and end-users meet face-to-face and are engaged in direct dialogues through visual and creative activities. In a narrative approach, empathic designers facilitate indirect user involvement guided through various kinds of tools such as representations, narratives or role-playing (Wright and McCarthy, 2008).

Secondly, it unfolds a creative collaboration setting for various experts from different departments in public sector to meet and build a shared understanding. In existing ways of developing public service, they do not necessarily meet together. In the empathic design process guided through visualization, three-dimensional modeling or role-playing, they come to realize different perspectives and conflicts. And by going through the identified conflicts, they could achieve a mutual understanding of each other and a shared goal. In the context of public service development, end-users' experiences can provide a ground for the service developers and providers to focus on and build a shared goal.

Lastly, in line with the abovementioned potentials, empathic design could bring changes into organizational practices and culture. Empathic design aims to resonate with people's feelings and attitudes, rather than addressing

only rational thinking. Visual and tactile components involved in empathic design tools could help employees in public organizations and partners realize their existing ways of working and assumptions so that they can reflect on them.

The organizational change through empathic design is a long-term process, though. Junginger and Sangiorgi (2009) explain that changing work patterns and mindset, and organizational norms and culture involves resistance and requires a long-term plan that consists of small-scale experiments and pilot projects. According to them, small-scale pilot projects can have a fundamental role to open the way to transformative changes, in a similar way to prototypes in a design process.

In following sections, we describe a series of small-scale design experiments as part of a bigger development project carried out with a municipality in Finland. Through these case studies, we unpack benefits of empathic design in public service network, especially in terms of the above-reviewed challenges.

DOING EMPATHIC DESIGN WITH A MUNICIPALITY

Case 1: Orchestrating Different Perspectives through Design Games

Case 1 is one of pilot projects of a large municipality in Finland (later refereed as the City). The umbrella aim of the City is to create internal and external networks, which could support innovation driven by users at service encounters, including service partners in companies, frontline staff members and end-users. Public organizations more and more outsource to, and collaborate with, companies or community organizations for developing and offering services in a more effective and customized way. Thus it is very important to create a collaborative service system among public organizations, private companies, other relevant partners and end-user citizens.

The Case 1 describes the first pilot project for achieving the City's goal. The focus of this pilot project, titled as the 'Service Journey', was to improve the service offerings and systems for small and medium-sized entrepreneurs in a social and healthcare area. The City was interested in design thinking and innovative methods for planning and facilitating collaboration with various stakeholders in the area. The 'Service Journey' project was launched as a joint effort with university research teams. The university research teams introduced co-design approaches with the empathic design mindset to challenge the conventional work culture of the City departments. Three co-design workshops were conducted, involving social and healthcare business entrepreneurs (customers), employees in the City departments (developers and providers), and other relevant partners such as service design consultancies to which the City has outsourced design work.

The goal of the first two workshops was to gather information and experiences from the current situation and to map out the expectations towards the new Service Journey project. The first workshop focused on social and healthcare entrepreneurs and there were fourteen entrepreneurs attending the session. The second workshop was organized for the employees of the City and ten officers participated in the workshop. In the third workshop, both parties, ten officers and fourteen entrepreneurs, were brought together to discuss and negotiate current issues raised from the previous workshops and to envision an ideal collaborative model and a service system and journey.

The biggest challenges appeared even before the workshops. The project team realized that there was a lack of communication among the project participants, not only service stakeholders but also the project researchers. In addition, unfamiliar terminologies used in the administration or in the design approach caused communication problems. It was thus imperative to understand each other's status of knowledge and expectations and build a mutual goal in the project. Therefore, the university design research team created a big poster of a stakeholder map, and different parties in the project team wrote time their expectations on the map. Through this exercise, the project team was able to understand each other's expectations and roles much better, which led to set main objectives and scope of the project. This stakeholder map, visualizing the whole network and relationships, also helped the City employees realize missing parties who should be involved in the project.

Figure 1. Stakeholder map created by the project members for a mutual understanding before the project (photo courtesy: Hakio and Mattelmäki 2011)

Another big challenge was to introduce empathic design tools to the project participants, especially the City employees. The City employees were not familiar with visual and generative tools, which could look far from a serious job. They had difficulties to draw a clear picture of the procedure and expected outcomes from the empathic design process, as they are used to take actions when the procedure and the expected outcomes are clearly defined. This gave them insecurity and skepticism towards the design tools. When co-design sessions were introduced through pictures and powerpoint presentations, the City employees had impressions that they look like a childish kindergarten play rather than professional and productive working. Issues related to trust towards facilitator's competence, risk of losing individual's credibility and face in the eyes of fellow co-workers, and fear towards unfamiliar methods emerged, too. The design research team then decided to organize a small exercise for the City employees to have hands-on experiences of those methods. The exercise partly clarified what would be done but the feeling of uncertainty was still present until the actual workshops were started.

All three co-design workshops were designed based on the design game structure (Brandt, 2006; Vaajakallio, 2012). Structure of rules of the design game, such as turn-taking rules or random effects, could challenge the norms of traditional meetings in the City organizations and encourage equal participation. In addition, the physical setting and interactions of design game were to encourage a playful and out-of-routine atmosphere, which could help the participants think and act out-of-box (Vaajakallio, 2012). As Sanders and Stappers (2008) framed design components as a 'shared language' in co-creation setting, the visual representations and tangible props used in the workshop could provide a shared language for various experts to express their perspectives and knowledge.

In the co-design workshop where the City employees and service customers gather together, the university design research team created a 'Service Journey' game. The game board was made based on the service structure, divided into three areas of the front stage, the encounters, and the back stage. The game board itself can be seen as a simplified application of the service blueprinting (Bitner et al., 2008). This was to help the participants deal with a complex service structure by walking through the game board with tangible props, such as cardboard human figurettes or image cards.

Figure 2. Service Journey game in co-design workshop (photo courtesy: Hakio and Mattelmäki 2011)

The cardboard was to represent various actors in the service network. The workshop participants gave the figurettes names and personas like “Ollie the Officer” or “Ellie the Entrepreneur”. They placed the ‘character’ on different sections of the game board, while discussing various topics together. The game also included visual props in forms of photo cards that could be used as placeholders of metaphors for the service development e.g. lighthouse. They also made notes on cards about various actors’ experiences, perspectives and concerns and place them on the game board. We found that this service journey game helped the participants have a holistic view to the complex service structure, otherwise hard to grasp. At the same time, walking through the service structure with the persona figurettes together with other participants helped them understand the service structure and the journey from individual actors’ perspectives.

Case 2: User’s Experiences as a Shared Ground through Empathic Probes

Our second case is another small-scale experiment with the City, which continued after the first case. This project, titled ‘Client-centred Service Network’, had three aims; firstly, to develop an individual-centred care managing system that aims to shift the focus to the client’s perspective: secondly, to experiment personal budget planning that would give more freedom for citizens to choose relevant services; lastly, to create a new kind of service network at the local environment that would support both aims above and at the same time create synergies between the local entrepreneurs and other actors.

The project focused on senior citizens services, especially in care families in which one needs care, for example, has dementia, and the other is officially named as a caregiver. These families are entitled to financial support for particular services that have been decided by the municipal care manager. The aim of this project was to create a system in which various services can be more flexibly offered from the network of public and private sector as well as third sector. It was to help families find a relevant service from the complex ‘jungle of service’. In the long run, the project aimed to empower families to better manage their own wellbeing, being introduced with multiple options and flexible systems.

In the beginning of the project, the external service design consultancies provided written persona descriptions and video clips of families for the project participants to understand needs of service customers. However, the university design research team found that these kind of representations have limitations to bring family’s everyday experiences, concerns and dreams to the service providers, especially when a system and a context of service offerings are complex. For example, the development of social and healthcare services for seniors can also consider their easy access to transportation such as taxi services. The university design research team introduced empathic probes (Mattelmäki and Battarbee, 2002) for more intimate and personal dialogues with them. The City employees from various departments were involved to design the probe tasks and questions. In this making process of empathic probes, the project teams were able to coordinate their objectives and interests, too. The probes kits consisted of a diary, workbooks with mapping exercises, drawings and writing stories to open-ended questions, such as;

- *I am exhausted. From where could I get support for my wellbeing?*
- *The ground for wellbeing, what is it made of?*
- *Things that keep my spirit lively*
- *Things I want to do in my life*
- *I miss from my past…*
- *Our hobbies and interests before and now*

The probes kits were filled by volunteering care families. The families expressed their everyday routines, joys, opinions and challenges in a surprisingly honest and touching way through the empathic probes. For example, some family carers even revealed issues that were difficult to speak aloud such as feeling of being a ‘prisoner’ at home, or the sadness of seeing the character of a spouse transforming into unfamiliar. The probe returns revealed that the service network appeared to the families quite fragmented.

In addition to the abovementioned tasks for collecting users’ everyday lives, the probes workbook also contained short stories that describe ideas for future services, which have been discussed within the City. The stories presented service ideas such as the digital service platform, new service interactions with care managers and the service card. The service card was actually prototyped with cardboard paper and included in the probe kits to help the care families imagine how it would be like to use the service card like a credit card. In this sense, the empathic probes in this project served as a vehicle to introduce possible service ideas to the customers and collect their responses to

them early on.

To share the insights from the probes returns and generate future ideas based on them, a co-design workshop was organized by the university design research team. The care managers and various stakeholders in the service network participated in this workshop. For the co-design workshop, the university design researcher made drawings of the everyday life of the families to communicate emotional aspects of the care families in a more vivid and empathic way. The drawings aroused emotional responses from the City participants and made them rethink what were the real needs of the families. These drawings and other visualizations made out of the probe returns functioned as shared grounds and languages for different parties to set a shared goal and generate ideas together.

Through the collaboration with the families through the probes, twofold roles of the empathic probes were identified: Firstly, the process of probing helped the families to open up both more general and specific challenges and to prioritize and point out the kind of services they needed; Secondly, the probing also supported the municipal care manager to see the reality beyond the official and professional viewpoint and adjust the service offering accordingly. In the evaluation report of the project, the probes were seen as the most innovative opening towards new practices in service development. Currently, based on the probes experiment, the tool and the process, named as *service probes* have been adjusted according to the feedback. The tools have been used in 33 families and the aim is to spread this practice wider in the future. While the probing activities as such did not support the whole network, it concretised the human-centeredness in the large service network and the potentials of design approaches for rethinking what is meaningful (Fulton Suri, 2003b).

OPPORTUNITIES AND CHALLENGES OF EMPATHIC DESIGN IN PUBLIC SERVICE NETWORK

After these two projects, the follow-up interviews were conducted to investigate how the project participants, especially the City employees, evaluated the project and what kinds of influences the projects created. In this section, we discuss opportunities and challenges of doing empathic design in public service network based on our observations during the projects and the interview results. The interview quotes presented in this paper were originally in Finnish but translated in English by authors.

Holistic and Tangible Understanding of the Complex Service Network

In the Case 1, we found that the design game structure with visualizations of the service structure, the persona figurettes, and interaction rules helped service developers see an overall picture of the complex structure of the public service. What is more important, they were able to understand the service structure not just through rational reasoning from the bureaucratic perspective, but rather through immersed experience from various individuals' perspective. This immersed, empathic understanding in a make-believe setting of the design games and props has been reported in recent studies on empathic design (for example, see Mattelmäki et al. 2014, Vaajakallio 201). On one hand, the visualization of the service structure as a game board enabled the service developers to make sense of how the current service system functions and various actors interact in the system. On another hand, their actions of touching and moving tangible human figurettes around the make-believe setting while discussing roles of various actors and their experiences, allowed them to indirectly experience the service structure through individual humans' point of view.

Bringing Customers' Experiences in the Network as Glue

In the Case 2, the City employees were able to have a better understanding of what actually matters for the care families and how they experience the existing services. In the follow-up interview, one City employee talked about the strengths of the probes kits and his motivation to use it in his future work.

> *"In these probes kits I found several issues from familiar customers, which I did not know before, even though I have worked with the customers. The probes kits helped to better understand the customers' real situations. When the social department of the City offers services that the customer does not want, a tool like the probes can help in understanding the reasons why. (an employee from social services department of the City)"*

In the further process that followed the probes in the project, customers' stories and experiences brought by the probes provided a shared ground for the City employees and other stakeholders to make decisions together. For example, in the co-design workshop after the probes, idea generation and elaboration oriented to customers' experiences. In other words, this shared understanding of customers worked as glue for collaboration in the service network.

Towards a Creative Collaboration Platform

In the development of public service network and offerings, it is crucial to bring the 'backstage' components for planning. In the two case studies, the empathic design tools proved useful to bring people from different organizations together, challenging the organizational boundaries and breaking the existing professional conventions. As one of the most meaningful benefits, according to the interviews, the co-design workshops created a collaborative platform that engages various people in face-to-face dialogues. It brings people together. These people had not necessarily met during the decision-making processes in their traditional practices. One manager from the City expressed her wish for more face-to-face meetings with other departments.

> *"We should gather more often with the other departments. There have been only a couple of sessions of management's education (with the aim of developing the cross-functionality). Already before it was seen problematic that the middle management does not meet each other. Middle management, however, is the unit that operates things in the city…There does not exist a forum for departments' middle managers to socialize, where they could exchange experiences and familiarize with the practices of other units. Many things could have been done in a more agile way if we knew what the others were doing (a service manager from Social Services Department of the City)."*

In the Case 1, the design game provided an opportunity for various people from different organizations and status, with different knowledge, to meet together and bring their voices to the table. The service users – i.e. entrepreneurs, and the employees of the City were given a chance to express their opinions and created shared goals. The structure, rules and props of the design game encouraged an equal participation among project managers, the City employees and business entrepreneurs. The open and creative atmosphere of the workshop setting faded the formal roles and built informal roles (Hakio et al., 2011). When the participants from different departments of the City became familiar with each other, they were able to start discussing the concrete proposals for improvements rather than concentrating on accusing different parties about the problems of the current situation. As a result of these discussions, the participants identified other missing parties that should be involved in the project, such as politicians and higher-level decision-makers.

Resistance and Skepticism

While seeing potentials and interests, the two case studies revealed the resistance towards empathic design approaches in public organizations and their skepticism of applying them in their everyday work. The mindset of empathic design that is experiential, human-scale, experimental and iterative is still foreign to most people working at public organizations. This observation also resonates with the challenges recently reported from collaborative design projects with public sector (for example, see Vaajakallio et al., 2013).

Time pressure also challenged people's ability and willingness to participate. Furthermore what is once experienced as fresh and innovative does not cause similar reflections if used routinely. The issues of how to motivate the employees to participate in such collaborative activities from the first place and whom to involve were also addressed in the interviews;

> *"A system where official invitations are sent from the upper level does not work any more. Then it leads to having people involved that are not interested in the project, but they come to sit in the meetings because of their position. Position does not lead to engagement but interests in doing together and making changes do. People who are enthusiastic and bring their own competences are needed (a project manager from Social Services Department of the City)."*

In everyday practices in organizations, it is easy to go back to the conventional way of working to deal with tasks at hand, as one of the City employees well puts it;

"I have felt that people would like to do more but they face some self created guideline or regulation that prohibits doing it. People would like to be involved but then you face that we cannot do this or this is not our basic objective. Or, that there are no resources."

CONCLUSION

In this paper, we discussed how empathic design tools could be applied to the development of public service network through two case studies. Extending from their original aim to enhance designers' understanding of users experiences in a dyadic relationship, the potentials of empathic design tools for enhancing mutual understanding and solution-oriented collaboration among different parties in the service network were discussed. In the two case studies carried out with the municipality in Finland, empathic design in form of a co-design workshop could unfold a physical setting that different parties meet and have face-to-face interactions. Empathic design tools like the empathic probes brought users' experiences and stories to the collaboration setting so that the service developers and partners could have a better, 'empathic' understanding of their customers and use this understanding for collaboration.

In addition, we also aim to explore empathic designer's new role as a facilitator for empathic and creative collaboration in complex service networks. Although we see potentials and opportunities, doing empathic design in public sector and networks around it is still very challenging as our observations indicated. To enable a change in public sector and its collaboration with other partners to a more human-centered and creative way, designers should have better strategies and knowledge of how to bring changes to organizations. Collaborative projects with public sector, like the two case studies presented in this paper, can be considered as experimentation for designers (Sangiorgi, 2011; Junginger and Sangiorgi, 2009).

As Junginger and Sangiorgi (2009) suggest, the changes can start from artifacts level. Adopting tools might be a small change in a peripheral level, but as the experiences accumulate, it can also continue to bring more fundamental changes in their ways of working and mindsets, and in the long run, organizational culture. In addition, it was not only for the public sector to try out service design, but for the designers to become familiar with the organizational process in public sector, gain trust and become part of a network.

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Human-Centered Design: Integrating Systems & Services around People by Providing a Common Ground for Action

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ABSTRACT

Service engineering and service design, though distinct in their origins, theories, concepts, methods and practices, share that they are both consequential productive arts for people who depend on their outcomes. The ideas, methods and practices of human-centered design are therefore relevant to both professional fields. Yet, how human-centered design is being practiced and applied depends on the interpretation of the concept, or the "designer's stance" (Buchanan 2011). In this paper, I trace the shifts in design thinking and the role of people in service engineering and in service design. I argue that human-centered design challenges the systems view of service engineers and service designers and requires them to reach out to each other. For this reason, I conclude that for these two disciplines, human-centered design provides a common ground for purposeful action: to arrive at the best solutions that work for people inside and outside of organizations and to conceive of, plan and deliver services that embrace the full human being, not merely a person's purchasing power or cognitive abilities.

Keywords: Service Engineering, Service Design, Human-Centered Design

INTRODUCTION

"The walls between art and engineering exist only in our minds." – Theo Jansen

Service engineering and service design, though distinct in their origins, theories, concepts, methods and practices, share that they are both consequential productive arts for people who depend on their outcomes. It is therefore not surprising that the ideas, methods and practices of human‐centered design are inherently relevant to both professional fields. One can argue that service engineering has emerged within the organizational context whereas service design has slowly entered into organizations from the outside. Service engineers are more likely to be in touch with members inside an organization and may have fewer contacts with the very people an organization tries to reach. Service designers, in contrast, can be seen working with "end-users", customers and other people who seek to make use of an organization in one way or another. Service designers have only recently started to engage with the internal complexities and realities of organizational systems. The concept of human-centered design is relatively new to both fields. To embrace human-centered design presents a significant shift for both professions in how they

think about, approach, develop and deliver services. Why and how this is the case, requires some discussion and reflection on the meaning of service in service engineering and in service design. We can also gain some insights by inquiring into the kinds of problems service engineers and, respectively, service designers, are concerned with. How does each profession talk about people? How do they engage them? I have turned to key literature in both fields to find some answers. In my search, I have intentionally focused on the 'professional discipline' of service design and not more broadly on the design of services. In my mind, this is an important distinction because when we inquire into the design of services, we have to consider a much longer and more diverse history that includes, for example, the design of services in the public sector and in government (Junginger 2012). Once we have achieved more clarity about how service engineering and how service design approach services and service problems, we can explore what and how human-centered design might contribute, if anything, to both professions.

ON THE MEANING OF SERVICE & THE NATURE OF SERVICE PROBLEMS IN SERVICE ENGINEERING & SERVICE DESIGN

Service and Service Problems in Service Engineering

The discipline and profession of service engineering has formed around ideas of optimizing service operations (Salvendi & Karwowski 2010). These efforts were informed by theories of systems engineering and early systems theory, which focused on matters of system optimization. The character and nature of the problems service engineers have concerned themselves with most fit the category of "tame" problems described by Rittel & Webber (1973). These are problems that allow only for "one best answer", or an "optimal solution." Service engineering emerged as a discipline within organizations and within businesses to address issues of workflow, processes and tangible systems. It builds on knowledge and theories developed in the engineering sciences, including systems engineering theories. The idea of "service" evident from early service engineering studies and practices, is to service a system like a mechanic services a car. The principle of optimization calls for identifying the optimal balance between physical forces, natural laws, and predictable human behavior. The service for people is to provide a car that moves or, respectively, an organizational workflow or other process that moves smoothly and automatically in the background. To achieve this, a service engineer needs to have a good grasp of the system at hand–its physical elements like handles, cogs and wheels but also transportation and technical laws in a literal and metaphorical meaning. People do play a role in this service interpretation. Like the owner of the car, they receive instructions how to maintain the car, to keep it running and in good shape. People's behavior, whenever possible, is studied and quantified to express human behavior in terms of probabilities that can then be used to predict future behavior. In service engineering, people serve the system so the system can do what it needs to do, which in turn constitutes a service *to* people. With the advent of service science, a more balanced and more integrated service concept has emerged. One of the field's journal's, "Service Science", defines service science as follows:

> "Service science is the emerging study of complex service systems. It involves methods and theories from a range of disciplines, including operations, industrial engineering, marketing, computer science, psychology, information systems, design, and more. In fact, it often requires more than the application of individual methods from any single discipline. Effective understanding of and innovation in service systems often require combining multiple methods to consider how interactions of people, technology, organizations, and information create value in various contexts and under various conditions."[1]

Although service science embraces a different systems perspective, one that "involves methods and theories from a range of disciplines," the purpose of the design activity remains solidly rooted in the value creation paradigm. Naturally a service ought to create value to a person, yet the human aspect of the value creation is not specified or explicit in service science any clearer than it is in service engineering. The focus of study and research remains the "service system" of which people are but one of the elements that possessing attributes, limitations and behaviors in the same way a fiber cable or software system does.

[1] Service engineering: The Product is in the foreground, the Leistungsbündel (capacity bundle); the technology, the process, the (http://link.springer.com.proxy1-bib.sdu.dk:2048/book/10.1007/3-540-29473-2/page/1).

Service and Service Problems in Service Design

Early service design theories –for example, the Service Blueprint by Shostack (1984) – are actually quite similar to some of the theories in service engineering: They are more concerned with the "engineering" of the system than with conceiving of the kinds of services that center on people. Service design originally formed around transactional service experiences (Bitner et al 1990), which researchers referred to accordingly as "encounters" or "touch points" (cf: Shostack 1985; Czepiel, Solomon & Surprenant 1985). The initial problem for service design was therefore to design for smooth transactions –more so than for human interactions. The transactional service model can be traced directly to the theories around the transaction cost approach in the economic organization developed by Oliver Williamson (1981). Services in the transaction cost approach have a different role than services that concern themselves with human relations or human interaction. In the transaction model, customer intimacy becomes a strategy to reduce transaction cost for the organizations (cf: Langenkamp 2010) and can present an eerie and almost creepy rationale of getting close to people: to invade people's privacy for corporate gains. This transactional view of service design is also expressed in the concept of 'servucation', a term that combines the two words service and production. Servucation has been introduced by Eglier & Langeard (1987) and refers "to the production and delivery of services" (Gummesson 1990).

There are several indications that transactional service experiences struggle to meet the criteria for holistic and integrative design approaches pursued by human-centered design: Aside from segmenting interactions and experiences into isolated encounters and touch points, the design of transactional service experiences rarely captures a person's needs and desires beyond known market relevant characteristics. Most service design research therefore focuses on "customer" or "user" needs and experiences of a specific service encounter or touch point. The basic challenge of a service is to make it interesting and relevant to people. A service, like any other product, then has to convince or persuade a person that it is something that person can benefit from. Persuasion can be done in different ways, either by seduction, force, or by presenting a clear value proposition of what this service entails and provides. The closer one can get to the customer, the more one can know about a person, the more one can target advertising and specific products and services. Service design has to begin to deal with unsettling questions of when and where it concerns privacy issues and when and where it wants to serve business interests and where it is concerned with services for people, communities and societies. Most importantly, services that seek to get closer to people have to earn and maintain people's trust. That this is a problem for pure service providers has become obvious by the data gathering and data sharing activities of companies like Google, Facebook, and Twitter.

We can summarize that the original meaning of services in service design focused on adding value to consumer goods and on adding value to organizations. In other words, services were perceived as tools to maximize sales and to tie existing customers to a specific product. The purpose of these services was not so much to support and empower people but more so to reduce cost for organizations: for example, by strengthening their bonds with existing customers since this is more cost efficient than generating new customers. Although the resulting services sought to engage people, they have often done so uncritically– serving the organization better than the people the organization needed to reach and engage.

ABOUT SERVICES, SYSTEMS & SYSTEM INTEGRATION

One of the most obvious commonalities between service engineering and service design is their concern about systems. The idea of systems is pervasive and ubiquitous in the engineering sciences as it is in design studies (cf: Archer 1965; Simon 1969, Alexander 1964). Both the service engineer and the service designer are concerned with identifying, defining patterns and shaping relationships. Both deal with connecting "parts" and "wholes", and their work ultimately gives form and expression to some "thing", be it tangible or intangible. However, what we view and understand systems, that is, what we consider to be part of a whole and what we exclude, is often a matter of training and education. Service engineers are trained to pay attention to aspects of a system that concern optimization to keep a system running smoothly. The core of their theories is geared to ensure smooth system operations. Service designers, on the other hand, tend to be trained to pay attention to the flow of experiences, a concept introduced by Csikszentmihalyi (1990). This means that both professions are basically concerned with system integration. In the words of Richard Buchanan, system integration is a Fourth Order design problem (Buchanan 1995). Buchanan suggests that the plurality of design problems can be understood when we think of them as problems of communication (first order design), as problems of construction (second order design), as problems of strategic planning (third order design) and as problems of systems integration (fourth order design). The point of the Four

Orders of design is that we can find different interpretations and roles for design along different lines of practices. We can also use the Four Orders of design to reflect on how we experience and engage in systems differently with different design activities.

When we use the Four Orders of design to make sense of the systems view in Service Engineering and in Service Design, we quickly find that despite their respective concern about system integration, both service engineering and service design rarely address fourth order design problems. It is the complexity of the systems involved in fourth order design projects that distinguish these design activities from those of the other orders (Golsby-Smith 1994). The challenge of fourth order design problems is to integrate communications, constructions and interactions in ways that make them meaningful, usable and useful for people. Fourth order design is marked by wicked problems (Rittel & Webber 1973; Buchanan 1992) and indeterminate situations (Dewey 1942). Yet, the technical and organizational interfaces of service engineering focus mostly on form, materials, and function, and as we observed above, with tame problems. Design problems in service engineering are therefore more characteristic of the design practices in second order design. In contrast, service design that focuses on interfaces and encounters shows characteristics of third order design. We have to be careful then when to distinguish some system integration efforts from fourth order design problems. Our reflection on service engineering and service design demonstrates that each of these design problems imply and convey a different kind of systems thinking and involves a different kind of system integration. A logo, for example, does not come into being as an isolated independent artifact. From its conception to its final production, the logo remains part of a larger system. Thus even design activities of the first order deal in one way or another with system integration.

Establishing service engineering and service design as two different kinds of design orders that deal with two different kinds of design problems may help explain some of the friction and confusion that exists between the two fields and professions. Just recently, I was serving on a committee to assess candidates for a new service design professorship. The position was placed in a technical university. Low and behold, the majority of the candidates who applied were rooted in service engineering, not in service design. Their résumés bore witness to their abilities in developing measurements and classifications *for* optimizing services but were devoid of even rudimentary methods of participatory design, co-design. They were simply not trained to work with people. On the same day, I got to listen to a service design professor who explained service design exclusively in transactional terms. These two examples illustrate that when it comes to services, we are continuously dealing with and encountering different kinds of systems views, each of which seeks to achieve a different kind of system integration to achieve a different kind of purpose.

ABOUT SERVICES & HUMAN-CENTERED DESIGN

Human-Centered: Weak and Strong Interpretations

Being human-centered means different things to different people. In order to make this concept meaningful in the context of service engineering and service design, we need to draw some boundaries. Winograd and Koch (1997) explored human centered design for its relevance and implications in their field human computer interaction. They found a gamut of "wide" interpretations to "strong" interpretation of this concept. A "wide" interpretation puts "human-centered design" on equal footing with "user-centered design" and "user experience." Whereas user-centered design draws heavily on insights from human factors, user experience builds on theories of "pleasurable objects" (Jordan 2002). According to these views, objects are pleasurable when they consider a person's psychological, ergonomic, emotional and social implications. In contrast to this "wide" interpretation, Winograd and Koch identified a "strong" interpretation, which refers to first principles of human rights and human dignity (Buchanan 2001) and also to issues of sustainability and the social (Krippendorff 2006).

A core distinguisher between the wide and strong interpretation of human-centered design is thus the understanding of people: In the wide interpretation, human being are categorized, classified, and labeled, for example, as a user, operator, patient, or consumer. Being so classified, people are assigned a role in a *transactional* exchange-based relationship: We offer, you use–you use, we offer or provide. Our ability to arrive at the kinds of human environments and human experiences we are striving for hinges on our ability to distinguish between transactional exchange models and design approaches that consider and respect a person as a full human being. A strong interpretation of human-centered design positions us to evaluate our design efforts along human dimensions: Are we achieving the kinds of human experiences and human environments we want to create? Do our services help us

fulfill our strategic and organizational purposes, which ultimately have to "serve" people in ways that contribute to sustainable, just and dignified human living?[2] And if not, how could they? This strong interpretation insists that our actions, our constructions, our inventions, our organizational systems operate at their highest level of efficiency and their maximum capability when they work for, support and enable people.

If we return to Rittel & Webber's distinction between tame and wicked problems, we can draw parallels to the "wide" and "strong" interpretation of human-centered design. We find that "tame" problems typically apply user-centered design principles and methods that focus on user experiences. The strong interpretation, in contrast, is much more likely to engage with wicked problems. On their own, service engineering and service design have been able to address tame problems quite well. But as Rittel & Webber observed in 1973, our ability and success in mastering tame problems has led us to the gates of wicked problems. Neither service engineering nor service design in their current framework are prepared to address these wicked problems on their own when they concern open societal problems:

> "The difficulties attached to rationality are tenacious, and we have so far been unable to get untangled from their web. This is partly because the classical paradigm of science and engineering—the paradigm that has underlain modern professionalism—is not applicable to the problems of open societal systems. (…) "The kinds of problems that planners deal with—societal problems—are inherently different from the problems that scientists and perhaps some classes of engineers deal with. Planning problems are inherently wicked."

Human-Centered Design as a Common Ground for Action

We are beginning to see the rise of a strong interpretation of human-centered design in service design theory and practice informed by pragmatic philosophies and the art of rhetoric. This shift in perspective brings service design closer to the ideas of human-centered interaction design, where a product or service is regarded as mediator between people (Buchanan 1995). Service no longer is about backstage-front stage operations or about transactions but about human relationships. And these human relationships weave in and out of organizational systems, defying efforts to optimize "service operations and processes" but instead, call for humanization of organizational processes, procedures and systems. It is through the stronger interpretation of human-centered design that we can link service engineering and service design. It is through the efforts of understanding the needs and opportunities within the organization as well as the needs and opportunities outside of it that we can discover, invent, develop and deliver new kinds of services and service models. A service designer who disregards organizational operations and processes will not succeed in implementing a service design solution. Likewise, service engineers who forget that technology depends on cultural acceptance (Buchanan 2001b) will also fail in their best efforts to improve this world. A human-centered design approach to services re-interprets terms like servucation and shifts their mechanistic emphasis on the production system towards the human system. We can move from service and production (the original meaning of Servucation) to service and education ("Servucation"). In consequence, the service problem shifts from one of producing services to one of educating, engaging and enabling people.

A service so re-defined identifies and integrates all elements of a system around people who use a specific service voluntarily or mandatorily; ensures that all necessary information, materials and equipment are available at the appropriate time in a form that is accessible, understandable, useful and desirable at every step along the way to complete a specific task or to make an informed and deliberate decision. A service so perceived and developed around a human being depends on the integration of materials and function, organizational operations, and form. It follows that service engineers and service designers have to work hand in hand to create useful, usable and desirable services in a landscape of messy and ever-changing organizations.

It is in this light that we can look to human-centered design as a common ground for action for service engineers and service designers to integrate systems around people. For service engineering, human-centered design offers a new rationale and a new organizing principle that embraces the human being beyond human factors and ultimately concerns itself with systems that matter to people. For service design, one of the challenges remains to move beyond services as goods and to take a stance for the very people they design for and with.

[2] 'A' product in this context stands for the outcome of a human design effort. Therefore, organizations and policies, too, are treated and discussed as products.

The human-centered design approach also introduces an ethical dimension to services that has been absent in both the transactional service design approach and in the optimization focused service engineering approach. Services, more so than any other designed product, have direct implications for people and people's lives. Service designers concerned with services in a transactional model escape that question because they can always claim that a service is only being used when it presents a "true offering" to the person using it. Why should a service designer worry about if that service should even exist? A human-centered design perspective tends to be more critical and more reflective on the implications a specific service has not only for the individual using it but also in the larger social and human context. A human-centered design approach does invite critical questions like "does this specific service actually do a disservice to individuals? The environment? Society?" Because human-centered design concerns itself with first principles like human rights, human dignity and justice (Buchanan 2001; Krippendorff 2006; Winograd & Wood 1997), services are expressions of these principles as much as they are facilitators. There is the real possibility that service designers can create a pleasurable and enjoyable experience around a service that pursues sinister motives. By keeping a close eye on human-centered values, it is easier for service designers to identify projects where their design skills are being used to achieve objectives that are opposite their own values and aims.

In service engineering, ethical questions have also been avoidable. The rise of environmental responsibilities and ultimately corporate social responsibilities has, however, already encouraged service-engineering scientists to consider the impact of their work.

SUMMARY & CONCLUSIONS

The origins of service engineering and service design point to some remarkable parallels although the direction both professions set out from seemed in opposition: service engineering began in the organization and for the organization; service design began outside the organization but also for the organization. The term engineering is interesting because it leaves no doubt that engineering is an activity with a time component. A service that is being engineered is a service that is being tinkered with, tested, changed, tested again. Service Design, as a term, in contrast, has been leaning too strongly on traditional concepts of design that, in their final form, present a form independent of time. But while we can park a car and put down an object, we cannot do this with services. Services are fleeting and inherently temporal.

The point of this paper is to show the commonalities of both professions, their individual strengths but also their distinct weaknesses when it comes to systems integration around people. It is here where human-centered design can serve as a common ground for both professions. While I feel I argued that point, I have not looked into specific theories, such as Actor-Network or Product Service System theories (cf: Morelli 2003) or Action research (cf: Argyris & Schön 1986). Actor Network theories, however, fit quite well into the transactional model and often promote the transactional function of services. Action research approaches on the other hand are methodologies that also cross organizational boundaries. I am therefore fully aware that I have simplified my argument by focusing on the origin of service design and service engineering. I did this deliberately, though, because I am still missing such discussions in service design. As in all fields, we can find people and projects that seek to overcome these mainstream tendencies. Already, as I have pointed out, have individual service designers began to explore the implications of human-centered design (cf: Sangiorgi 2011; Holmlid 2006, Holmlid & Evenson 2007) . There remains, however, a lingering confusion among researchers and practitioners as to what is "human-centered" and what is "user-centered design". This has significant implications for services. A user-centered service might be meaningful and usable to a person, but a human-centered service will also consider the ethical dimensions of a service. At this time, simply not enough service designers and service engineers are prepared and/or willing to address ethics in their projects. Even in the design of machine-to-machine systems, we should still be asking ourselves how this machine-to-machine system contributes to our human living, how it enhances, endangers or changes the way we go about living.

This is the contribution then of human-centered design in a wider sense: a sensibilization and awareness that what we make has consequences. For service designers and service engineers alike human-centered design presents a common ground for action when human dignity, human rights and human environments and communities become the organizing principle. This is not a manifesto against organizational productivity, organizational profitability or economic efficiency. Au contraire. The more we are concerned about people, the better we can go about innovation

useful, usable, meaningful and desirable services–all of which people will be happy to pay for without having to be seduced or mislead. Human-centered design has brought a shift in perspective for people involved in developing services and introduced a vast range of new methods to both service engineering and service design, its key impact might be the one least tangible: Its focus on services integrated around human beings offers a common ground for otherwise competing disciplines. Human-centered design challenges service engineers to work together with service designers and vice versa. Rethinking the purpose of a service to enhance human living becomes the common ground for action that enables the integration of services and systems around people.

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Section 4

Software as a Service: Achieving Security via Usability, Trust, and Privacy for the Internet of Services

Designing Usable, Yet Secure Authentication Services: A User-Centric Protocol

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ABSTRACT

User authentication is a vital and critical service in many modern interactive applications including online banking, commerce, government as well as critical infrastructures protection. Such critical software systems should provide highly secure services for establishing if user access should be granted or not. As it will be highlighted in this paper, there is an intrinsic conflict between creating user authentication services that are secure, yet easy to use by the end-users. Our main goal is to adopt a human-centric approach which consists to study the intimate relationship between usability and security before the user authentication service has been implemented and deployed. We propose a framework that models the usability and security symmetry meaning the security consequences of usability issues. It suggests a novel usable security protocol through an inspection method named Usable Security Symmetry for dealing with usable security of user authentication methods that in turns will guide the development of truly secure and usable user authentication systems. The framework uses NGOMSL (Natural Goals, Methods, and Selection Language) to understand the user cognitive processes involved in user authentication while helping to identify and model the diverse situations of conflict between usability and security attributes.

Keywords: Security Usability, User Authentication, Information Security, Human Computer Interaction.

INTRODUCTION

Security-sensitive systems require the management of user accounts that include personal profile and give access to sensitive data and services. A user is a single entity whose behavior is solely identified within a computer-based system (i.e. Personal Digital Assistant (PDA), workstation, server login, Web sites, etc.). Individual users classically correspond to individual people, but they might also represent particular system services or resources. Most accounts are protected by an easy keyboard password that even a novice hacker can crack easily. Once inside, hackers use the attacked account for a diversity of nefarious activities, such as launching distributed denial of service (DOS) attacks, distorting Web sites, stealing billing and credit card information or making counterfeit purchases. Distribution of budget for security initiatives, information security, has increased from 17.7 percent in 2008 to 18.5 percent in 2009.

However in the last decade, we have seen a major shift from what was broadly recognized as security best-practices and standards. Within the advent of mobile and Web services, the access to almost any system protecting the organization's information assets is a critical concern. Data security (90%) is most frequently mentioned as a vital concern for IT security organizations, followed by application security (86%), and business continuity/disaster recovery (84%). Data security tops also the list of business objectives, with 89% mentioning protection of corporate data and 87% mentioning protection of personal data. Most of the spending on information security countermeasures are dedicated to confidentiality and integrity solutions which two sub-factors contributing to the overall security. The solutions includes firewalls to protect the information perimeter of an enterprise (or encryption), Virtual Private Networks (VPNs), and anti-virus and intrusion detection to safeguard the actual information.

However, without user authentication products to safely identify users, most of these tools fail to deliver their

promises. For example, inefficient user authentication marginalizes perimeter security and access controls, showing vulnerabilities in the confidentiality and integrity areas. The growing trend toward identity theft, or employing stolen names, birthdays and identification numbers to perpetrate fraud, would meet firm resistance if strong authentication practices were universally employed. Privacy violations, another example, are seriously compromised by weak user authentication. User authentication is crucial issue in confidentiality and integrity when the application has to identify huge numbers of users which is a costly and overwhelming task.

However, most of the time companies forget to address issues related to the weakest link in the security engineering of user authentication: the human experience and the usability concerns. The front side of the service showing to the user – should be designed so that it is suitable to the risk involved and as easy to use as possible. Applying too low a level of security might compromise the integrity of the company's process. But applying too high a level for a low-risk process means the process will be too hard to use and will confront low usability rates. Indeed, security and usability are both essential in user authentication and management. One of the biggest challenge facing heterogeneous organizations is providing usable and secure access, authentication ("who do you claim to be"), and authorization ("we will grant you these rights") of users to systems. Besides, the majority of contemporary computer users for example need to authenticate to a company network several times *during* work *day*. Another particular concern in authentication according to (Cranor and Garfinkel, 2005) is that authentication technologies do not fail gracefully. Failing gracefully means that even if authentication fails (e.g. user forgets her/his username but gets the password right) the system can give her or him a partial access to the service or secure and fast support in getting login data to a safe place.

The fundamental question is the following: How is it possible to ensure usability of user authentication without compromising security and vice-versa? It is broadly held that security and usability are two opposing goals in system design (Cranor and Garfinkel, 2005; Jøsang et al., 2007; Nielsen, 2000) but there are several cases in which security and usability can be synergistically enhanced by reviewing the usable security approach. In considering the extent that users are important in the authentication process, a company's goal is to select an Authentication Method (AM) that is suitable to the risk involved and as easy to use as possible. Applying too low a level of security might compromise the integrity of the company's process. But applying too high a level for a low-risk process means the process will be too hard and will confront low adoption rates. As stated by Penn (2008), the key criteria when assessing such solutions are ease of use, portability, cost, security, manageability, and cross-channel utility.

Our objective is to build a harmony between usability and security while providing requirements and design tools grounded in specific usability and security principles. In certain situations it is possible to concurrently increase usability and security by revisiting user interface/usability design decisions that were made in the past. In other situations it is possible to align the requirements of security and usability by changing the human environment in which the system will be used. In this paper, we introduce a framework that its goal is not to address usability and security after the product has been manufactured, but to make security a natural outcome of the requirements and design phase of the authentication development life cycle.

CREATING SYSTEMS THAT ARE BOTH SECURE AND USABLE

The Challenging Issues

To motivate this research, one can mention the CSI/FBI Computer Crime and Security Survey (2008) on how without a proper user authentication system (the "door-entry" of any system), organizations are susceptible to potential attackers. This survey defined 13 types of attacks or computer mishandling resulting in direct financial loss to the survey's participants. The survey questions the different sorts of computer attacks and incidents, which are in fact directly related to user authentication: Unauthorized access represented (29%), Insider Abuse (4%), Theft/Loss of proprietary information (9%), Password Sniffing (9%), and finally Theft/Loss of customer data represented (9%). In the real world, organizations struggle to enforce security policies — even the most basic ones (e.g. password). When users have unsupervised physical access to a mobile device, they can usually do whatever they wants with it, for example even authenticate themselves through the software token installed in the mobile device since they know their friend's username and password. As a result, most of these policies violate the Big Stick principle: Whoever has physical access to the device is allowed to take it over (Stajano, 2003) (as in the previous example). These policies are extremely hard to enforce and thus scarcely of practical usage. The Big Stick Principle is a very high-level security policy model which identifies a set of cases in which authentication is superfluous. In the Internet of services era, it is worth noting that five out of the top 10 Web application security vulnerabilities are directly or

indirectly related to authentication according to (OWASP, 2009).

Research on usable security user authentication methods are traditionally about the evaluation of Pretty Good Privacy (PGP) (Whitten and Tygar, 1999), public key encryption program primarily intended for authentication and email privacy, anti-phishing authentication mechanisms (Dhamija et al., 2006) security toolbars (Wu et al., 2006), user authentication mechanisms (pictorial passwords) (Angeli et al., 2003), security user studies (Chiasson et al., 2007), secure User Interface (UI) for network applications (i.e. authentication of the communication) (Jøsang and Patton, 2003), design principles and patterns for computer systems that are secure and usable (Cranor and Garfinkel, 2005), and some general white papers about user authentication.

In recent years, Human Computer Interaction-Security (HCI-Sec) researchers have been applying HCI techniques in security software. However, there are no methods or techniques to effectively design secure and usable user authentication systems from the HCI perspective. Despite all these efforts made by researchers and organizations to provide suitable authentication methods, vulnerabilities still remain. Mechanisms and models that are complicated to the user will be misused. When an authentication method is too demanding the user might not keep up with the increasing workload (e.g. users might refuse to sign up to a Web site due to its complex strong authentication method). Thus, organizations often tend to blame the users for the human failure of not handling complex and demanding technical systems. However, (Norman, 1988) argues that what we often view as human error is the result of design flaws that may be surmounted. Additionally, according to the Computing Technology Industry Association (CompTIA, 2002), human errors turn out to be one of the major causes of security breaches in organizations; they account for 84% of security breaches in 900 private and public American organizations.

More research effort is needed on usable security systems. It aims to study how information security and usability factors should be handled in the system, including both front and back-end processes, and taking into consideration the resources and costs involved. It is critical to the effective adoption and deployment of user authentication methods. As a matter of fact there is no set of recognized usable security standards particularly targeted to user authentication methods but rather only to security mechanisms in general. As expected, there are numerous examples that fully characterize this hypothesis such as the so-called password complexity, locking Personal Identification Number (PIN) systems, cumbersome data input of challenge-response calculators, lack of usability in security software, “negative redundancy” of biometrics systems when users are authenticating to a system (e.g., combine a username/PIN with fingerprint), and so on. Moreover, to reduce management and support costs, organizations are placing more and more of the burden of authentication on the user (i.e. key stakeholders like employees, partners, end-users, etc.), forcing them to perform - at the enterprise’s discretion - lifecycle-management tasks (i.e. self-service user authentication) such as token activation, password replacement, and certificate renewal.

The Case of Strong User Authentication

Strong authentication relates to systems that entail rigorous user identity verification, which is accomplished through multiple factors for authentication. It allows us to irreversibly determine the user’s identity or the integrity of precise data. Strong authentication also presumes that access to a network is extremely hard to break, thus creating a secure network. The goal of strong authentication is to strengthen the security by replacing the classic authentication method of password for a software-only authentication solution with dynamic password generators, or software and/or hardware authenticators like smart cards, biometrics, CAPTCHA, and so on. Traditional authentication assumes we know something: the user and the password.

Strong authentication assumes that the username and the password are known even if the password is generated automatically. A password generator offers the user the choice to allow the system to assign passwords to usernames and logins. Password generators use an amalgamation of case sensitive letters, numbers, and symbols mathematically generated to offer the user with the strongest, hardest to hack passwords. A single factor authentication is not secure. Actual information security requires an amalgamation of mechanisms (i.e. multi-factor user authentication) to verify who the user is, what the user knows, what the user has, or where the user is. Verifying who the user is typically requires a Personal Identification Number (PIN) to attest what the user knows. The PIN combined with a biometric method, such as a fingerprint or iris scan, attests what the user has, or a smart card or digital certificate also assures what the user has and a Global Positioning Satellite (GPS) receiver (e.g., an iPhone with a Google maps application installed) corroborates where the user is.

Combining multiple user authentication methods generates almost infallible user authentication on the Web, just as multiple levels of identification provide security for the physical access control. For example, a user who enters the

top secret area of a military building might be asked to present two pieces of identification which is information known only to the user, match a fingerprint, and finally type in the combination for an electronic door lock. Once inside, the user still has to log onto the computer. Multi-factor user authentication such as this has been employed for a long time in physical world security systems. There are currently several authentication technologies to select from, and they each verify the identity of a user and grant access to resources. Nevertheless, they essentially diverge in the level of security they offer as shown in Figure 1.4. While passwords are usually considered weak forms of authentication, token and especially Biometrics have been established as much stronger forms of authentication.

Users frequently and understandably resist strong authentication because it adds additional steps to their login and Internet sessions. Once they are authenticated, users' identities are securely established. As expected, corporate users are more receptive to strong user authentication, especially since it is intrinsic to their jobs. Generally speaking consumers have shown more resistance to additional or intrusive steps that eliminate anonymity. Many security experts foresee equivalent trends toward stricter user authentication for Internet consumers as e-commerce continues to increase and an increase in novel kinds of services that require strong authentication in the market.

Authentication policies are required to manage how the authentication methods interoperate. These policies orchestrate user authentication methods, such as the methods to employ for specific resources, the order in which to employ them, and the back-up activities to be carried out should the selected methods fail. Developing user authentication policies typically requires the expertise of highly skilled security system designers to put -the system into operation on- a long-term basis. Automated user authentication management systems are only in their infancy to ease the human-intensive effort usually associated with deploying and operating strong authentication. However, that same automation on one end- pushes the burden to the other end of the chain, which is the end-user.

The greatest challenge of strong authentication is to make fraud more difficult for an attacker while respecting the constraints associated with an application: the technical, economical, and organizational environment (Braz and Aïmeur, 2005).

NGOMSL: A METHOD FOR COGNITIVE TASK ANALYSIS

Users employ programs for performing their tasks. Cognitive Task Analysis (CTA) have been used to boost human performance while guiding the development of tools that support the cognitive processes required for a task (Chipman et al., 2000). Within our research, we used CTA to provide a description of the conceptual and procedural knowledge utilized by users as they perform, for example, authentication tasks such as accessing a protected network resource using a Knowledge-Bases Authentication (KBA) method (e.g. security questions as an emergency access method). GOMS is the most widely used method of CTA. First introduced by Card et al. (1983), it refers to a family of human information processing techniques that attempts to model and predict user behavior. The acronym GOMS stands for Goals, Operators, Methods, and Selection Rules. GOMS is both a performance model and a cognitive task analysis method. The GOMS modeling technique has proven extremely successful in developing accurate cognitive task models (Williams and Voigt, 2004). Some of the types of applications in which cognitive task models have been applied in their research include assessing human-computer interaction complexity, determining the productivity of human-computer interfaces, and analyzing an interface design to determine whether methods can be automated.

We investigate NGOMSL (Natural Goals, Methods, Selection Language) (Kieras, 1996) analysis to understand and identify the cognitive processes involved in user authentication. NGOMSL is one of the GOMS models that support quantitative predictions for systems that have not yet been built. NGOMSL is a structured natural language notation for representing GOMS models and a procedure for constructing them. An NGOMSL model is in program form, and provides predictions of operator sequence, execution time, and time to learn the methods. An analyst constructs a NGOMSL model by performing a top-down, breadth-first expansion of the user's top-level goals into methods, until the methods contain only primitive operators, typically keystroke-level operators (e.g. click on "Sign In" button with left mouse button).

Furthermore, NGOMSL refines the basic GOMS concept by representing methods in terms of a cognitive architecture called Cognitive Complexity Theory (CCT) (Kieras and Polson, 1985). This cognitive theory allows NGOMSL to incorporate internal operators such as manipulating working memory information or setting up sub-goals. Because of this, NGOMSL can also be used to estimate the time required to learn how to achieve tasks. NGOMSL is a structured natural language notation for representing GOMS models and a procedure for constructing them (Kieras, 1996). An NGOMSL model is in program form, and provides predictions of operator sequence,

execution time, and time to learn the methods. An analyst constructs a NGOMSL model by performing a top-down, breadth-first expansion of the user's top-level *goals* (e.g. Access a Word file) into *methods* (e.g., Select word), until the methods contain only primitive operators, typically keystroke-level operators (e.g. Move cursor to middle of word with the mouse), and select rules (e.g., If the application is GAME, select CTRL-W-METHOD).

THE USABLE SECURITY PROTOCOL

As already highlighted in the introduction, making a system secure and usable can be achieved if and only if it is a pre-hoc consideration. This strengthens the argument made by other HCI-SEC researchers (Balfanz et al., 2004; Flechais et al., 2003; Yee, 2004) that security and usability must be developed in unison from conception right through to development. According to Yee (2004), integrated iterative design means iterative development processes based on repeated analysis, design, and evaluation cycles, rather than linear processes in which security or usability testing occurs at the end. Although many teams have adopted iterative processes, few seem to incorporate security and usability throughout. The usable security protocol adopts an iterative process that aims to build and maintain the trade-off between security and usability.

Protocol Architecture

The usable security protocol is a human-centric framework that aims to structure, develop, and control the process of the Usable Security Symmetry user authentication inspection method (Figure 1). It starts with the gathering of Primary, Secondary, and Tertiary Data. Then, the Cognitive Science Model (theoretical approach), which is based in Cognitive Ergonomics, is established in parallel with the Computer Science Model (demonstrational approach) to demonstrate the inspection method. Next, an orderly and sequential seven-step methodology assists in the actual development phase. After that, the Validation and Verification (V&V) phase is undertaken to validate our protocol by using a multi-teller automated machine.

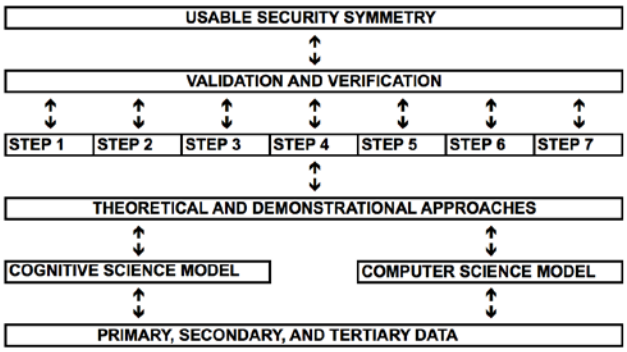

Figure 1. Usable security protocol architecture and methodology:

The six stages indicated in figure 1 and that form the essential of the protocol are:

- Step 1: Define the mission and conceptual design objective
- Step 2: Identify the most representative user authentication methods categories
- Step 3: Perform the NGOMSL model
- Step 4: Develop the user authentication risk assessment
- Step 5: Define the usability criteria for the evaluation of the user authentication method
- Step 6: Develop the Usable Security Symmetry inspection method
- Step 7: Demonstrate the inspection method using a multi-teller automated machine and a One Time Password (OTP) authentication method

Protocol Methodology Development

Step 1: Define the mission and conceptual design objective

This stage consists of specifying the usable security use cases. Each use case identifies a type of users (e.g. Super Admin, etc.) and working context in which an existing user authentication method is used. It aims to collect data to

understand what authentication method is used, how it works, and what its functionalities are. Examples of use cases include the following: *i. Check Business E-mail; ii. Update the hardware token user interface specification; iii. Make electronic funds transfer;* and *iv. Access a file on a personal laptop.* This stage includes also a classification analysis is undertaken to specify the main user authentication methods to be used for the purposes of the user authentication inspection method.

Step 2: Specify the most representative user authentication methods categories

The user authentication methods are identified as follows: i. *Password/PINs* (wired network-based task): username and password login operation in a desktop environment; ii. *One-Time-Passwords* (wireless/token network-based task): real-time generated OTPs based on the challenge-response method; iii. *Out-of-Band Authentication* (wired and wireless network-based task): utilization of two separate networks working concurrently to authenticate a user (e.g., PC computer and smart phone interaction), and finally iv. *Biometrics* (wired network and electronic access control-based task): logical and physical access control (e.g. fingerprint).

Step 3: Perform the NGOMSL Model (Natural Goals, Methods, Selection Language) analysis

Using the user authentication methods categories identified previously, we use NGOMSL to predict the learning time and execution time based on a program-like representation of the procedures that the user must learn and execute to perform tasks with the system. We first specify standard primitive external operators (e.g., Type <username>), mental operators (e.g., Recall <passcode>), and analyst-defined mental operators (e.g., Think-of <VPN Dialer>). Then, we generate task description, high-level user Goals, Operators, Methods for accomplishing Goals, and total execution and learning times estimates for each of the user authentication scenarios.

The time analysis of the data gathered for each set of the four task scenarios (figure 1) was based on the operator sequences, execution times, and procedure learning times. As shown in Table 1, the user took 28.85 seconds, which, is the total execution time (TET) for T1 using the Password/PIN, and so forth for the tasks T2, T3, and T4.

Task Scenario	Description	Authentication Method	Total Execution Time(s)
T1	Check Business E-mail	Password/PIN	28.85
T2	Update the OTP hardware token UI spec	OTP	45.31
T3	Transfer 15,000 to the Bank of America	OOBA	93.77
T4	Access a file on a personal laptop	Fingerprint	20.46

Table 1: Total Execution Time by task scenario.

The TET does vary depending on the type of the authentication method used. In fact it takes more time if the user employs an OOBA method' This is because the user interaction during authentication is more demanding than the other authentication methods as shown in Table 2. The results show the total execution time for the set of four authentication benchmark methods, which is the profile for the **Method for goal: Log into the system** in Table 2. The profile includes the total time in seconds spent using this method and the percentage of the time spent on it. Our research is more concerned with the investigation of the authentication portions of the tasks scenarios as shown in Table 2, which are the time related to the **Method for goal: Log into the system**.

Task Scenario	Method for goal	Authentication Method	% of Total	Total Execution Time(s)
T1	Log into the system	Password/PIN	83.93	23.25
T2		OTP	12.75	28.13
T3		OOBA	25.16	26.83
T4		Fingerprint	1.88	9.16

Table 2: Total Execution Time by user authentication method: Log into the system.

The main factors influencing the amount of time a user spends authenticating to a system are the number of different artifacts to interact with and the type of authentication method. The Password/PIN takes more time to be performed, 23.25 seconds, when compared to Fingerprint recognition, 9.16 seconds. The former is a Knowledge-Based Authentication (KBA), which requires users to prove the knowledge of a single secret, memorize items, and recall

them when accessing a specific system. The latter is Biometrics, which recognizes users physically through their fingers; no cognitive process is directly involved. Using OTP takes a little more time than OOBA, given that either users need to interact with different artifacts and make use of KBA which directly involves cognitive processes. With OTP users are required to refer to a hardware authentication token, then type the code displayed there on their application (e.g. VPN application). In addition, users need to remember the PIN (i.e. 4-digit) but not the password (i.e. strong password like Rtyr78nM!), which facilitates memory retrieval, although this authentication method is the one that takes more time. As expected, the fingerprint (Biometrics) takes the least amount of time out of all methods. No cognitive process is directly involved (e.g. not KBA), and there is minimal interaction with artifacts when using a USB drive. The authentication processing time may vary depending on the infrastructure, the equipment, and also on different versions of the authentication methods.

Also in parallel, the identification of the main cognitive areas of focus relating to user authentication is established (i.e. perception, attention and memory, mental models) followed by the definition of the appropriate cognitive architecture [i.e. adaptation of the Executive-Process/Interactive Control (EPIC) (Kieras and Meyer, 1997), and State Operator and Result (SOAR) (Laird et al., 1987) architectures], which lead to our Cognitive Model of User Authentication (CMUA) It provides a relevant contribution to the understanding of what and how cognitive processes are involved in user authentication. On the basis of this formalization, CMUA is the first attempt to build a cognitive model for user authentication methods. The architecture and the underlying processing cycle are shown in Figure 2.

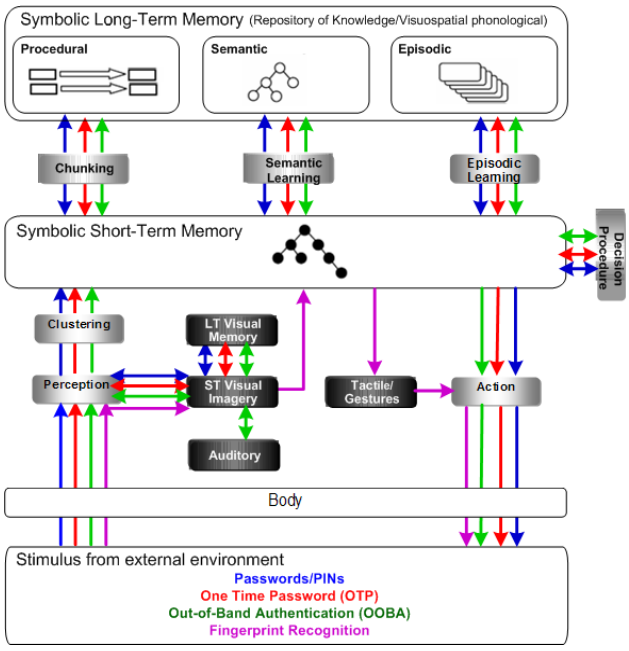

Figure 2. Cognitive Model of User Authentication (CMUA)

This model helps to determine how and what cognitive processes are involved in user authentication tasks such as perception, attention and memory, mental models, chunking, clustering, and so on. It also serves as the basis for the development of the Usable Security Symmetry inspection method. The four most representative categories of user authentication methods are depicted in our model with the following colors: *Password/PINs (➔), One-Time Password (➔), Out-Of-Band-Authentication,* and *Fingerprint Recognition in Figure 2.* . Figure 4.8 depicts the user authentication tasks with their corresponding cognitive and motor process flows shown in colored arrows as follows: PPs OTP ➔ OOBA ➔ FR.

The CMUA consists of a LTM, which is encoded as production rules, and a STM, which is encoded as a symbolic graph structure so that objects can be represented with properties and relations. Symbolic STM holds the agent's evaluation of the current situation derived from perception and via retrieval of knowledge from its LTM. Action in an environment takes place through creation of motor commands in a buffer in STM. The decision procedure selects operators and detects impasses. At the lowest level, CMUA's processing consists of matching and firing rules. Rules provide a flexible, context-dependent representation of knowledge, with their conditions matching the current

situation and their actions retrieving information relevant to the current situation.

Step 4: Develop the User Authentication Risk Assessment

This assessment must be done prior to the development of the usable security inspection method itself. It is a vital step to identify the most critical vulnerabilities and threats related to online user authentication (user-to-machine). This assessment determines which security review should be considered within each usability criterion in the inspection method. It describes the user authentication assets, threats, and vulnerabilities along with their corresponding descriptions and mitigation strategies. It also shows the types of rating scales for Threat, Vulnerability, CIA (Confidentiality, Integrity, and Authorization model), Probability, Asset Value and Asset Exposure Classifications, Total Impact and Total Risk Ratings, and finally Risk Reduction Strategy as shown in Figure 3.

Authentication Asset/Target	Threat (T) Description	Vulnerability (V) Description	CIA	Threat Rating	Overall PC/E		Overall Exposure/Impact			RA	Risk Reduction Strategy
					V Rating	OP= T+V	Asset Value Classification	Asset Value Exposure	TI= AVC + AEC	TR= OP x TI	
1.Password Personally identifiable medical Information stored on Structured Query Language (SQL) Server	Account credentials of data entry clerk stolen	Overly complex password requirements cause users to write down passwords and leave them in obvious places.	CIA	3 Medium	3 Medium	6	4 Substantial	4 Serious	8	48	Mitigate by reducing password complexity requirements, - enforcing policy to not leave passwords in obvious places, and providing user training in password use. Compromise of SQL data could result in large fines as a result of HIPAA[58] violations. Also, loss of public confidence could result in long-term loss of business.

Figure 3. User authentication risk assessment matrix excerpt.

Step 5: Specify the usability factors and criteria

To specify the usability factors and criteria to be employed in our inspection method, we use the Use Integrated Measurement (QUIM) (Seffah et al, 2006). QUIM adopts the viewpoint of most HCI standards while decomposing quality in use into different factors, then into criteria which are measurable attributes. For the purposes of our inspection method, the following nine usability factors and eight criteria have been considered:

- Usability factors: Minimal Action, Minimal Memory Load, Operability, Privacy, Security, Load Time, and Resource Safety

- Usability criteria: Efficiency, Effectiveness, Productivity, Satisfaction, Safety, Trustfulness, Accessibility, Universality, and Usefulness.

Step 6: Develop the Usable Security Symmetry Inspection Method

The Usable Security Symmetry is a checklist-based inspection method. It involves having a group of evaluators systematically examine a user interface and judge its compliance with security and usability principles. It can be used to guide a design decision or to assess a design that has already been created. When using it earlier in the requirements and design phase, this method helps security designers to make more informed decisions before the bulk of the functionality design is done. "Symmetry" is an important concept introduced by the inspection method we are proposing. Symmetry is one idea by which a human through the ages comprehend and create order, beauty, and perfection." The word, order, is in fact a synonym of harmony. Our utmost goal is that security and usability will no more be two separate entities, but will work in harmony to produce secure and easy to use authentication methods.

As the inspection method provides very specific and practical review questions (not general ones), it is common to unfold issues and as well as opportunities for the overall functionality improvement. According to Nielsen (1992), usability specialists were much better than those without usability expertise at finding usability problems by heuristic evaluation, one of the most popular inspection methods. Moreover, usability specialists with specific expertise (e.g., security) did much better than regular usability specialists without such expertise, especially with regard to certain usability problems that were unique to that kind of interface. Thus, the Usable Security Symmetry

inspection method is developed for system designers - acting also as evaluators – who have knowledge in security especially user authentication.

A partial view of our checklist is shown in Figure 4. Depending on the type evaluation we wish to conduct, the checklist can be quite long. The evaluators are given the possibility to collapse or expand each checklist item (e.g., # 1.3), thereby facilitating "Occurrence" data visualization.

Usable Security Symmetry Inspection Method										
1. Usability Criterion: MINIMAL ACTION										
Capability of the application to help users achieve their tasks in a minimum number of steps (i.e. the length of transactions and procedures). It concerns perceptual and cognitive workload for individual inputs or outputs.										
#	Usability Review	Occurrence			Comments	Security Review	Occurrence			Comments
		Y	N	NA			Y	N	NA	
1.1	Can the user select the				Users could do	Is a single ID credential using a				-
1.2	Is the workload low and simple				-	Have strict password policies				Security policy
1.3	Is the authentication carried out				It seems pretty	Is authentication of principals to				-
1.4	Has the user to re-authenticate				This can take	Does the permissions strategy be				-

Figure 4: Usable Security Symmetry inspection method excerpt.

The inspection checklist is related to the following issues:

(i) Identify one (or up to 5) security designers and/or usability professionals to examine the system on an individual basis,

(ii) Develop the usability Review Questions in conjunction with the Occurrences

(iii) "Occurrences" are represented by Y (Yes), N (No), and NA. Y (Yes) represents that the authentication method being reviewed complies with the Usability Review question; N (No) represents that it does not comply with the Usability Review question, and NA (Not Applicable) means that the Usability Review question does not apply for that particular authentication method. The default value for the Occurrences fields is empty (none)

(iv) Comments column: If there are no comment, we should include a dash "-" given that leaving it blank can mislead evaluators into thinking that data are missing.

(v) The outcome of the inspection checklist is a list of usability and security problems in the interface with references to the predefined usability criteria and security aspects

(vi) Finally, review any identified concerns, and assess their compliance with your criterion. Then, allocate a severity level for each grouped concern based on the impact to the end-user, and provide recommendations to fix the problem

Step 7: Demonstrate the inspection method using a multi-teller automated machine and a One Time Password (OTP) authentication method.

The Validation and Verification phase is undertaken by using a Multi-function Teller Machine (MTM) and a hardware OTP token, as an example. To illustrate how our inspection method can be applied in a real world scenario, the following three-factor authentication use case is employed which is "Transfer funds to an international bank account" by using a Multi-Function Teller Machine (MTM).

> *A user, Alice, needs to transfer US$5,000 to an international account by dealing either with access control and strong authentication. She first authenticates herself to the MTM using a smart card and a PIN (the bank PIN policy states that a PIN must have 4 digits and 1 letter). In high-value financial transactions environment, procedures to control access to several areas of the card become predominantly important. The degree of security changes with the degree of sensitivity of the data related to the application, which requires another layer of security to the current system: Biometrics. The MTM asks Alice to prove again her identity. So in addition to the bank card and PIN, Alice must provide a biometric authentication such as palm recognition - a multiple factor authentication.*

The OTP authentication method in turn, which was the subject of the GOMS analysis, revealed the difficulties users have in terms of the user interaction with the system. The OTP demo is a wireless-and-token based authentication task, which consists of the following elements: Wireless Local Area Network (WLAN), hardware token with OTP functionality, Personal Identification Number (PIN), and tokencode. Finally, a usability testing is performed to identify the high-priority usability issues. The testing assesses the usability of user authentication tasks involving

remote access, Secure Socket Layer (SSL), and Virtual Private Network (VPN), which is commonly known as SSL-VPN user authentication, a two-factor One Time Password (OTP) system that provides strong authentication.

A CONCLUDING REMARK

So far, there has been very little research on usable security of user authentication methods although a considerable body of research work has been made for computer security mechanisms in general other than authentication methods. Therefore a usable security protocol is needed for user authentication. To build reliable, effective, security yet usable systems, the proposed inspection method take into account usability concerns of authentification mechanisms and their potential security threats. Systems should be built so as to be easy to learn and use by the average corporate or consumer computer user. According to Sasse (2004), "Don't focus only on UIs to security tools - the big problems are in security requirements, job design and user involvement." That is exactly what the proposed method is all about. Additionally, according to Whitten and Tygar (1999) using methods for usability evaluation that concentrate on the interplay between usability on security assist developers to discover usability problems threatening the security of a system. This research has investigated the security consequences of usability issues and presented a novel usable security protocol which uses an inspection method named Usable Security Symmetry for dealing with usable security of user authentication methods. We hope it will guide the development of more secure and usable user authentication systems.

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A Snap-Shot of User Support Services In Earth System Grid Federation (ESGF): A Use Case Of Climate Cyber-Infrastructures

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ABSTRACT

Cyber-infrastructures have changed the process of research. Researchers can now access distributed data from all parts of the world with the help of cyber-infrastructures. User support services play an important role to facilitate researchers to accomplish their research goals with the help of cyber-infrastructures. However, the current user-support practices in cyber-infrastructures are being followed on intuitive basis (at least in climate e-infrastructures) thus over-burdening cyber-infrastructure employees. The main contribution of this paper is to present the snap-shot of the current user support practices in a cyber-infrastructure of a climate science known as Earth System Grid Federation (ESGF). ESGF is a leading distributed peer-to-peer (P2P) data-grid system in Earth System Modelling (ESM) having around 2700 users distributed worldwide. The questionnaire conducted with the climate cyber-infrastructure projects' employees presents the picture of the current user support situation by highlighting their profile, utilization of various communication media, user-request service time, attributes of incoming user problems and information requests. The respondents of the questionnaire were 26 support staffs of cyber-infrastructure projects, from different parts of the world. The paper then presents the critique of the current user support process in ESGF and finally emphasizes on the need to streamline user-support in cyber-infrastructures.

Keywords: Cyber-infrastructures, Climate Science Data-driven Research Projects, User Support, Help Desk, Service Desk, Human Systems Integration, Service Engineering, Globalization, Service as a Process

INTRODUCTION AND BACKGROUND

Services are everywhere in the world. They cover large variety of businesses types and fields including services in the scientific domains. Call center, user support, help desk are well established concepts in the service industry, where volumes of customer/client or user requests are processed daily, thus providing help to the requestors. The contemporary user support is offered, in the form of self-help via support websites, online tutorials, wikis; or

contacting an expert via traditional help-desk (N. K. Y. Leung, 2006; N. Leung & Lau, 2007) and via service-desk (Jäntti, 2009, 2012a, 2012b) in commercial and non-commercial sectors. Cyber-infrastructures are deployed to access and share the data and computing resources mostly for the research purposes. They are also referred as e-Research, e-Science, e-Science infrastructures and collaboratories (Hey & Trefethen, 2005). Users of cyber-infrastructures use them to access data for their personal research goals. The user-support process in cyber-infrastructures helps researchers to mitigate all (technical but not limited to that) problems that might arise during the interaction of a user with the cyber-infrastructure. Users are mainly researchers and they need to accomplish various tasks of research within a specific time-frame via accessing and downloading required data stored at the various locations (nodes) of cyber-infrastructure, distributed globally. The user-requests are the inputs to the user support process and are processed by the staffs (also known as user support employees) of a cyber-infrastructure with the help of tools and methods (whether automated or manual) to service the incoming user-requests, thus meeting the user support needs. In cyber-infrastructure user support is provided; however, it needs more attention as well as investments (Soehner, Steeves, & Ward, 2010).

The user-support process in cyber-infrastructures is directly affected and is evolving with the evolution of cyber-infrastructures. It is vital to test and be aware of the user support procedures currently in practice, which are most of the times taken care by the infrastructure developers themselves. It is noteworthy to observe by the authors that the evolution of cyber-infrastructure technologies is partly dependent upon the communication taking place within the support staffs and users. The support staffs in their joint collaboration with each other as well as their interaction with the users discover new features that can be introduced in cyber-infrastructures while handling the user related issues. Therefore, it is important to analyze the support process and enhance its productivity as well as its efficiency in order to save time and supporting efforts of the cyber-infrastructure employees. This is possible if the current situation of the user support process in cyber-infrastructures is observed. In this study, information gathered empirically, by analyzing the methods, tools and techniques employed by cyber-infrastructure staffs (i.e. staffs who also are doing user support activities) via a survey questionnaire presents the part of the picture of the contemporary user support practices in Earth System Grid Federation (ESGF), at least from the employees' perspective. The outcomes of this study will enable future cyber-infrastructure projects to organize their user support process in a better way. This study is an important milestone in the field of cyber-infrastructure user services for the reason that it will be laying a foundation of a user support recommendation framework or good practices in cyber-infrastructures user support; that can be suggested after studying ESGF user support system. This user support recommendation framework can then be used to standardize other similar cyber-infrastructures with in the climate domain or other domains. Currently, the authors are working on it.

In this paper, the user support of a well-established climate cyber-infrastructure ESGF is taken as a case study. Moreover, the focus of this paper is on the outcomes of the survey-questionnaire, delineated in the form of a snap-shot of the current user support services in ESGF. It is important to note that, cyber-infrastructure staffs who support users have also other tasks to be done at the same time, for instance; programming, strategic planning, node administration and others, apart from servicing end-user requests. Therefore, it is pertinent to capture their thinking about the current user support practices in ESGF and other associated projects of climate e-Science. The rest of the paper is organized as follows: Section 2 describes the work related to cyber-infrastructure and user support concepts. Before depicting the snapshot of the current processes in ESGF in Section 4, Research methodology is explained in Section 3. Finally, section 5 describes the critique of the current user support, followed by conclusion and discussion in section 5 and 6, respectively.

RESEARCH METHODOLOGY

The snap shot of the current user support practices in cyber-infrastructures was captured in this study via survey-questionnaire and via participatory observation. The goal of the survey questionnaire was to investigate the current user-support process in use in main projects of cyber-infrastructures (related to climate science). There are different methods available to conduct survey for instance: by-mail (post), telephone etc. However, online questionnaire was the method chosen for this survey because it is quicker, automated and supports complete anonymity of participants (Lazar, Feng, & Hochheiser, 2010).

As this research focusses on improvement of the user support process in climate cyber-infrastructures, therefore conducting survey with the staffs of climate cyber-infrastructures is a vital step. The reason of conducting a survey

with the staffs of cyber-infrastructures as the "target population" (Couper, 2000), is because these staffs though maintaining and further developing cyber-infrastructure are also partly are involved in supporting users. Therefore, these staffs can be partially called user support staffs. The questionnaire was divided into 5 different sections to get information about the following: Structure of support, time related factors in user-support process, communication factors in user-support process, user requests related factors in user-support process, users related factors in user-support process and collect data relating to sample description and introducing basic social biographic data with self-rating about their expertise.

LIMITATION OF THIS STUDY

The outcome of this survey questionnaire hinge on the responses of the cyber-infrastructure staffs that support users. There is a danger that these responses might be based on estimation of the staffs, who were the respondents in this survey-questionnaire, which might not reflect the actual picture of the current support process. There is little or no documentation available about the current support process in practice to verify the responses. However, keeping with the data triangulation scheme, the quantitative and qualitative data collected from this survey will later be not only tallied but also verified with different sources. These other sources include; interviews conducted with the support staff, users and other stakeholders, the mailing-list communication between the end-users and the support staffs. Finally, conducting focused group validation. Despite small sample size of the respondents, the data collected is still useful and the results are significant. Due to small sample size detailed statistical analysis is not shown in this paper; only results from descriptive statistical analysis are presented. Similarly, some of the basic biographic data is also not presented and discussed in this paper. During the time of writing of this paper, the results of survey-questionnaire are complete. However, results of interviews and archival analysis are yet to be compiled.

PORTRAYING THE SNAP-SHOT OF THE CURRENT USER SUPPORT PRACTICES

This empirical qualitative cum quantitative investigation revealed number of issues where attention should be paid to and the situations are needed to be improved in the current user-support process in the climate cyber-infrastructure projects. These issues include allocation of time, human resources, response time, time to solve the user-problems, characteristics of user requests, support tools, support structure and others.

In the survey questionnaire, mostly ESGF employees (17 out of 26) took part as respondents. Other respondents included the staff from C3Grid which is connected to the ESGF infrastructure as both of the project host common climate data projects. From the survey and participant observations one can see that male members are part of the cyber-infrastructure team as IT is dominated by male members, we need to encourage women to take this position. All support staffs have technical as well as scientific knowledge and all staffs have at least Bachelors as the minimum qualification and PhD as the maximum qualification. This indicates that the respondents are well-qualified and highly skilled. On top of it the employees are also sufficiently experienced with the support activities.

The current staffs that do user support in climate cyber-infrastructure projects like ESGF and others are dominated by the technical experts followed by some staffs who also have some climate domain knowledge. However, it is prominent from the survey questionnaire that the employees dedicate at least from 1 hour (as answered by 42% of the participants) up to maximum 4 hours (as answered by 12% of the participants) of their daily work time to user support activities. 21% of the participants dedicate 2 hours and 3 hours each from their daily work to user support activities (see figure 1).

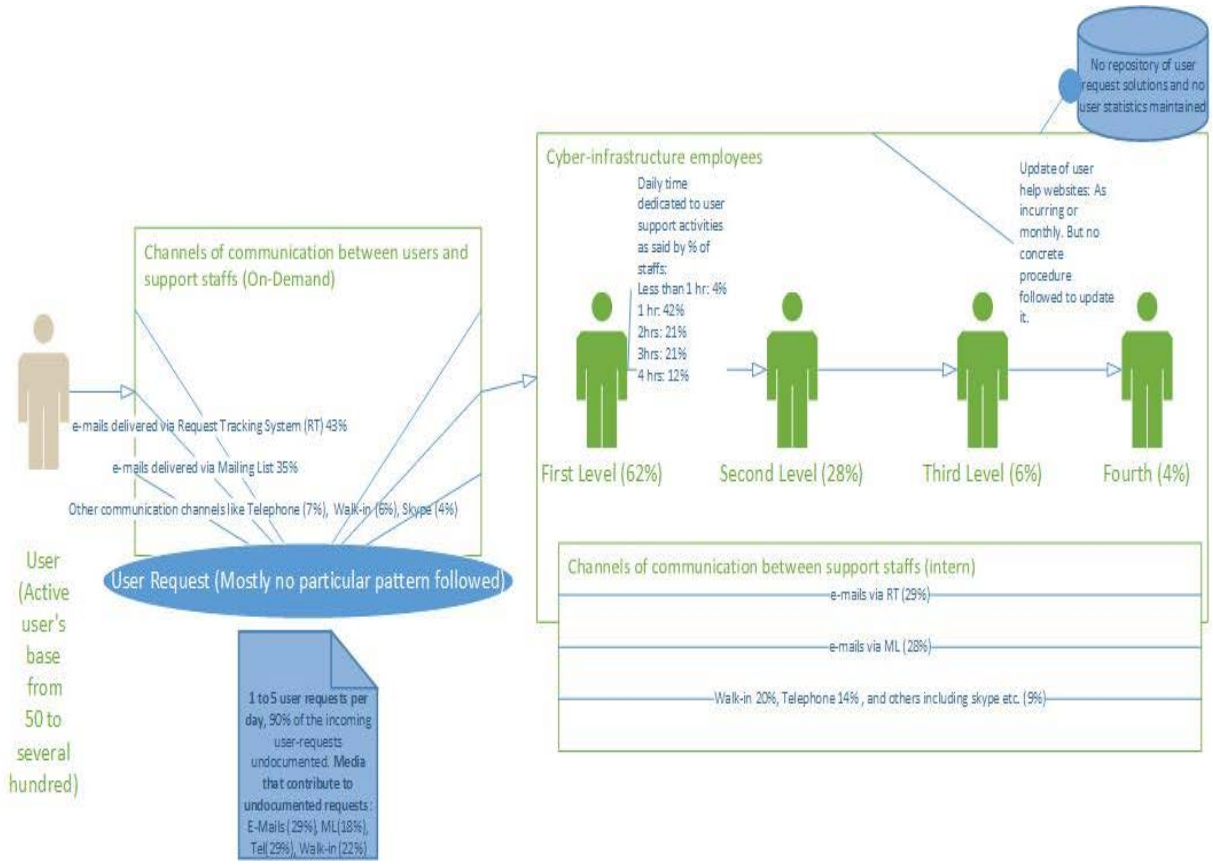

Figure 1 The current user support scenario in climate cyber-infrastructure projects.

It is an important observation that the participants are not only doing support activities, but also doing other activities, such as software development, infrastructure administration, research activities and other non-support activities. The following activities are popular amongst the support staff: Software development (as stated by 68% of the respondents), writing documents (68%), which are the major activities i.e. most popular activities amongst respondents which occupy their time. Other activities include system administration (60%), research work (44%), administrative activities (40%) and data related activities (40%). In ESGF, there are no dedicated user support employees i.e. an exclusive user support team hired for user support, thus performing user support activities only.

User support model is diverse and distributed. This observation is in accordance to the structure of an organization, which is distributed globally. Moreover, the user support type in climate cyber-infrastructures is mainly on-demand that is why time zones where users live are important. For example, for the users who are in Europe, the support people with in the European time-zone are relevant and the support people in USA are in a different time-zones. It is important to take care of the time-zones while planning a timely and efficient user support process.

In user support process of climate cyber-infrastructures, there are no levels of a user query escalation formally defined. Therefore, the role of first level staff (FLS)[1] and second level staff (SLS)[2] is not hardcoded in support process of ESGF-like climate cyber-infrastructures. In the current climate cyber-infrastructure user support framework, taking the global picture, there is no definite classification in N-tiers i.e. FLS and SLS. In some support units there is a practice of two-tier user support system (41%) whilst in others there is one-tier (41%) support structure. The rest of the support units are not organized into any tiers Thus in ESGF user support system FLS and

[1] First Level Support (FLS) is also known as Front Line Support meaning that the incoming user queries are handled by the front line staff which are generalists and non-specialists. The user queries that could not be handled by FLS are referred to Second Level Support (SLS) for further treatment.

[2] Second Level Support (SLS) is also known as Second Line Support meaning that the incoming user queries are handled by the second line staff which are specialists.

SLS both exist in parallel. However, sometimes SLS (Second Level Support) is getting questions directly. So there is no complete distinction between one or two tier support structures as in other support infrastructures in other IT domains.

More than half (62%) of the incoming user requests are treated by the staffs of climate cyber-infrastructure at first level i.e. without forwarding it to a second person. However, 28% of the incoming user requests are handled by two levels of staffs. This means that staffs who receives the request at first, refers the request to another colleague; for instance; for further treatment. This phenomenon is known as second level escalation. Similarly there are three and four level escalations with 6% and 4% of incoming queries each in the current user support process. From this result one can say that the incoming queries (62%) treated by single staff may contain *simple and routine*[3] queries, similar to the one observed by Leung and Lau (N. Leung & Lau, 2006). Only few users use a particular pattern of a request. If a user-request is treated by many support staffs i.e. many support levels, this shows the total number of human resources allocated to solve a user-request thus the treatment of user-requests might get expensive.

Most of the respondents (70%) claim that they need up to 3 hours to reply to the user-requests on the average. So, response time works fine. Almost 43% of the incoming user-requests (user-problems) can be solved within an hour. These incoming user-requests that are solvable within an hour may be classified as simple problems (with respect to solution time). Previous research by (Knapp & Woch, 2002; N. Leung & Lau, 2007) has confirmed that a majority of the incoming queries are simple and routine. Solution time of user request works fine in the current user support system.

Most of the support staffs (68%) believe that it might take a day or up to 2 days to get a reply after delegating it to a peer support staff. It is vital in the support process to reduce the reply time after request delegation is made to another staff to make support process faster and efficient. It is interesting to note that none of the respondents are of the opinion that the response from the second support staff can be within an hour. This observation further strengthens the distributed nature of the support process in climate cyber-infrastructures.

Most of the respondents believe that the user's base (total number of end users) range from 50 to several hundred. According to recorded responses, numbers of incoming requests from end-users per working day are from 2 to 5. This means in this case personal relationship can be made with the users. According to the survey results, it is evident that most of the end-users as according to the observation of support staff's (59%) perspective are satisfied with the support process. However, there is a room for further improvement in terms of satisfaction because no one is "very much" satisfied (as according to survey) with the support process, which is similar to the satisfaction-level of support staffs.

Most of the support staffs (80%) do not collect statistics of incoming user requests. Multiple delegation (MD)[4] is not always made in user-support process in climate cyber-infrastructure projects. However, there is a practice of multiple delegations in the user support process only to a limited extent. The update of user-support information on the user support portal i.e. e-support is not regular. Most of the incoming user-requests are in English language.

From the results, one can deduce that in cyber-infrastructures, "e-mail" leading to RT and mailing lists (ML) is the major mode of communication between users and the support staff as opposed to telephone in some other organizations using IT help-desk support, also known as call centers (Major sources of user contact table 21 Lau and Leung 2007 Journal of CIS). According to respondents (support staffs), users prefer e-mails leading to RT (Request Tracking software) the most as it was ranked the highest. It is noteworthy to observe that this evidence is similar to the evidence from Q. 23 of the survey. The users just like support staffs prefer e-mails leading to Request Tracking software (RT) the most. Mailing lists (ML) are ranked second. Therefore, from these results one can deduce that in e-Science users do not prefer other media as a priority, only e-mails "leading to RT" is the popular mode of communication between users and the support staff. This result is in accordance to the distributed nature of cyber-infrastructures. From the results one can infer that even in the internal communication between cyber-infrastructure

[3] Simple and routine queries are the queries that can be solved by FLS in very little time. In some cases, if adequate and relevant information is provided to the user then a user may solve the issue him/herself. Example of simple and routine queries include: Password queries, account queries, hardware and software enquiries.

[4] Multiple delegation happens when a user support staff sends the requests at the same time to various colleagues to treat the request further.

staffs, "E-mail leading to RT, followed by Mailing List" are also the popular media. It is important to note that some of the incoming user-requests remain unresolved, which is not a positive sign.

Most support staffs handle user-requests in a non-documented way i.e. after or during treatment of user requests the documentation about the nature of solution or the nature of problem is not made and stored in a repository. Most of the support staffs (90%) as according to responses collected from the survey, do not document the incoming user-requests. It is interesting to know the different forms of communication via which non-documented user-requests are received by the support staffs. From the survey results, it is evident that the unrecorded e-mails, telephone calls followed by walk-in and unrecorded mailing lists are the media which are used for undocumented user-requests. None of the support staff said that they need to write more than two times, which means that the incoming user requests are generally understandable.

In the current user support process there is no categorization of the incoming user requests done. From the survey, different possible sub-categories of the first proposed main category i.e. general information are suggested by respondents as follows:

- Authentication category; i.e. getting logged in
- Software usage category; model compilation, debugging, optimization, feature development, software installation
- Quality control; Queries about correctness of the data which have been downloaded
- Projects e.g IPCC AR5, CORDEX,, CFMIP, LUCID;
- Models: ECHAM6, MPIOM, JSBACH, HAMOCC, CCLM4
- Data publication category; how to publish data i.e. data publication?
- Post-processing of data
- Data citation
- Miscellaneous

CRITICISM AND SUGGESTIONS FOR IMPROVEMENT

In the current user support process in climate cyber-infrastructures, there is no assignment of user support roles. Consequently, top computer scientists end-up performing the duties of the front desk, in parallel to their main (core) duties. Cyber-infrastructure employees already have a daily plan of action (P) in their memory i.e. doing activities such as software development, data curation, writing documents etc. So, the planned tasks are known beforehand. The incoming events (E) or event tasks, which are user's or other employee's requests that can be triggered at any point in time, are actually interruptions to their daily work plan of action. Therefore, the incoming event tasks may affect the routine of employees, affecting the planned tasks. As a consequence, it requires cyber-infrastructure employees to allocate more time (T) to process user queries or alternatively dedicating less time to their core tasks. Employee's contribution to process user queries is not formally recognized by the cyber-infrastructure management in such a way that incentives are provided to the employees who process user requests.

There can be two types of event tasks: First, explicit event tasks, meaning that task performed on the request of a user or an employee i.e. responding to users' or other employee's e-mail received. The second type is an implicit event task which is performed by employees based on their own cognizance (awareness); for instance; updating the web page by inserting relevant information for users or inserting an alternate solution in the repository after its discovery. So all of the planned tasks and event tasks are needed to be prioritized and there is no priority rule existing in the current user support practices. The current priority is based on employee's own judgment, which is noteworthy to be investigated further by asking employees. After prioritization of tasks, tasks are then actually performed within a specific time (T) using certain means (M). T and M are generally also not recorded in the user

support process of climate cyber-infrastructures. The current practice of T and M varies from location to location and time.

There is no central repository or database to record user requests and the solutions. Consequently, the solution to the redundant enquires or enquires of similar nature cannot be known or matched via a central information retrieval system. Though, help webpages are available at the ESGF and its associated web links, however, a central information retrieval system is currently not available to the users or to the employees where relevant information can be sought by browsing the categories of redundant queries and their solutions. It is in the interest of users as well as employees of cyber-infrastructures that a knowledgebase and information retrieval system may be designed, developed and made available online. At first it seems a lot of effort and it may require resources but in the long run it will benefit the users and employees both.

From the survey results, it is an important observation that not all questions are answered by the employees. Because of the multiple channels of communications and no ticket assignment mechanism in the user support process, some of the user requests might be over-seen (at some intervals). At times, the user support staffs that are scattered world-wide, may rely on other colleagues and may not find themselves responsible to answer or even to take all user queries. So keeping in view the current arrangement of user support process, no one feels answerable, which is not a positive aspect of the current user support process in climate cyber-infrastructures.

In a nutshell, there is a process of user support which is existing in the climate cyber-infrastructures but it is not formally defined in the cyber-infrastructures in such a way that it is measured in terms of quality, cost and standardization. Its resources are explicitly allocated or it is organized as per wishes of cyber-infrastructure users. So far, there was no survey conducted to capture and analyze users' wishes or to measure usability and accessibility of UI of ESGF and ESGF-like cyber-infrastructures and users' help portals. There is no process owner(s) of the user support process and in the ESGF governance scheme there is no explicit regulated process about user support process in ESGF.

Unfortunately, there is no categorization of the incoming user queries and no information is available about the categories. Therefore, all the incoming user requests are answered based on the experience and knowledge of cyber-infrastructure employees. There is no document, repository (database) or an information retrieval system available where the user request categories can be stored for future reference in order to avoid redundant effort of working similar user requests. Similarly, there is no user self-help culture where the users may look at the self-help retrieval system to get the initial information about the problems they are facing.

In the current user support process, users do not provide feedback or suggestions to improve the whole process. Similarly there is no mechanism of rating solutions. Users can be motivated to provide suggestions and rate the solution by developing a facebook-like platform where a user may also comment on the problems of other users. The solution time, employee's responses time to user and between supports staffs, in case the request is delegated, is not uniformly defined and agreed upon by all stakeholders. Service level agreements (SLA) can be made and applied to regulate the current user support so that the employees know that they have to deliver some quality of service within a specified time. Plausible SLA can be formulated by forming a consensus between executive committee, the technical committee and other stakeholders of ESGF cyber-infrastructure.

CONCLUSIONS

Looking at the results of the survey one can say that in a nutshell, the user support process is working fine for the time being. However, this does not mean that it will work in the same way it is working now, in future forever. Therefore the current user support process in ESGF and ESGF-like cyber-infrastructure needs stepwise reforms and standardization. If appropriate measures are not taken at the right time (i.e. now) to standardize and study the requirements of end-users then the user support process can deteriorate in future. Because the data holdings offered by ESGF are on the increase day by day, besides ESGF is expanding its services to other domains such as chemistry and biology. So in future, as evident from history of ESGF; it is foreseen that there will be continuous changes in the architecture of ESGF and ESGF-like cyber-infrastructures as well as in their organization. These changes do affect the user support process on the whole. Since there are no dedicated user support staffs in ESGF and ESGF-like cyber-infrastructures, it is imperative to introduce dedicated user support staff at least at the first level support. The notion of user support staff or human user support agents is not formally defined in ESGF and its associated cyber-infrastructures in the same manner as the position of data manager or data steward was not part of e-Science in the

past. However, with the passage of time the designation of data manager was formally recognized and nowadays in the field of e-Science data manager is a position that deals with data curation and data quality control activities (Karasti, Baker, & Halkola, 2006). In the same manner the importance and necessity of user support manager is being felt in climate cyber-infrastructures. One can assign a user support staff position to a student or a less qualified person who is able to mitigate the simple and routine queries in the user support process in cyber-infrastructures, so that the top computer scientists are not busy with doing trivial tasks. Moreover, it is suggested that the position of user support manager be introduced in the cyber-infrastructure projects and the user support manager can be a process owner at a particular user support unit at a particular location that can manage his/her user support activities falling in his/her jurisdiction.

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An Insight Survey of Innovation Laboratories Worldwide

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ABSTRACT

During the last decades, the drastic changes in market, customer needs, technology and perceptions have stepped the world into an era of innovation, where organizations are continuously striving for an advancement of products, methods or processes to better meet the varying demands of society and keep their edge in a globally competitive environment. The way of innovation is not straight forward and encompasses different obstacles which need to be alleviated in order to design and implement a successful innovation that drives commercial value in the market and brings growth to companies. Subsequently, some dedicated and specialized physical environment is needed to support the innovative activities in a systematic way and minimize the effects of these barriers; this requisite has led to the emergence of innovation laboratories. Currently, a number of innovation laboratories exist around the globe, that are very divergent in terms of capabilities, features and resources; however, this variation and their potential have not been thoroughly investigated. We present the results of a study that identifies the salient features, potential and capabilities of existing innovation laboratories and serves to streamline further research in this domain in order to strengthen their existence and potential, and maximize the use of their innovative services.

Keywords: Innovation Laboratories, Innovation Support, Innovation Services, Innovation Management

INTRODUCTION

Innovation has always been a driving force for growth (Zahra & Covin, 1994), and the challenge is to continually innovate new technologies and new capabilities. Innovation is about using change to better meet the needs and values (Damanpour, 1991). Different authors have described the concept of innovation in different ways. Some scholars have perceived innovation as a discrete product "a new idea, method or device" (Damanpour & Evan, 1984) and (Kimberly & Evanisko, 1981), while the others see it as a process "the process of introducing something new" (Rogers, 2010). In the literature, it appears that innovation means different things to different people (Damanpour & Schneider, 2006); however, the common thing in all perspectives is the newness or the novelty of the substance. Therefore, innovation can be described as "an idea, a practice, or object perceived as new or improved by an individual, organization or society" (Damanpour & Gopalakrishnan, 2001).

During the last decades, the drastic changes in market, customer needs, technology and perceptions have stepped the world into an era of innovation, where organizations are continuously striving for an advancement of products, methods or processes to better meet with the varying demands of society and keep their edge in a globally competitive environment (Howell & Higgins, 1990), (Ettlie & Reza, 1992). The way of innovation is not straight forward and encompasses different obstacles which need to be alleviated in order to design and implement a successful innovation that drives commercial value in the market and brings growth to companies. Subsequently, some dedicated and specialized physical environment is required to support the innovative activities in a systematic way and minimize the effects of these barriers; this need has led to the emergence of innovation laboratories.

An innovation laboratory is an emerging phenomenon, that is getting a rapid popularity among all sectors of the world and largely functions as public-private partnerships where firms, academics, public sector authorities, and citizens work together for the creation, development and implementation of new products, processes, services and technologies. The term 'innovation laboratory' does not have a single definition. By some authors it has been characterized as dedicated physical environment with collaborative facilities to support and stimulate creative thinking (Magadley & Birdi, 2009). Others elaborate the concept a bit further as dedicated facilities to support creative behaviors and innovative activity by providing resources and enabling for reconfiguration of new projects (Lewis & Moultrie, 2005). Later on, Gey summarized that "an innovation laboratory includes two characteristics: a physical environment and a facilitator" (Gey, Meyer, & Thieme 2013). In the broader sense, the term can refer to a methodology, an organization, a system, an arena, environment and/or a systematic innovation approach; however, in the scope of this paper we consider an innovation laboratory as a dedicated physical environment that supports and fosters the innovation process through the provision of different collaborative services and the resources (equipment, methods and tools).

The innovation laboratories offer great diversity of skills to innovate something in a collaborative physical environment and play a vital role in the successful implementation of innovation in every field of the world. They have helped hundreds of companies around the world to enhance their capacity to innovate and maintain their market leadership. They provide the necessary tools for the generation, discussion and assessment of ideas; the simulation tools and the test environment; to assist the organizations to foresee the future obstacles and reduce the risk factor in implementing the innovative ideas into their businesses without investing too many resources on their own. (Thieme & Meyer, 2011). They lead to the successful innovation by supporting the interaction between the technology push actors (research institutes) and the demand pull actors (companies) (Meyer & Thieme, 2010).

Recently the concept of innovation laboratories, hereafter referred to as InnoLabs, has immensely grown and now a good number of InnoLabs exists around the globe. Owing to the fact that the concept of InnoLabs has been originated only few decades back, little research has been carried out in this area. Since the literature does not show any comprehensive study regarding the worldwide diversity of InnoLabs in terms of features, services and resources; there is a dire need of a systematic study elaborating their capabilities and potential and presenting a complete insight of all InnoLabs. The study "An insight survey of Innovation laboratories worldwide" is first study ever of its kind about the InnoLabs and intends to explore their potential and diversity and to establish a snapshot of the InnoLabs' capabilities in terms of resources, major ideas, methodologies, typical innovation processes, time frames and so on. The paper is an attempt to streamline the further study on InnoLabs in order to strengthen their existence and maximize the use of their innovative services.

METHODOLOGY

The goal of our research is to construct a comprehensive picture of the state of the art InnoLabs. In order to achieve this objective, the study was conducted in two phases. Initially, a web based study was conducted in order to collect information about various InnoLabs existing worldwide from their official websites. The websites were searched by using different search engines with different keywords. A total of 190 InnoLabs were identified and a preliminary assessment of the offers and potential of the InnoLabs was made (Meyer et al., 2014). In the second phase, an online survey was conducted by means of a questionnaire to better verify and improve the findings through direct contact with the identified InnoLabs. An exploratory analysis of the data was performed to identify the various features, services and characteristics of the InnoLabs.

Survey Design and Dissemination

The survey consisted of an online questionnaire comprising 32 open ended and nominal scale items allowing the respondents to provide single or multiple answers for a question depending on the type and nature of the criteria to be assessed. The questionnaire also provided the opportunity for the respondents to supplement their answer with additional information or comments. The questions were organized in seven sections with each section regarding a different dimension that was to be assessed about InnoLabs such as, introductory information of the lab, information about the offers provided by lab, innovation processes, methods and tools used in innovation processes, facilities provided by lab, process related statistics, and other supplementary information. The questions were structured and a brief explanation was provided for the complex terms used therein.

Survey Participants' Demographics

Owing to the fact that the term Innovation Laboratory has been coined just recently, the literature does not mention the exact number of InnoLabs existing around the globe. We considered the 190 labs identified by the web-based exploratory research during the first phase of the study. We are aware that more physical spaces providing the innovative services also exist, which were not identified by the web-based research. They remain unidentified because either they are not listed on the web, or are not listed in combination with our search terms and are not linked to other laboratories' web sites.

We approached and invited the 190 identified InnoLabs to take part in our online survey through e-mail and a clear consent was provided at the beginning regarding data privacy policy. A few days later, the InnoLabs who did not respond to the first invitation were sent a reminder for participation in the survey. At maximum three reminders for participation were sent to the invited InnoLabs with regular intervals. As a result, 35 out of 190 invited InnoLabs, participated in the survey. Out of this more than three fourth of respondents (27 labs) completed the survey while the rest of the InnoLabs (08 labs) answered it only partially. The respondent participants of the survey were found to be located in different regions of the world. Most of them are situated in developed countries while few are in the BRIC countries. We tried to rule out a possible language bias in the list of InnoLabs (Meyer et al., 2014). Figure 1 shows the geographic distribution of participating InnoLabs.

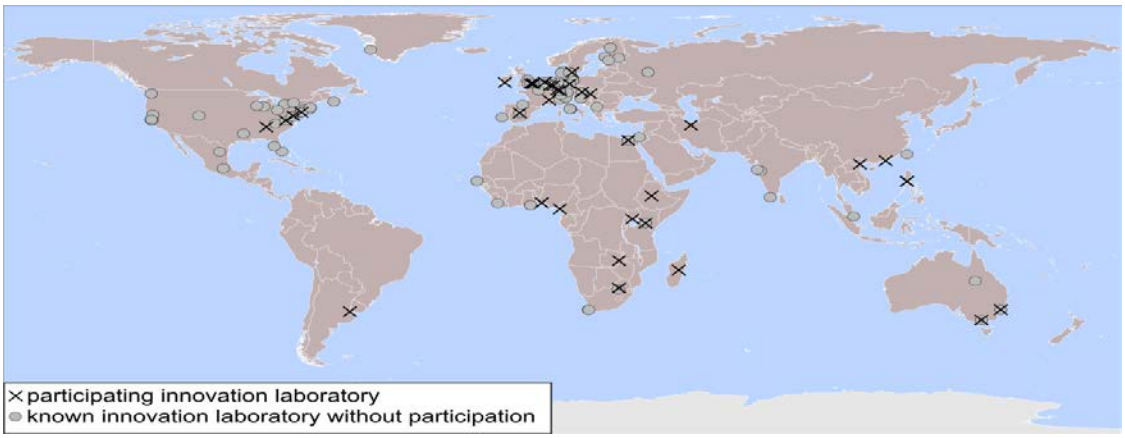

Figure 1: Geographical representation of participating InnoLabs of the survey. (N=35)

The participating InnoLabs of this study have originated over the years. More than 74 % of the Innolabs have been established after the year 2007 with only few labs originating earlier. The starting years of our thirty five participating InnoLabs are shown in figure 2. From our data we cannot distinguish if this distribution is due to a short life span of InnoLabs or if the number of InnoLabs founded really increased around 2010.

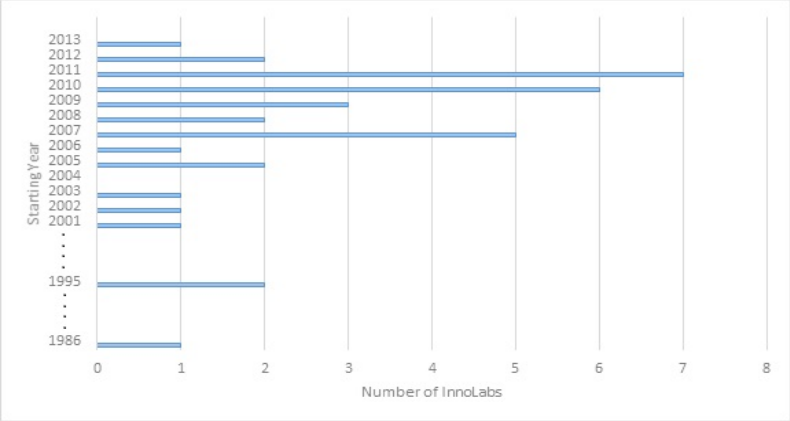

Figure 2: Starting year of the participating InnoLabs of the survey. (N=35)

Data Analysis

The software package R, programming for statistical computing (http://www.r-project.org), in version 3.0.1 was used to evaluate the data collected through the questionnaire and to create most of the diagrams presented.

RESULTS

Areas of Knowledge in which the InnoLabs Provide Innovation Support

Innovation is needed in nearly every field of the world. Thus, InnoLabs offer the innovative services in various areas. As illustrated in figure 3, the major area wherein the InnoLabs provide innovation support seems to be IT and software development as about 70% of the respondent InnoLabs provide their innovative services in this field. This high level of focus in IT and software development is followed by InnoLabs' concern with business processes and service engineering. About 58% of the respondent InnoLabs claimed to provide innovative services in business area, and about 55% of the InnoLabs provide their support in the field of service engineering. The innovative services in the field of social services are provided by about 27% of the InnoLabs. The electric and mechanical engineering, finance, healthcare, and media and design areas seem to be focused by only few of the participating InnoLabs. These areas are supported by 18%, 15%, 12% and 9% of the respondent InnoLabs, respectively. In addition, few of the InnoLabs also provide innovative services in other fields such as innovation studies, architecture, logistics, community participation, but, the number of such InnoLabs is small (about 27%).

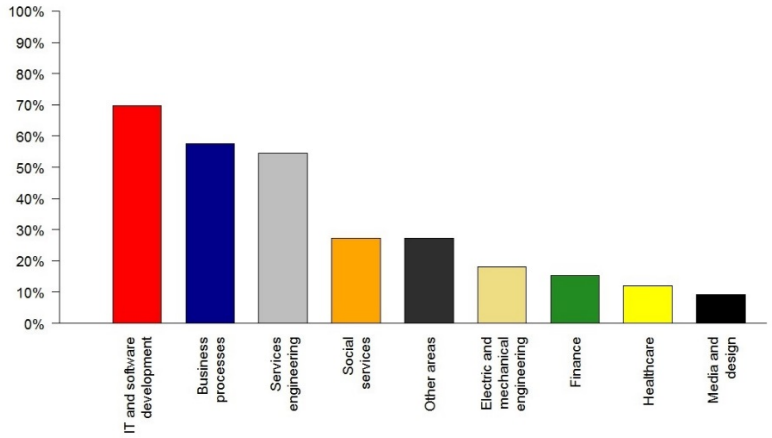

Figure 3: Areas of knowledge in which the InnoLabs provide innovation support.
(N=33, multiple selections possible)

Types of Services Offered by the InnoLabs

Innovation is not a single event or activity, but it is a process, which encompasses a number of activities to be supported by InnoLabs. During the web-based study, we generated a list of possible innovative services that an InnoLab may offer (Meyer et al., 2014). The list includes facilitating the customers to get in contact with experts, organizing moderated innovation sessions to transmit valuable experience and know-how from the experts to the customers, providing consulting services, providing physical co-working space and open meeting places, designing rapid prototyping tools and engineering tools, assistance in finding suitable funding sources for innovative ideas during the business startup, providing the means for contact to the normal citizens, and training. The survey revealed that the most common service provided by the InnoLabs is the provision of linking services with experts and organizing moderated innovation sessions for customers to acquire knowledge regarding innovation opportunities, processes and strategies. The provision of such services suggests that InnoLabs act as intermediaries in the innovation process. Linking services with experts are offered by 84% of the respondent InnoLabs while the provision of moderated innovation sessions is the second most common service offered by 81% of the participating InnoLabs. About 62% of InnoLabs provide startup mentoring services, while both the consulting services and provision of open meeting place are provided by 59% of the respondent InnoLabs.

Half of the participating InnoLabs provide co-working office space. The development of rapid prototyping tools, establishment of contacts with normal citizens, development of engineering tools, and support for the funding brokerage are provided by 44%, 38%, 22% and 19% of the respondent InnoLabs of the survey, respectively. The training services stay last in the elevator and are provided by only 16% of the InnoLabs. In addition to these services, about 9% of the respondent InnoLabs provide support services in other domains as well including social innovation methodologies, sustainability visions and research and technical tools for animal tracking.

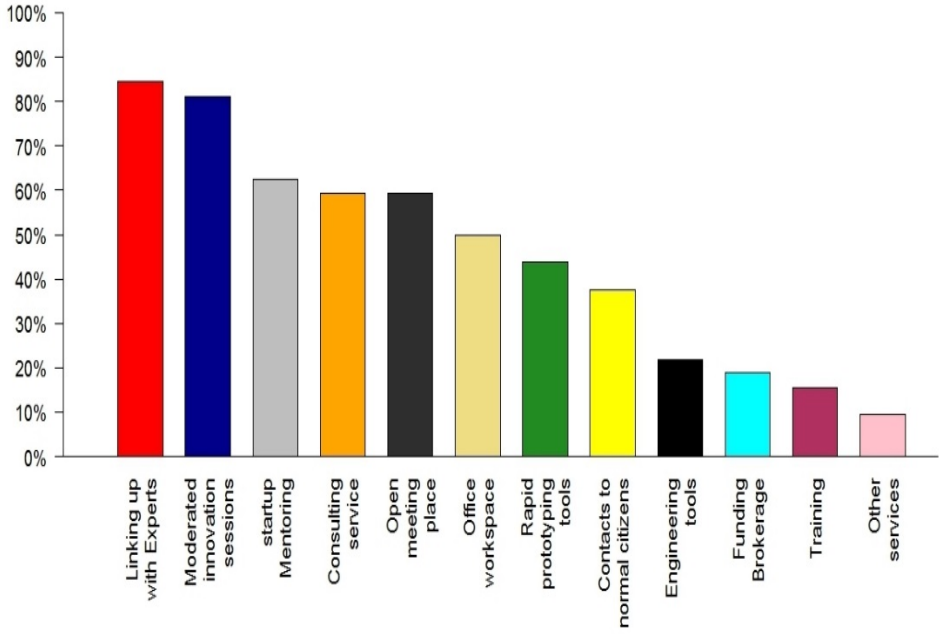

Figure 4: Types of services offered by InnoLabs. (N=32, multiple selections possible)

The Access Criteria for users of the InnoLabs

Innovative services are required by various users for commercial, educational, research, cultural and political use. The access criterion for the InnoLabs is not uniform across all groups of users and depends on who asks for services. Users may have paid access, free access, mixed access or no access, provided by the InnoLabs. The findings of our survey show that the employees of the InnoLabs, students and academic users can access most of the InnoLabs free of cost. The academic users can access around half of the InnoLabs (48%) free of cost, get a mixed access to 32% of the InnoLabs, paid access to about 16% of the InnoLabs and cannot access 4% of InnoLabs. Subsequently, the students get free access to about 65% of the InnoLabs, while 15% of InnoLabs provide them mixed access and paid access is provided by 4% of the InnoLabs. Interestingly, they are restricted to access 15.4% of the InnoLabs. Regarding employees of the InnoLab, slightly more than the three fourth of the InnoLabs (76%) provide them free access, 20% InnoLabs provide them mixed access, 4% of the InnoLabs offer paid access and none of the InnoLabs restricts them to access.

In contrast, innovative services for business organizations are mostly available after paying for each service. The SMEs and big companies other than the partner companies of the InnoLabs are only entitled for paid access to most of the InnoLabs. They have free access to very little number of InnoLabs. Any big company gets paid access to 41% of the InnoLabs, and mixed access to one third of the InnoLabs. Interestingly, they are entitled for free access by only 11.1% of the InnoLabs. SMEs have paid access to 39% of the InnoLabs, mixed access to 36% of the InnoLabs and free of cost access to 14% of the InnoLabs. Surprisingly, 11% of the InnoLabs do not allow the SMEs to access them in anyway. In the case of partner companies, slightly more than half of the InnoLabs (56%) provide mixed access to them while each of paid access and free access is provided by 19% of InnoLabs. They are restricted to access by only few InnoLabs, which amounts to about 7%. The normal citizens tend to have mixed access to a larger number of InnoLabs (nearly half of the InnoLabs) while the number of InnoLabs providing them free access is only 8%. Normal citizens are restricted to access higher number of the InnoLabs (24%) as compared to any other group of customers.

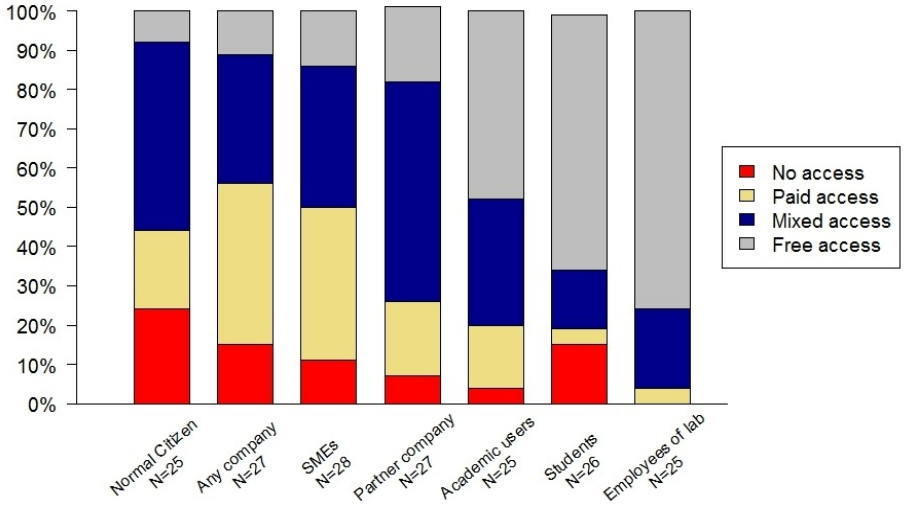

Figure 5: Who and in what way can access the InnoLabs?

Number of People Working for the InnoLabs

Number of people who work for and represent an InnoLab may affect its efficiency and performance. The survey shows that the number of people working for most of the InnoLabs is lower than 10. Slightly more than one third of the respondent InnoLabs (about 37 %) indicated that their employees count up to 5 whereas 26% of the InnoLabs have 5 to 10 employees. The number of InnoLabs having employees more than 10 is very small. Only about 9% of the InnoLabs indicated up to the 15 employees, 6% of the InnoLabs account for up to 20, 17 % of the InnoLabs have up to 50 people and 6% have more than 50 people working for them.

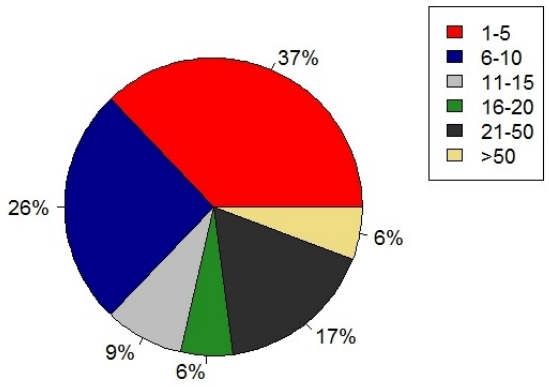

Figure 6: Number of people working for InnoLabs. (N=35)

Types and Number of Employees Working for the InnoLabs

Different types of employees including moderators, experts (engineers, programmers, and designers), scientists, social workers, unskilled workers and administrators can work for an InnoLab. The number of employees of different types working for an InnoLab highly influences the efficiency of the lab. The findings indicate that most of the InnoLabs either do not hire some of these types of employees or only employ them in very small number. The moderators, scientists and the experts seem to be either not employed in most of the InnoLabs or their number is limited up to the 5. As shown in figure 7, about 38% of the respondent InnoLabs of the survey employ 2 to 5 moderators; 33% of the InnoLabs have only one moderator while 17% of the InnoLabs do not have any moderator at all. Only few of the InnoLabs (about 13 %) employ more than 5 moderators. Regarding the experts hired by a lab, slightly more than half of the InnoLabs have 2 to 5 experts. Remarkably, all of the InnoLabs hire at least one expert. The scientists working for the InnoLabs are also fewer. About 14% of the InnoLabs employ a single scientist and 23% InnoLabs employ 2 to 5 scientists while the number of scientists approaching 10 and more than 10 is reported by

14% of the InnoLabs, each. Most surprisingly, 36% of the respondent InnoLabs do not have any scientist working for them. Most of the InnoLabs do not have any social worker working for them as well, which amount to about 82% of the survey participating InnoLabs. The remaining InnoLabs only have up to 5 social workers. The number of InnoLabs reporting the absence of an unskilled worker is also high (about 60% of the InnoLabs). About 10% of the InnoLabs have a single unskilled worker, and 25% of the InnoLabs have 2 to 5 unskilled workers. Few of the InnoLabs (5%) have slightly more unskilled workers but the number does not exceed by 10 anywhere. The administrators in an InnoLab are also limited up to 10. About 36% of the InnoLabs reported only one administrator, more than half of the InnoLabs (54.5%) indicated 2 to 5 administrators, 5% of the InnoLabs have up to 10 administrators. Surprisingly, some of the InnoLabs (5 %) do not have any administrator at all. Some of the InnoLabs (40%) also claimed to have some other types of employees numbering up to 10.

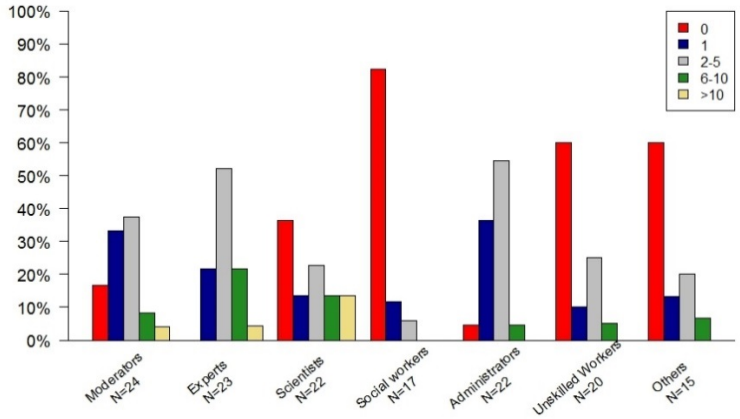

Figure 7: Types and number of employees working for the InnoLabs.

Time interval of a Whole Typical InnoLab Process

A complete innovation process encompasses a number of activities such as, identification of problem and opportunities, consultation and requirement analysis, design of the solution, implementation and maintenance etc. The time taken by InnoLabs to complete an innovation process is variable and depends on the type of innovation project. As shown in the figure 8, more than half of the InnoLabs (57%) take several months to accomplish an innovation process, while 13% of the InnoLabs take even longer time, about one year or more. Only few of the InnoLabs reported innovation process time up to one month. The innovation process time period of exactly one month, several days, or one day was reported by 9% of the InnoLabs, each. Only 4% of the respondent InnoLabs claim to complete an innovation process within several hours.

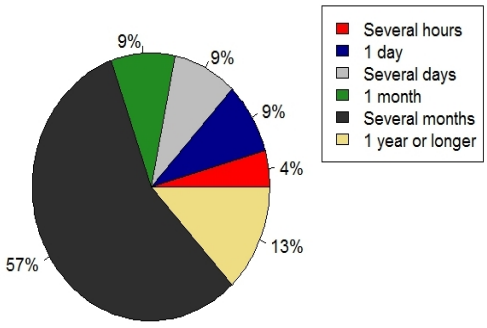

Figure 8: Time interval of a whole typical InnoLab process. (N=23)

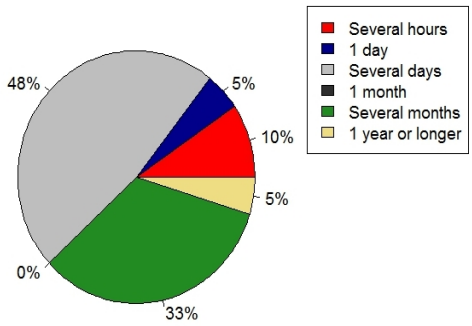

Figure 9: Typical accumulated InnoLab time spent together with a customer for the whole InnoLab process. (N=21)

Typical Accumulated Innolab Time Spent Together with a Customer for a Whole Typical Innovation Lab Process

Customers who ask for innovation services are the main component of the innovation process and the InnoLabs provide the services in close connection with them. However, customers only spend some time of the whole innovation process in the InnoLabs. This amount of time depends on the innovation project and the type of support asked for. As shown in figure 9, most of the InnoLabs reported this consultation time as up to one month. About 48% of the InnoLabs spend several days with the customer, while 5% of the InnoLabs take one day and 10% of the InnoLabs take several hours of consultation with the customer. The time of InnoLab spent with customer approaches to several months in case of 33% of the InnoLabs and 5% of the respondent InnoLabs of the survey take even longer time approaching to one year or more.

Extent of Utilization of Different Sources of Funding by the InnoLabs

Funding is the fuel on which InnoLabs run and provide their services to the community. An InnoLab can take different avenues to attain funding, and more than one option can be used. The performance and efficiency of InnoLabs depends on the type and amount of money they have. In terms of finance the sources for the InnoLabs may vary from 100 percent public funding to 100 percent private funding. As shown in figure 10, the survey revealed that most of the InnoLabs utilize private funding. Interestingly, more than the three fourth of the InnoLabs (83%) utilize the private funding to some extent, of which about 27% depend only on private funding while another 27% of the InnoLabs have acquired some public finance as well but private sources constitute the major portion of financing. In contrast, only 12% of the InnoLabs have acquired 100 percent public finance while about 15% of the InnoLabs use the combination of both sources, however the public funding makes the bigger part of the financing. An equal utilization of both sources (public and private funding) is reported by 19% of the InnoLabs.

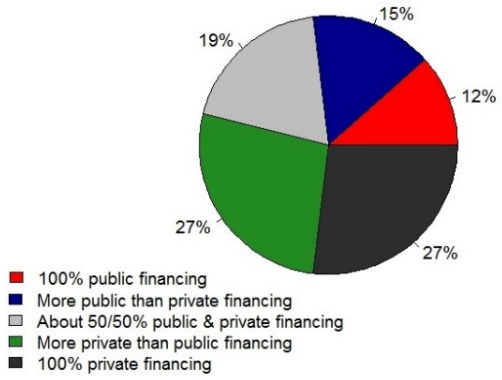

Figure 10: Utilization of different funding sources by the InnoLabs. (N=26)

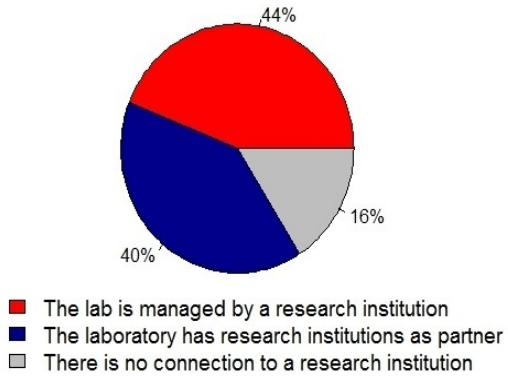

Figure 11: Connection of InnoLabs to research institutions. (N=25)

The Connection of InnoLab and Research Institution

Innovative services are not steadfast and require research to be conducted regarding the different aspects of developing and implementing the successful and sustainable innovative products, processes or technologies; therefore, InnoLabs may be affiliated with research institutes such as a university etc. The survey results revealed that InnoLabs usually have some connection to research institutes, either they are being managed by research institutes or having partnerships with them. As shown in figure 11, about 84% of the respondent InnoLabs reported a connection to some research institute, out of which 44% are managed by some research institute while the remaining 40% have research institutes as their partners. Only few of the respondent InnoLabs (16%) work in isolation from any research institute.

Typical Customer of the InnoLabs

As illustrated in figure 12, Small and medium enterprises constitute the most common user group of the 67% of the respondent InnoLabs of the survey whereas big companies and students are most common users of the 52% of the InnoLabs, each. The academic customers, employees of the InnoLab owner, and normal citizens are regarded as typical customers by 41%, 37%, and 33% of the InnoLabs, respectively. Other types of customers make up the common user group of only 11% of InnoLabs.

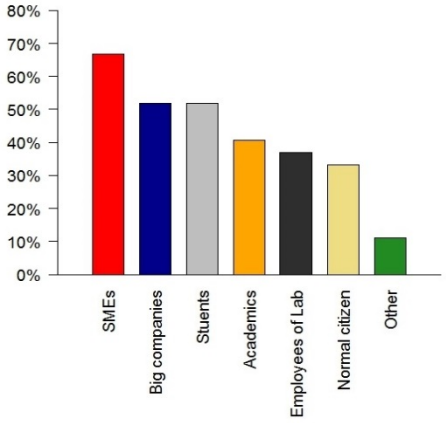

Figure 12: Typical customer or user of the InnoLabs. (N=27, multiple selections possible)

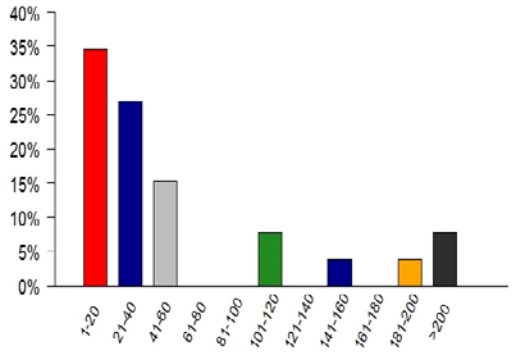

Figure 13: Recommended capacity for customers in the InnoLab. (N=26)

Recommended Participant Capacity in the InnoLabs

The study shows that the maximum number of participants that a particular InnoLabs can accommodate lies under 60 for most of the InnoLabs. As shown in figure 13, about 35% of the InnoLabs can accommodate up to 20 participants, 27% can facilitate up to 40 participants and only few InnoLabs (about 15 %) reported the capacity for 60 participants. The number of InnoLabs accommodating more than 60 participants is very small.

Process Related Statistics of the InnoLabs:

a. ***Number of InnoLab processes started per year:*** The number of processes that InnoLabs initiate per year is limited to the maximum of 15. The survey shows that one third of the respondent InnoLabs start 5 projects per year. Slightly fewer InnoLabs (30%) start up to 10 processes while only 11% start up to 15 processes annually. The number of InnoLabs initiating more than 15 processes per year is very small. Only 4% of InnoLabs claimed to start about 16 to 20 processes yearly. The number of processes in the range of 26 and 30, or 36 and 40, or more than 50 per year is initiated by 7% of the respondent InnoLabs.

b. ***Number of people involved in a typical InnoLab process:*** The number of people including employees, partners and customers involved in a particular innovation process seems to be up to 15 for most of the InnoLabs. The maximum number of InnoLabs reported between 6 and 10 people involved in a process. Referring to table 1, about 21% of the InnoLabs involve up to 5 people in a typical innovation process, 35% of the InnoLabs engage 6 to 10 people while 21% of the InnoLabs reported 11 to 15 people per process. The number of InnoLabs involving more than 15 people in a project is small.

c. ***Number of employees involved in a typical InnoLab process:*** The employees only constitute a portion of all the people involved in the innovation projects of the InnoLabs. A number of up to 10 employees involved in a typical innovation process were reported by most of the InnoLabs. About 69% of the respondent InnoLabs of the survey involve up to 5 employees only whereas 24% indicated 10 employees per process. The InnoLabs incorporating more than 10 employees is very small.

d. ***Number of projects for which the typical customer uses an InnoLab:*** A particular customer may undertake a number of projects in an innovation lab. Most of the labs indicated that the number of projects that a

customer undertakes with them is limited up to 5. About 82% of the InnoLabs reported the project count per customer within this limit, 12% of InnoLabs reported 6 to 10 projects per customer while only 6% of the InnoLabs indicated 16 to 20 projects per customer. The number of projects beyond 20 was not reported by any participating InnoLab.

e. ***Number of maximum projects for which one customer uses an InnoLab:*** The InnoLabs reported the number of projects that one customer undertake. The number of maximum projects taken by the best customer for most of the InnoLabs (70%) is up to 5. The count between 6 and 10, or between 11 and 15, each was observed in 10% of the InnoLabs. About 5% of the InnoLabs account for each, 16 to 20, or 36 to 40 maximum projects per customer.

Count (Processes/ people/ employees/ projects)	**Processes started per year (%) N=27**	**People per process (%) N=29**	**Employees per process (%) N=29**	**Projects per typical customer (%) N=17**	**Maximum projects per customer (%) N=20**
1 – 5	33.3	20.7	69	82.4	70
6 – 10	29.6	34.5	24.1	11.8	10
11 – 15	11.1	20.7	3.4	–	10
16 – 20	3.7	3.4	–	5.9	5
21 – 25	–	6.9	–	–	–
26 – 30	7.4	–	–	–	–
31 – 35	–	–	–	–	–
36 – 40	7.4	6.9	3.4	–	5
41 – 45	–	–	–	–	–
46 – 50	–	–	–	–	–
> 50	7.4	6.9	–	–	–

Table 1: Process related statistics of the innovation laboratories. A dash ("–") indicates zero percent.

Use of Methods and Tools by the InnoLabs:

Innovation development, implementation and realization requires a number of technical tools and methods. Almost all of the InnoLabs (93%) agreed with the utilization of a wide variety of tools and methods to support innovation processes whereas the remaining InnoLabs have shown a neutral response. The various methods that InnoLabs use include service blueprinting, brainstorming sessions, collaboration, prototyping, business model canvas and others. In addition, most of the InnoLabs (89%) agree that a good methodology is very important for the success of an innovation laboratory while the other respondent InnoLabs of the survey indicated a neutral response. Most of the InnoLabs also agree with the use of the loops/iterations in a typical innovation process (about 73%). The various tools used by InnoLabs include modeling and simulation tools, moderation tools, software development tools, designing and presentation tools and others.

Criteria	**Agree (%)**	**Neutral (%)**	**Disagree (%)**
The innovation laboratory utilizes methods and tools to support innovation. (N=27)	92.6	7.4	–
Loops or iterations are used in a typical innovation process (N=26)	73.1	26.9	–
A good methodology is important for the success of the innovation laboratory (N=27)	88.9	11.1	–

Table 2: Use of methods and tools by the innovation laboratories. A dash ("–") indicates zero percent.

DISCUSSION

The 21st century has seen the drastic evolution in innovative products and processes. In the past, many organizations have been able to survive even with very limited innovation; they used to focus on providing quality products and simply update them to a level that maintains their competitiveness in the market. Nowadays, it is not enough for the organizations to just provide quality products; instead the changes in market, customers and technology have made it obligatory for organizations to innovate at very high levels. Thus, day by day more customers seem to utilize the services of InnoLabs in order to integrate innovative products and services into their businesses. InnoLabs support the design and deployment of innovations by providing the collaborative physical environment for the customers. They support the human activities involved in the innovation process by assisting the customers in determining market needs, finding new opportunities, evaluating the feasibility of proposed innovative ideas and implementing them through the provision of various innovative sessions, training and experts' opinions.

The divergent nature of the various InnoLabs existing worldwide enables them to offer numerous innovative services in almost every field of the world including industry or technology areas that are deemed to have a significant cross-cutting economic and social impact such as ICT, service engineering and business; and the fields that are key to the substantial existence of the society (e.g. finance, healthcare, media and design) at the rate the world is changing. The range of services that InnoLabs provide to customers including individuals and business organization is very wide. They help their customers with the actual realization of innovation in their businesses through various means of establishing their contact with experts to equip them with proper guidance regarding the analysis of opportunities, development of efficient and improved methods and tools, innovation management strategies and other innovation related tasks. InnoLabs are mostly free to access for academic, research or educational use, while their services for business organizations are usually available on paid basis. However, few InnoLabs also entitle business customers for free access thus providing an opportunity for the business organization with limited resources available to afford the integration of innovation in their products and services, despite of the risk associated with introducing something new.

The adoption of a specific approach to innovation development and the array of instruments that goes with it is a major step towards the successful innovation. As the demands of market, customers and organizations are very dynamic in behavior, a variety of methods, strategies and tools for innovation are also required to meet these divergent demands. InnoLabs utilize a wide array of methods and tools at different phases of innovative processes and work in close connection to some research institute in order to explore the ways and ideas for more advanced or improved methodologies, and the design and implementation of a set of methods and tools by taking full advantage of the benefits of new technologies. InnoLabs carry out various innovative projects per year of different time frames and manners by utilizing the different sources of funding (public, private, or combination of both).

Limitations of the Study

The quantitative analysis of the study is restricted to the data obtained from the thirty five survey respondents and can be more validated and solidified by increasing the number of responses. The sample size seems to be small and InnoLabs responded to the survey voluntarily, thus making a random sample that does not represent the whole population accurately. Only the InnoLabs identified by the prior web-based study were invited via email for the participation in the survey and the alternate means of identifying more InnoLabs were not used. Furthermore, the study depicts a worldwide summary of InnoLabs and the geographical biasing was not taken into consideration.

CONCLUSIONS

The InnoLabs have evolved considerably in last years and there are obvious gains in innovation. The InnoLabs serve as catalyst for enhancing the innovative capability and potential of the individual and business customers and enable people to better meet the requirements of innovation imposed by the changes in market, society and customer perceptions. In the scope of this paper, we have presented the divergent nature of InnoLabs existing around the globe in terms of major concern areas for innovation support, the different innovative services offered, the access options for different groups of customers, the types and statistics of employees, typical customers, size, innovation process counts and time durations, funding sources, research connection, and use of methods and tools in design, implementation and actual realization of the innovations. The study lays the foundation brick toward the further categorization of the InnoLabs.

ACKNOWLEDGEMENT

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Service Networks in the Area of E-Mobility

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ABSTRACT

E-mobility (e-mobility) systems experience a growing interest in politics and economy. However, establishing this new technology in the market is a huge challenge since both, customer and supplier, have to think about mobility in a new way. To attract e-mobility to customers, new service offerings are an important channel. For creating such service offerings, various actors have to interact in new relationships and networks, focusing on current and future customer needs. To give a first understanding of such service networks and how far they can be described as "service networks" in a common theoretical sense is the goal of the paper. Based on a literature review in the fields of network and service network theory, general characteristics with which (service) networks can be described are elaborated. The different players on the e-mobility market are introduced and the network they form is classified using the characteristics from (service) network theory.

Keywords: e-mobility, service, e-mobility service network, network theory

INTRODUCTION

Due to the increasing importance of renewable energy systems for addressing the problem of climate change and limited oil reserves, e-mobility seems to be one part of the solution. As energy conversion and transport activities are two of the main contributors to the CO_2 emissions, fostering the large-scale use of battery electric vehicles (BEV) is one important way to reduce the emissions according to the Inter-governmental Panel on Climate Change (IPCC) targets. In 2011, they set the reduction target of CO_2 emissions for developed countries to 80%–95% by 2050 (EU, 2011). To achieve this, actions have to be taken in several areas.

E-mobility offers a twofold solution for the problem. First, the fact that BEVs are much more energy-efficient than traditional internal combustion engines (ICEV). The efficiency factor of ICEVs varies around 35 percent in contrast to over 90 percent offered by BEVs with the result that less fuel is needed for the same driving range and hence less emissions are generated (BMBF, 2013). The second aspect is the easier integration of renewable energy sources in the transport sector when using batteries of electric cars as distributed energy storage systems (Budde Christensen et al., 2012). To reach the ambitious goals for CO_2 reduction, renewable energy sources have to be introduced in a large scale to the energy system. However, natural power sources are difficult to exploit due to their high fluctuations in electricity production. Appropriate energy storage devices are still lacking. That is the point where BEVs come into play. Their battery can be used to balance fluctuations in electricity production by intelligent charging (smart grid) i.e. the electricity amount with which the vehicle is charged depends directly on actual energy production patterns (ibid.). These valuable aspects make it necessary for governments to cope with the challenges aligned with e-mobility and to further engage in the issues of technology and infrastructure development.

The governmental initiatives have on the one hand side led to an improved public perception and growing interest in e-mobility issues. On the other side, though, are high capital costs and restricted driving range still resulting in the fact that most BEVs are still part of professional business fleets i.e. private owners are the minority (Ried et al., 2013). Established automotive manufacturers try to minimize risks by integrating the BEV production and distribution in their current ICEV production lines to exploit scale effects (Müller et al., 2014). To establish e-mobility in

society, however, innovative business models are needed to attract customers. According to (Capgemini, 2012), the most important characteristics of an e-mobility leader are flexibility and innovation capability. Both aspects tend to be rather found at small and medium companies e.g. start-ups and niche players than at large organizations. That makes it difficult for large automotive manufacturers to meet this challenge alone (Hewitt-Dundas, 2006). That is why the European governments emphasize the importance of these actors to address changing mobility habits and make e-mobility more popular to a larger customer base (Müller et al. 2014). One key is the early anticipation of changes in customer mindsets to be able to develop solutions that really matches the ravages of time. E-mobility with its unestablished market structures offers a huge potential for new businesses to anticipate latest customer trends and offering appropriate services.

One of these trends is the concept of "using instead of owning". The paradigm is getting more and more popular not only among younger generations. The success of businesses that address these trends such as car sharing services prove the change in customer behavior right. (Thompson and Weissmann, 2012) explain this phenomenon with the rise of mobile technology. As a way for transcending time and space, smartphones offer a new way towards a "sharing economy" i.e. the use of services as platforms for the share of goods or other things in a professional form.

To put the sharing economy concept on a professional stage is the challenge and opportunity for new business models also in the field of e-mobility. The business of car sharing, for example, has been growing over 500 percent in Germany since 2012 (Bay 2013). The concept is attractive to customers since raising gas prices makes the owning of cars less attractive and second, smartphones have become ubiquitous which makes application-based services easy to share and promote (Thompson and Weissmann, 2012). By offering the German car-sharing service "DriveNow", BMW is one of the traditional automotive manufacturers which are already shifting from just selling the product BEV to selling the mobility service which is provided by using the car, a trend also identified by (Giordano and Fulli, 2012). Since BMW had no experience and capabilities in the business of rental services they set up an alliance with SIXT, a large car rental service provider. DriveNow is now part of the BMW mobility concept "360° Electric" which is promoted as comprehensive service solution for the use of their EV "BMW i3". A network of different service offerings strives to satisfy all needs a customer might have when using their BEV. Navigation services for charging infrastructure or parking slots but also for optimized city ways in rush hours are offered (BMW, 2014). With further partners in the network like Vodafone, ADAC, airbnb and the US web service start-up Life360, BWM uses the expertise of different industries to provide a completely new and innovative mobility experience to their customers.

Offering a BEV is no longer just the production and distribution of the car but far more than this. E-mobility tends to become a disruptive technology, i.e. a technology which breaks up established market structures and enables the formation of new actors and alliances (Müller et al., 2014). The BEV customer expects at least the same convenience as with a traditional ICEV. These customer expectations can only be served with new ways of business interaction. The information and knowledge required for this, however, are distributed among various players, partly with a completely different industry background. To get access to them, collaboration in newly emerging business networks will be necessary (Müller et al., 2014). The analysis of collaboration in networks has been subject of numerous studies e.g. in the fields of business and economics, social studies or computational science. However, analyzing and accompanying the development of an emerging market such as e-mobility raises new questions that cannot be answered appropriately with current literature. These are topics concerning e.g. the capabilities required in such service networks, the selection of appropriate partners and the role of ICT as fundamental enabler.

To set the scientific foundation for further research in this field is the goal of this paper. To achieve this, the paper is divided into three parts. First, the concept of e-mobility service and e-mobility service network is elaborated and defined to provide a common understanding of the research topic. Second, to prepare the analysis of the networks observed in e-mobility, a collection of indicators which are commonly used in literature to describe (service) networks are proposed. In the last part, the different players in the e-mobility network are presented. Furthermore, the network they build up is analyzed and described by the help of the indicators introduced in part 2.

TOWARDS A DEFINITION OF E-MOBILITY SERVICE NETWORKS

When analyzing e-mobility service networks a clear definition is necessary to ensure a common understanding of the topic. The term "e-mobility" consists of *electric* and *mobility*. The Oxford Dictionary defines "mobility "as the "ability to move or be moved freely and easily". Common means of mobility are bicycles, cars, trains, ships, and aircrafts, while most of today's cars are powered by internal combustion engines (ICEVs). E-mobility as understood

by the majority of authors in this field is the use of battery electric vehicles (BEVs) such as battery and fuel cell EVs. Hybrid and plug-in-hybrid vehicles use both, an electric and internal combustion engine, to optimize both range and the driving experience (Lopes et al., 2011). Although some authors consider them as being a part of e-mobility, this paper only focuses on BEVs without fuel cell EV. This is since the building of new service networks is most likely to occur in this field of e-mobility. In this work, the following definition will be used to describe e-mobility.

Definition [e-mobility]:
E-mobility encompasses all activities, goods and services concerning BEVs and which are provided and used to satisfy the mobility need of the customer.

The characteristics and definitions of a service are strongly depending on the perspective the authors take and the scientific background they represent. The discussion of what can be considered as a service is filling several works such as of (Maglio and Spohrer, 2008, O'Sullivan et al., 2002, Spohrer et al., 2007, Vargo and Lusch, 2004). Since the scope of this paper is the introduction of a new domain of service interest, this work builds on the following definition of (Mele and Polese, 2011).

Definition [service]:
A service implies an activity (or series of activities) in which various resources are utilized by a supplier in interaction with a customer in order to develop a solution to certain needs (Mele and Polese, 2011)

When combining the terms, e-mobility and service, the following definition covers the various aspects of the domain adequately namely the relevance of customer interaction when using e-mobility services such as navigation, charging or vehicle-to-grid integration (in the context of B2C services). But also when considering B2B services such as roaming or services for business fleets, the service customer is always in charge to provide some kind of information or activity to achieve its goal. Hence, the definition used in this paper is covering these aspects.

Definition [e-mobility service]:
An e-mobility service is an activity (or series of activities) in which various resources are utilized by a supplier in interaction with a customer in order to satisfy the mobility need of the customer.

Based on a literature review in the areas of service network and service system theory as well as service supply chain theory, a sample of 43 paper were identified as being relevant for the purpose of the study. Depending on the area, different aspects turned out to be characteristically for specific concepts and more important for the understanding of a service network than others.

For a better understanding, a selection of definitions which are either the most prominent ones in their domain (e.g. Spohrer et al., 2007, Vargo and Lusch, 2004, Baltacioglu et al, 2007) or which offer a dedicated definition for a service network are shortly presented in Table 1 together with their scientific foundation. Service supply chain (SSC) publications offer a stronger focus on the linearity of the service process and have a tendency towards searching for similarities to traditional manufacturing supply chains to apply their established models (like the supply chain operations reference model (SCOR)) on services. Although several authors acknowledge the differences between both concepts the strict thinking in producer/consumer lines is still obvious (e.g. Youngdahl and Loomba, 2000, Giannakis, 2011). One of the scarce publications which try to define the SSC concept with a network approach is (Baltacioglu et al., 2007). According to their understanding, services are the result of "a network of suppliers, service providers, consumers and other supporting units that performs the functions of transaction of resources required to produce services…". In this work the understanding of services as a kind of product is still dominating which appears in phrases like "transaction of resources required to produce services". Hence, the approach of service supply chain seems to be inappropriate for the development of a service network definition that fits the scope of the paper. A domain that seems to be more suitable for this purpose is the field of marketing. Being one of the parental sciences, marketing scholars have early tried to define services and hence the collaboration in service networks.

Author	Type of Network	Definition	Scientific Background
Kothandaraman and Wilson, 2001	Value-crating Networks	In value-creating networks, value is co-created by different actors, such as suppliers, original equipment manufacturers (OEMs), third-party service providers and customers.	Marketing
Spohrer et al., 2007	Service Systems	A value-coproduction configuration of people, technology, other internal and external service systems, and shared information(such as language, processes, metrics, prices, policies, and laws).	Service Science
Baltacioglu et al. (2007)	Service Supply Chain	The SSC is the network of suppliers, service providers, consumers and other supporting units that performs the functions of transaction of resources required to produce services; transformation of these resources into supporting and core services; and the delivery of these services to customers.	Manufacturing
Barile (2010)	Viable Service System	Viable systems are systems in which the composing sub-systems share a common goal and the system, as a whole, has a determined finality.	Marketing
Vargo and Lusch (2011)	Service Ecosystem	A spontaneously sensing and responding spatial and temporal structure of largely loosely coupled, value proposing social and economic actors interacting through institutions, technology, and language to (1) co-produce service offerings, (2) engage in mutual service provision, and (3) co-create value.	Marketing
Voskakis and Nikolaou (2011)	Service Network	Service networks consist of interdependent companies that use social and technical resources and cooperate with each other to create value.	Computational Science
Scott and Laws (2010)	Network	An organisational form characterised by repetitive exchanges among semi-autonomous organisations that rely on trust and embedded social relationships to protect transactions and reduce their costs' (based on Borgatti and Foster, 2003, p. 995)	Service Science
Gebauer and Paiola (2012)	Service Network	A loosely coupled collection of upstream suppliers, downstream channels to markets and ancillary service providers.	Marketing

Table 1: Concepts for Service Network collected from various scientific domains

Being one of the parental sciences, marketing scholars have early tried to define services and hence the collaboration in service networks. A remarkable observation when analyzing the literature in this area is the existence of a variety of terms such as "viable service systems" (Barile, 2010), "value-creating networks" (Kothandaraman and Wilson, 2001), just "service systems" (Spohrer et al., 2007) or, when referring to commonalities with biological ecosystems, using the term "service ecosystem" as (Vargo and Lusch, 2011) are proposing. All terms seem to mean more or less the same however the inconsistent collection of different definitions makes it difficult to extract the core of the concepts. What can be summarized is the dominance of value co-creation as the main perspective on the exchange between the members of the network and especially between service provider and service customer. The customer is now considered as an active part of the service process and not just the recipient of a service delivery as described by (Baltacioglu et al., 2007). For this paper, the following definition will be used to describe an e-mobility service network. The emphasis lies on the satisfaction of customer mobility needs and the organization in a kind of business network.

Definition [e-mobility service network]:
A business network of service providers that offer solutions concerning the use of BEVs which satisfy the mobility needs of the customers.

For a further analysis of e-mobility service networks, the knowledge of features that characterize service networks in a common sense are necessary. For this, publications from network, business network and service system theory have been examined and commonalities were elaborated.

SERVICE NETWORK CHARACTERISTICS

The collaboration between organizations in networks has been subject of numerous publications over the last decades covering different disciplines such as transaction cost or resource-based theory (e.g. Pfeffer and Salancik, 1978, Williamson, 1991, Kilduff and Tsai, 2003, Borgatti and Foster, 2003, Brass et al. 2004). Application domains of network theory including e.g. organizational theory and behavior, strategic management, business studies, health care services, sociology, communications, computer science, physics and psychology (Provan et al., 2007). Over the last decades, several characteristics have been emerged as being appropriate parameters for the description and analysis of networks in various fields. Formal network analysis is a central element mathematical based research domains such as operations research, computational science or social network studies. Established parameters for general network analyses are density indicators (i.e. the strength of relationship), centralization (i.e. who is the most powerful member) and clustering values (i.e. which parts of the network are more or less active) (e.g. Goodwin, 2004, Brandes and Erlebach, 2005, Provan et al., 2007, Scott and Laws, 2010). For this study, such "formal" parameters have been considered as well as parameters with a more business-oriented focus. In summary, five main characteristics have been identified:

1. *Internal Structure (Centralization, Clique*s): this comprises questions like how far the network is dominated by a few members or the strength of the relationships between them. A further point of interest is the occurrence of similarities in the structure of such relationships (i.e. isomorphism) or the degree of clustering or the existence of holes in the network (Goodwin, 2004, Provan et al., 2007), Haythornthwaite, 1996, Möller et al., 2005).
2. *Governance:* this comprises questions like the mechanism which is used to manage the network and the content that is exchanged within the network relationships. Also questions concerning the quality of business relationships such as informal mechanisms are influencer of network dynamics (Provan et al., 2007, Hakansson and Ford, 1995, Goodwin et al., 2004).
3. *Drivers:* this comprises questions about the motivation factors for organizations to enter a network. Examples may be a volatile environment, i.e. global competition and changing markets or the provision of access to valuable resources (Nordin et al., 2013, Brass et al., 2004, de Man, 2004).
4. *Enablers:* this comprises questions concerning the factors that enable the collaboration in networks. Examples may be a common language, social institutions (e.g. monetary systems, laws, etc.) and information and technology (Iakovaki and Srai, 2009, Drzymalski, 2012), Nordin et al., 2013).
5. *Outcomes:* this comprises questions concerning the (long-term) consequences for an organization when engaging in the network. Examples may be simply surviving and innovation or an increased stability and resistance to change (Nordin et al., 2013, Goodwin et al., 2004, Brass et al., 2004).

These parameters will be used to characterize the e-mobility network in a more detailed way than just presenting the actors involved. Issues such as the distribution of power within the network, dynamics and changes in relationships that can be observed when analyzing the network over a longer period of time may be topics of interest to better understand the network as a whole.

E-MOBILITY - A SYSTEM OF SERVICE NETWORKS?

The market of e-mobility is currently suffering from different problems. (Giordano and Fulli, 2012) describe them as a "deadlock situation where all stakeholders are waiting for a breakthrough to ignite the process". According to them, the customers are waiting for cheaper BEVs with a longer range limited by the battery while car manufactur-

ers are afraid to invest in the development of new BEV models without the perspective of a market potential. Battery suppliers in turn await the commitment of the car manufacturers to engage in the e-mobility market to increase their research and production facilities. In order to understand the complex interaction dependencies in the market, relevant players involved in today's e-mobility market are introduced and explained in the following section.

Player within the E-mobility Network

The players in the e-mobility market have the common goal to provide e-mobility in a technically and economically attractive manner. Based on a comprehensive market research, main players have been identified and characterized in Figure 1.

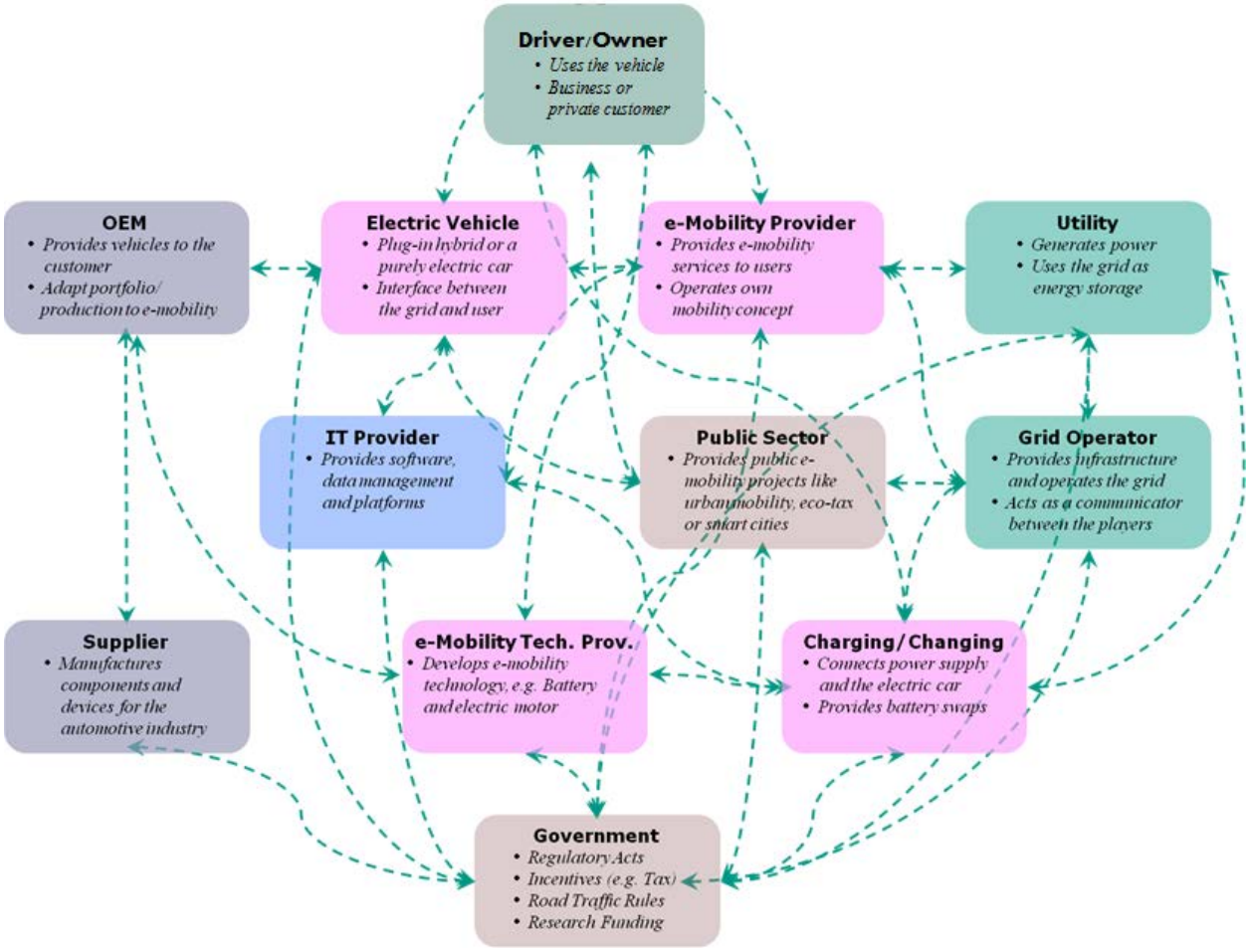

Figure 1: E-Mobility players (based on Capgemini (2012))

OEMs (Original Equipment Manufacturer). OEMs develop, build and distribute the BEVs. Beside the producers of cars, also the manufacturers of electric motorcycles and electric panel trucks are count to the group of e-mobility OEMs. Most of the providers are traditional car manufacturers which mainly offer internal combustion engine vehicles (ICEV) and subsequently extend their product portfolio with electric or hybrid vehicle offerings. Examples are Nissan ("Nissan Leaf"), BMW ("i3") or Toyota ("Prius"). Only Tesla ("Model S") offers a pure electric vehicle portfolio.

Suppliers. BEVs contain several components which are completely different than those used in ICEVs. Those are in particular the battery, the electric motor and the power electronics (Basshuysen and Schäfer, 2011). Some OEMs produce the parts by themselves, others buy them from suppliers. As already observed among the OEMs, there are established supplier companies which already produce parts for the ICEVs and which are now enlarging their portfolio with an e-mobility segment. However, there are also suppliers which have not been involved in the car segment

since e-mobility came up. Provider of lithium batteries or electric engines are examples where knowledge from other industries is now used for e-mobility. BEVs depend on electricity. Stored as chemical energy, the electricity is made available to the engine if needed. Suppliers of charging infrastructure are developers of software components as required interfaces as well as producers of hardware such as parts for the charging stations or recharger cables. Examples therefor are the German manufacturers Mennekes as a worldwide leader for charging plug systems or Bosch which offers an open IT-system for the connection and management of charging stations.

Utilities and Grid Operators. With the provision of electricity, energy providers play a significant role in the e-mobility network. Usually they collaborate with public charging station providers. In this case, the customer typically has a contract with the charging station provider with monthly or yearly payments. The charging station provider in turn is bounded by contract to the energy provider to whom it has to pay a beforehand defined reward margin. Hence, to evade such reward sharing, many energy providers already offer their own charging station services. Several energy providers also offer special charging tariffs for end customers who prefer loading their BEVs at home, including charging infrastructure or as additional service package when buying a BEV.

Charging/Changing Provider. Charging the battery is one of the essential requirements when using a BEV. The process of refueling can be conducted either by charging the battery with electricity or by changing the empty battery with a fully loaded one. The customer is charged either for the loaded electricity or the charging duration. An important aspect for the charging process is the difference in charging voltages in private and public charging stations since they significantly affect the charging duration (Honsel, Gregor, 2009). In BEVs several components are less stressed than in ICVEs. Examples are engine cylinders, clutch and gearbox. Due to this, the maintenance effort is lower than for ICEVs. However, also BEVs have to be maintained and, in case of accidents and wearout, repaired. For this, a comprehensive knowledge about high voltage systems is required to avoid accidents (Hunt, 1998).

E-mobility Service Provider. Services play an important role for the functionality of e-mobility and offer are high potential for new business models in this area (Kley et al., 2011). There are services which already exist for ICEVs such as workshop or leasing services and which are now adapted to e-mobility and then those which are closely related to e-mobility. Because of the limited battery range and still inappropriate developed charging infrastructure, e-mobility users need special navigation and mapping services. Based on ICT, such services either showing available charging stations close to the current BEV location, assisting by finding e-mobility-friendly urban infrastructure or they calculate an optimized route between two locations in advance. Such services are offered e.g. by established navigation system providers as external devices or are directly built in the BEV (Back, 2005). Beside navigation systems, other ICT-based applications have been developed to support the user. Examples are applications for smartphones (apps) which assist the charging and payment process or functionalities which offers the participation to car sharing communities. E-mobility requires a lot of new knowledge about cars and mobility in general. Driving schools have to be taught how to drive BEVs properly, car service workers need to learn how to handle the cars in the case of an accident. Similar to ICEVs, financial services assist the potential owner to handle the high investment costs while other service providers are specializing on technical consultancy such as e.g. the implementation of a private charging infrastructure at home ("wallbox"). A large-scale establishment of e-mobility mainly depends on the acceptance of (inter)national standards. A pioneering example for this group is the German eRoaming provider "Hubject". By offering a de facto charging standard interface, Hubject has the function of a clearing house which enables transregional e-mobility. The user perceives a maximum of convenience since the authorization and payment process is completely handled by Hubject. All partners in the network can to use the same infrastructure given that the Hubject interface OICP (Open Intercharge Protocol) has been implemented (Ried et al., 2013). For being allowed to participate to the road traffic, cars usually have to gain a MOT certificate. MOT tests check the general road suitability as well as, in the case of BEVs, specific battery tests like lifecycle and abuse testing. Accredited providers which are confronted with new technologies are now offering specific testing procedures e.g. for battery safety or temperature effects on electric engines (TÜV Süd AG, 2013). Since many EVs are used in business fleets, services for this group are a promising business field. Providers like "alphaElectric" offer a bundle of customized services concerning the selection of appropriate EVs, implementation of charging infrastructures and fleet management.

Governments. E-mobility as a new technology is currently strongly depending on federal subsidiess and public funded projects. Since the infrastructure is still underdeveloped, the governmental entity is an important stimulus for companies to take the risk and involve themselves in e-mobility. Most of the national and international e-mobility projects that are currently running are federal funded projects, most of them conducted by a mix of research institutions and companies (Bundesregierung Deutschland, 2010). In the field of e-mobility, several national and international associations have been founded in the last years. Typically they consist of private persons, representatives of the corporate sector and research institutions and further public sector entities. Some associations focus on single

players such as the new "UK Electric Vehicle Supply Equipment Association (UK EVSE)" launched in 2013 which focuses on the interests of electric vehicle equipment suppliers (EV Fleet World, 2013). Others such as the "Bundesverband Elektromobilität BEM" in Germany strive for a general establishment of e-mobility in society and business. Research institutions play an important role for the development of e-mobility. The electric engine research has been mainly forced by research institutions and engineering schools all over the world way before car manufacturers started to engage in the field (Ehsani, M. et al., 2009). Today, a lot of research is done in different areas concerning improved charging infrastructure systems, standardization initiatives, vehicle to grid technologies, business aspects of e-mobility, legal frameworks etc. (Kampker et al., 2013).

Private Customers. Only a small amount of private customers are already own a BEV since high investment costs and limited battery range are still high barriers (Giordano and Fulli, 2012). However, many private customers are already involved in e-mobility when using services that integrate BEVs in their offering. Examples are leasing and rental services or car sharing offerings. If considering also public transport services as e-mobility, in a broader sense, all users of trains and electric buses are part of this group.

Business Fleets. Most of the EVs are used within business fleets. Although electric cars are still much more cost-intensive in terms of capital and infrastructure, their operating costs are lower. Hence, extending the user base helps to spread the high initial costs over a larger amount of heads (Kley et al., 2011).

Commercial Service Fleets. Beside private and business customers who use BEVs just for private or business mobility aspects, there are providers which integrate electric cars in their service offerings. Examples are the German logistics supplier DHL which partly delivers its shipments in urban areas with BEVs or public/private transport provider which use buses or BEVs for their chauffer services.

Characterizing an E-Mobility Service Network

The overall question which aims to be addressed by this paper is how far e-mobility can be considered as a system that consists of service networks. Analyzing emerging service constellations in this so far product-shaped mobility market promises interesting insights into how large and established organizations have to think about their business and customers in a completely different way. To better understand the network, the five network parameters introduced in the section before are now used to describe the e-mobility network in further detail as just by introducing the actors involved.

The current market shows several patterns of *centralization*. According to the study of (Capgemini, 2012), the potentially most important and hence most powerful players in the emerging network will be the automotive manufacturers and the governmental entities followed by the automotive tier suppliers and charging providers. While subsidizing e-mobility with a vast amount of research funds to promote the concept, the government is inevitable and crucial for the success of the numerous e-mobility activities undertaken so far. The high influence of governmental subsidies on success or failure of e-mobility can be observed in Norway where the possession of a BEV is rewarded with several benefits regarding convenience (e.g. free parking slots, driving on bus lines) and monetary aspects (e.g. luxury tax-exemption of BEVs). As a result, e-mobility enjoys a higher public acceptance than e.g. in Germany. Established relationships accelerate the establishment of new business ecosystem. Interesting relationships can be observed between car manufacturers and tier suppliers but also between energy providers and grid operators. Both are valuable *cliques* that might be used for e-mobility. New players in the field are battery suppliers and charging infrastructure provider. Both are typically closely collaborating with car manufacturers to strengthen their competencies in this new domain such as e.g. the business relationship of Tesla and Panasonic shows (Capgemini, 2012, San Román et al., 2011, Budde Christensen et al., 2012).

The government is still the most important *influencer (governance mechanism)* in most countries where e-mobility is promoted. The use of subsidies is still the most powerful tool to make companies invest in e-mobility. But also the existence of common standards for the charging and billing processes as well as unsolved issues concerning data security are the important aspects that influence the dynamics into the network. Market mechanism such as raising gas prices, improved battery technologies that ensure longer driving ranges as well as the emergence of strong international competitors such as Tesla are influencing factors of the market development (Kley et al., 2011, San Román et al., 2011, Nordin et al., 2013).

Network Characteristic	E-Mobility (Service) Network	Source
Internal Structure (Centralization, Cliques)	Centralization: • Potentially most powerful players: OEM, Government • Medium powerful players: Automotive Tier Supplier, Charging Provider • Less powerful players: Energy Providers, Grid Operators, e-Mobility Service Providers Established Relationships (Cliques): • OEM <->Automotive Tier Supplier • Energy Provider <-> Grid Operators • OEM <-> E-Mobility Service Provider New Players: • Charging Infrastructure Provider • Battery Supplier • E-mobility Service Provider	(Capgemini, 2012, San Román et al., 2011, Budde Christensen et al., 2012)
Governance Mechanism	• Governmental Subsidies and Incentives • Existence of common standard interfaces (charging/billing), • Market mechanisms (electricity/fuel price, battery research, customer acceptance, market saturation, international competitors)	(Kley et al., 2011, San Román et al., 2011, Nordin et al., 2013)
Drivers for entering the Network	• High governmental subsidies and incentives • Early participation and establishment in an emerging market (First mover advantage) • Opportunity for new entrants to reinvent an "established" (mobility) market and to set up new market structures • Need to satisfy changing mobility needs of customers ("using instead of owning")	(Roland Berger, 2011, Budde Christensen et al., 2012, Nordin et al., 2013).
Enablers for Collaboration within the Network	• Established supplier relationships and infrastructure on which the partners can set their new offerings • Transparency/Trust/Long-term commitment between network partners • Common international standard interfaces (charging/billing) • ICT	(Kampker et al., 2013, Nordin et al., 2013).
Outcomes for individual organization	• Image improvement • Sales increase in core business by offering supplementing e-mobility services • Closer customer relationship • Grid balancing and energy storage (Utilities) • EV technology testing (OEM) • Compliance with CO_2 regulations (OEM) • Meeting mobility needs (customer)	(Kley et al., 2011), San Román et al., 2011, Nordin et al., 2013).

Table 2: Characteristics of an E-Mobility (Service) Network

The *drivers* for entering the e-mobility network are divers. Beside high governmental subsidies and incentives, an early participation in an emerging market to be one of the first movers in this field is one driver. New entrants such as battery suppliers perceive the opportunity to reinvent the "established" automotive market. In a different situation are e.g. the car manufacturers that have to react on changed mobility needs of the customers and hence are more forced to engage in e-mobility to avoid being outperformed by international competitors (Roland Berger, 2011, Budde Christensen et al., 2012, Nordin et al., 2013).

Important factors that make the network work, i.e. *network enablers*, are e.g. the above mentioned international standards for charging infrastructure interfaces. Without an agreement on common technological guidelines it is difficult especially for small provider to manage the risk of investing in a new technology with the insecurity that the system will be finally compatible with the rest of the environment. Another important aspect is the reliability of business partners. In such a volatile market like e-mobility, providers appear and others disappear, leaving the problem of missing responsibilities regarding e.g. spare parts in charging infrastructure which cannot be delivered anymore due to the disappearance of the provider (Kampker et al., 2013, Nordin et al., 2013).

For most of the organizations engaging in e-mobility, *potential outcomes* such as an image improvement or an increase in sales due to the development of new market opportunities. For car manufacturers e.g., e-mobility is an essential key to satisfy the CO_2 emission regulations. And finally it has to emphasized that e-mobility is offering a new way for car manufacturers to tighten their relationship to their customers (Kley et al., 2011), San Román et al., 2011, Nordin et al., 2013).

CONCLUSIONS

In this paper, the scientific foundation for further research in the field of service networks in the domain of e-mobility was set. The contribution of the work is twofold. On the one hand side, e-mobility as a key for addressing global ecological and economic problems was introduced. The necessity of services in this context was presented and further research in this motivated. On the other side, a literature analysis was conducted on the concept of service network in different scientific domains. Based on insights from network theory, five characteristics for service networks were elaborated and adapted to the field of service networks. Finally, the current players in the e-mobility network were presented and their relationships analyzed by using those network characteristics. The results presented in this paper have not been validated within an empirical study which will be the next step in further research activities. In addition, a further characteristic of service networks, which is not yet covered sufficiently in literature, is the interaction between customers und the providers and the alignment of value propositions on which the service generation is based. The topic has been identified as important aspect for further research since "the success of such service system networks depends on the alignment of value propositions between the service provider and its partners so that the service obligations are delivered to the customers as promised" (Kwan and Hottum, 2013). Hence, in further research it is planned to apply customer roles (see i.a. Sampson and Spring, 2012) to the service network model to understand motivation factors, collaboration and dynamics between, as well as risks for the involved parties. Furthermore it will be interesting to examine, how new arising service networks are able to change an established market structure.

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Section 5

Managing the Complexity in Transformative Service Design

Prejudice and Innovation: A Critical Relation for Designing Potentially Innovative Solutions

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ABSTRACT

Contemporary organizations are increasingly interested in augmenting their capacity to innovate. The most commonly adopted frameworks for innovation among corporations are the ones based on co-creation processes, particularly the ones related to the "design thinking" practices (i.e, human-centered design, open innovation, service design, lean startup and business model generation). These frameworks have fundamentally in common the assumption that people are sensible enough to understand different points of view. And that these frames of work will enable organizational teams to free themselves of their prejudices and embrace the "different." At the same time that a team's prejudice can distort understandings, it also plays an important role in opening up what it is to be understood. This text advocates that by being aware of the impacts of prejudice, tradition and the interplays between pre-understandings and understandings, organizational teams should have better possibilities to innovate, i.e. to create new propositions that will be perceived as valuable by a determined social context. A metaframework and future research are proposed.

Keywords: Hermeneutic, tradition, prejudice, knowledge, sharing, future, innovation, organization.

INTRODUCTION

Contemporary organizations call often for the myth of creativity, novelty and diversity through banal rhetorical formulations. Which, most of the times, evade a confrontation with a real legitimization of something that "modernity sought to permanently delete in its necessary process of continuous renewal of the ephemeral: tradition and prejudice" (Ginoulhiac, 2009, p. 282). These same organizations, increasingly interested in augmenting their capacity to innovate, are adopting several frameworks based on co-creation processes, particularly the ones related to the "design thinking" practices (i.e, human-centered design, open innovation, service design, lean startup and business model generation). Besides their promises to spur innovations, these frameworks have an explicit and formal focus on creating awareness of different perspectives of reality, "making the familiar strange and the strange familiar" (Amabile, 1996), and on "creating a team-based approach to innovation" (Brown, 2008).

Fundamentally, all of them are based on the assumption that people are sensible enough to understand different points of view. That these frames of work will enable people to free themselves of their prejudices and embrace the "different"; that they will enable people to make the "fusion of horizons", as described by the hermeneutical literature (Gadamer, 2004). Unfortunately, the necessary empathic understanding to "pivot" its own view of the world is not evenly distributed on a population. And, as the experiments described in this text are showing, a simple adoption of a design thinking framework may not be enough to free people of their own personal history (Kruglanski & Webster, 1996, p. 263):

> Specifically, individuals may desire knowledge on some topics and not others, and they may delimit their constructive endeavors to those particular domains.

And thus, it can happens exactly the opposite: some of these frameworks may actually promote particular kinds of visions and then not deliver on their promises to make "the familiar strange and the strange familiar" (Amabile, 1996). As it is known, there are several examples of organizations that adopted particular creative frameworks without resulting in any significant achievement towards fostering innovative propositions (Verganti & Öberg, 2013). Several researches emphasize that the process of listening to new and external interpreters "cannot be reduced to the application of a 'method'" (Thompson, 1997).

But it seems that in some cases the use of these frameworks did help enact an empathic understanding and spur innovative solutions (Brown, 2008). One reasonable explanation for that may lie in the very group of people that developed a new value proposition towards becoming an innovation. Not in the framework itself.

PREJUDICE

This present text advocates that one key ingredient for innovative efforts is the awareness of the prejudices at play on a determined social context. To understand what it is meant by the word 'prejudice' it is necessary to consider Gadamer's discussion about it. First, he advocates "that all understanding inevitably involves some prejudices." And, by prejudice, Gadamer means "a judgment that is rendered before all the elements that determine a situation have been finally examined" (Gadamer, 2004, p. 272).

Although since the Enlightenment the concept of prejudice acquired the negative connotation familiar today, it does not "necessarily mean a false judgment, but part of the idea is that it can have either a positive or a negative value" (Gadamer, 2004, p. 273). For example, one of its positive senses lies in the fact that it enables us "to understand history as well as ourselves" (Dobrosavljev, 2002). To make sense of Gadamer's detailed discussion on the subject, this text adopted the description of prejudice as *a vantage point where human finite understanding is situated in a historical process*.

Here enters the concept of *horizon* as "the range of vision that includes everything that can be seen from a particular vantage point" (Gadamer, 2004, p. 301), i.e. from a starting point where human finite understanding is situated. The concept of *horizon* can not be taken as a fixed condition faced by an individual (Alvesson & Sköldberg, 2009, p. 120). Although more research needs to be done about the possibilities offered by the design thinking frameworks, it is possible to assume that they should be entitled to offer the expansion and/or the fusion of horizons as their main byproduct result, at least potentially. This perception is corroborated by some streams of research that have linked the process of hermeneutical understanding to the one of innovation (Thompson, 1997; Verganti & Öberg, 2013) and to design practices (Jahnke, 2012).

The reading of Gadamer's works also offers a particular possible linkage between the concept of *fusion of horizons* and the co-creation frameworks through the German concept of *Bildung*. In English this word corresponds to 'formation' and can be described as (Gadamer, 2004, p. 15):

> […] keeping oneself open to what is other – to other, more universal points of view. It embraces a sense of proportion and distance in relation to itself, and hence consists in rising above itself to universality.

Keeping oneself open to what is other can be considered a fundamental condition for co-creation efforts. But as explained by Kruglanski & Webster (1996), people "may delimit their constructive endeavors" to very specific particular knowledge domains. And, depending on the personal history of the participants at such effort, this is something that is not as simple avoiding as just by adopting a "co-creative" framework.

It follows that every person starts the understanding process from a particular historical stand point. Then, through a process of *Bildung*, they move "in a circular pattern centrifugally towards understanding" (Jahnke, 2012). Jahnke also explains that this movement starts from their own prejudices and goes on in encountering the 'other' in an interpretive process.

This text advocates that the *understanding process* is a key condition for driving a new value proposition towards becoming an innovation.

Prejudice and Innovation

The contemporary corporative sensemaking discourses (Weick, Sutcliffe, & Obstfeld, 2005) have several examples and anecdotes that positively portrait the adoption of co-creation frameworks. One of these anecdotes, for example, was brought to life by Steve Blank (writer and lecturer at the Stanford University and at the University of California, both in the USA), who declared on an interview that Steve Jobs (one of the founders of Apple Computers, Inc) "was truly a renaissance man." Describing that Jobs "actually talked to a lot of people from a variety of fields" (Cook, 2013). Maybe what Blank meant is that Jobs was just curious and interested in knowing different perspectives. As most of the design thinking frameworks suggest, organizational people should have to free themselves from their entrenched stand point and go "out there" to meet the 'Other', to meet the different.

It is important to understand that Jobs himself was a very "different" person. As can be understood through reading several anecdotes in his biography, he used to be a radical vegetarian, and taking a shower was a rare event for him during his early adult life. To release stress he used to soak his feet in the toilet; and, before having a family, he used to rent bedrooms of his house to all sorts of "crazy people" (Isaacson, 2011). This kind of person has a privileged point of view of the social context. She or he can better reap the benefits of co-creation, on viewing the perspective of others, on creating "reality distortion fields," and the fusion of horizons. Which is not the same as to say that creativity is about "eccentric personality," it is not. As described by Amabile (1996, p. 2) in a text about creativity and innovation in organizations, "truly creative work is not only novel; it is also appropriate."

Thus, these anecdotes about Steve Jobs are also appropriate to make sense of two characteristics endorsed by the hermeneutical perspective: the openness to the Other and the "sense of what is feasible, what is possible, what is correct, here and now" (Gadamer, 2004, p. xxxiv), what is appropriate for a determined context. In that sense, the fusion of horizons can be defined as a combined capability of "persistent posing of ultimate questions" (Gadamer, 2004, p. xxxiv) in one extreme, *and* having a sense of what is 'feasible here and now'. That means that questioning endlessly a situation *or* focusing solely on what is feasible here and now will not commit persons in a determined social context to act. This *commitment to act* being understood as a sense making process (Weick et al., 2005) that produces new knowledge, which is the same as to say that it increases the capacity to act (Nonaka & von Krogh, 2009).

From a hermeneutical perspective, it is possible to describe the process of innovation as a social process of understanding and sense making. Thus, as a social process of interpreting and envisioning, and also of generative interpretation (Verganti & Öberg, 2013). One key aspect of this process of understanding is the fact that it does not proceed from a *tabula rasa*. So, to "understand presupposes preunderstanding." Alvesson and Sköldberg (2009, p. 120) also explain that preunderstanding is an obstacle to understanding. And to prevent it from developing into a vicious circle they write that:

> […] the existential hermeneuticians advocate a constant alternation between merging into another world and linking back into our own reference system. By means of this movement back and forth, we can successively come to an understanding of the unfamiliar reference system, something which also leads to the gradual revising and/or enriching of our own: there is a 'fusion of horizons' […].

From that statement, an innovation process can be described as starting from a new value proposition created by and presented to a determined social context. This new proposition has to be understood by that same social context from the preunderstandings shared by that group. Where an understanding of a new *part* fosters a new understanding of a *whole*. This would happen first individually, with each member of a group going through an interpretative process based on his own horizon of understanding. Then, in an iterative process involving the other members of the group, innovation process proceeds until it express "a nexus of personal meanings that are formed in a complex field of social and historical relationships" (Thompson, 1997, p. 439).

NEED FOR CLOSURE - NFC

If the central and critical role that prejudice plays in innovative efforts is accepted, the next step would be to devise how to enable organizations to act upon it. Several studies on innovation have focused on understanding "the new capabilities required to achieve a breakthrough" (Verganti & Öberg, 2013). One of these possible new capabilities might be the creation of *Bilgung* prone organizational groups. A particular stream of research based on the concept of Need for Closure (NFC) suggests that organizations can create groups with special characteristics that can emulate a kind of open-mindedness that relates to the concept of *Bildung*.

Need for Closure is a concept developed around 1990 by Professor Arie W. Kruglanski. Basically, it "refers to individual's desire for a firm answer to a question and an aversion towards ambiguity" (Kruglanski & Webster, 1996, p. 264). In a simple way, it is the level of closed mindedness of a person. It is also related to the sensemaking processes "of making do with whatever resources are at hand" (Weick et al., 2005, p. 145).

Important to note that NFC is not a biological characteristic of an individual, not like some sort of organic tissue deficit (Kruglanski & Webster, 1996). It is a motivated tendency to act as soon as possible, given the pressure that time and the lack of information and other resources may impose to an individual. To some individuals, this tendency is high. To others, it is low. Although it can be considered a stable personality trait of one person, it is also situationally malleable. Thus, it can vary along a continuum due to the social context she or he finds her or himself into.

Need for Closure and Prejudice

The assessment of individuals' NFC levels are done with a self-report measure questionnaire "designed to tap stable individual differences in the motivation for cognitive closure" (Webster & Kruglanski, 1994). As described in a previous paper (Manhães, Mager, & Varvakis, 2013), the NFC assessment instrument used to support the present discourse is a validated questionnaire, with 41 items (Lykert-type) bipolar-response summated ratings scale measurements (Roets & Van Hiel, 2011a, 2011b). The NFC also can provide a quantitative vantage point from which can be observed the relationship between the perceived innovativeness of the products resulting from a creativity workshop and the level of open mindedness of its participants. From that point of view, NFC can be defined as the "simplest determinant" of the *Bildung*'s propensity of a person and a group. Briefly stated, it is possible to devise a personality continuum measure for the NFC scale as having at its extreme points the *low* and the *high* NFC characteristics and, at its center, the *medium* ones. Below are presented short descriptions of each of these continuum points.

High Need for Closure

Individuals with high NFC tend to adopt workflows and guidelines more rapidly, i.e. tend to crystallize. They also tend to present an "unfounded confidence", which may lead them to have a more closed mindedness (Kruglanski & Webster, 1996).

Usually, high NFC levels individuals need a framework to act, otherwise they may feel uncomfortable in a situation considered too open in teleological terms. They also present a high task orientation characteristic and low

engagement in acts of social-emotional nature (Kruglanski, 2004). Thus, they efficiently adopt frameworks, but tend to be perceived as a less creative group of individuals.

This is a perfect match for efficiency-driven sense making discourse of organizations that focuses on "conformance, control, alignment, discipline and efficiency" as expressed by Dr Gary Hamel (Denning, 2012). It also can be related to what Verganti and Öberg (2013, p. 89) describe as the contemporary dominant theories of innovation:

> […] see problem solving as a process of progressive reduction of uncertainty (the earlier in the process the better, […]), and that assume that there is an optimal solution out there, you just need to find it […]

This characteristic of reduction of uncertainty, when enacted by a person, can have at least two different perspectives: "whereas the uncertainty-oriented persons approach uncertainty in order to resolve it, the certainty-oriented persons avoid it altogether" (Kruglanski 2004, p. 55).

Low Need for Closure

On the other hand, individuals with low NFC are reluctant in adopting rule-based and linear frameworks. That is what, perhaps, makes them more creative. They are also psychologically more comfortable in ambiguous situations and tend to prolong precrystallization periods.

Individuals with low NFC levels will feel uncomfortable if they are obliged to use a rule-based workflow. They tend to be oriented "more toward the social aspects of the group interaction" (Kruglanski, 2004) and neglect aspects of task execution. They usually tend to reject workflows but are highly creative. In a sense, this characteristic relates to the hermeneutic approach to innovation proposed by Verganti and Öberg (2013, p. 89):

> Instead, the hermeneutic approach, and in particular the iterative hermeneutic circle, opens up for a constant reinterpretation of the surrounding world. Rather than detecting new or uncertain information as early as possible in the process, it points to repeatedly bringing in new insights. Instead of keeping one constant perspective it is about bringing in several perspectives. Instead of deciding the course once and for all, the focus lies within the continuous turns within.

These NFC characteristics, although stable, are malleable in the same sense as *hermeneutic horizons* are. People under time pressure, for instance, tend to gravitate towards the higher limits of their NFCs. Thus, a low NFC individual submitted to a condition of time pressure should produce more disciplined, mechanical, and aligned solutions. Also, a high NFC individual involved in a similar situation would make the probability of creating non-empathic and non-innovative results to be insurmountable.

Medium Need for Closure

What can be said upfront is that the Medium NFC level individuals will feel comfortable with or without a framework. This is because they will either (a) create, (b) adopt partially or (c) completely adopt a pre-given framework. These alternatives will be chosen based solely on their understandings of the actual lived moment. This malleability produces, as illustrated by the Figure 1, the best perceived levels of innovativeness.

As stated above, Medium NFC individuals do not need pre-given frameworks. They are focused and pragmatic enough to respond to the constraints of a situation, and open minded enough to sense novel opportunities. Practically, all that they need is just a time frame. The fact that they are located at the best place of the continuum – the middle – permits to reap the highest benefits of the malleability of the NFC levels.

The research described below is showing that it is possible emulate the characteristics of Medium NFC individuals on groups of people. And, as it takes into account a socio-cultural perspective, this possibility of designing groups presents a hermeneutically favorable characteristic.

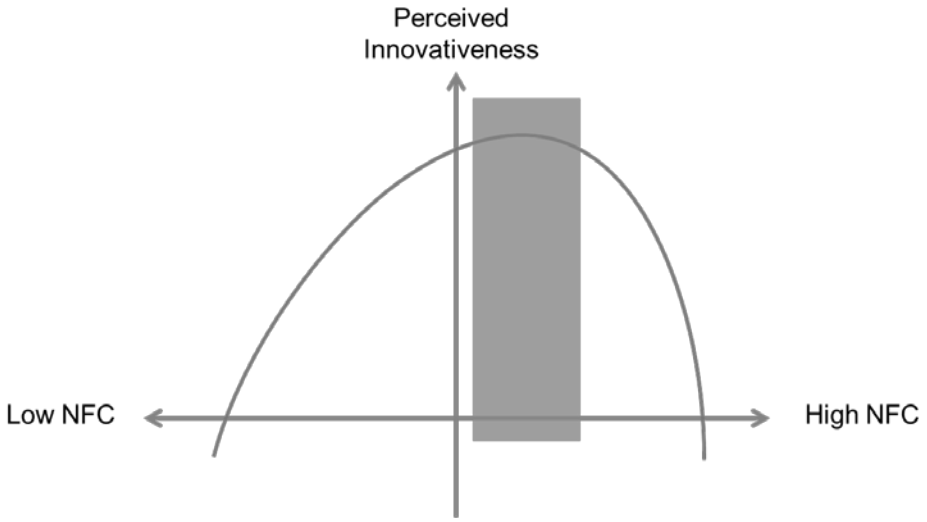

FIGURE 1: NFC levels and perceived Innovativeness (Source: Autors)

NFC AND EXPERIMENTS

The possibility of conducting innovative efforts through the design of groups based on NFC levels has the advantage of not need any pre-given "method" or enlisting only specific NFC level individuals for a team. Groups with members with diverse NFC levels seem to be able to create their own immanent logic (Adorno, 1965), which is a prerequisite to obtain the "original nonsense" of great works. The particular design of groups may also diminish the necessity of relying on "enlightened" leaders as the main driving force for innovative efforts. As advocated by Amabile (1996) and Verganti & Öberg (2013) the key role toward innovation should be played, primarily, by the highest levels of management (Amabile, 1996; Hennessey & Amabile, 2010; Verganti & Öberg, 2013). This assumption presupposes a "Renaissance" leadership, the existence of "enlightened" leaders throughout the organization. The possibility to design ad-hoc groups to lead innovative efforts seems to be a more pragmatic solution than the one of finding and hiring Jobs-like leaders. This is reinforced by the experiments related to this text that demonstrate that groups with a specific mean level of NFC create propositions that are perceived as more innovative during consensual assessments.

Experiments description

The cited experiments are being done as part of a PhD research and the concepts and ideas that were used to support these arguments are based on an extensive literature review. For ethical considerations, it is necessary to highlight the fact that the related research has not yet reached its theoretical saturation. At this stage of the research there are no ideal mean NFC values established as a target for groups' designs.

These experiments (E1 to E*n*), as illustrated in Figure 2, are divided into two parts. Part 1 is staged during creativity workshops where participants (H1 to H*n*) are divided into groups (G1 to G*n*) and each group have to create an innovative proposition (P1 to P*n*) at the end of the workshops. The NFC levels of each one of the participants are collected. At Part 2, the resulting product ideas (goods and/or services) are submitted to an independent panel of judges (IPJ-E1 to IPJ-E*n*) through a consensual assessment technique (Amabile, 1996; Hennessey & Amabile, 2010; Magnusson, 2003). These judges (J1 to J*n*) rate the products on three dimensions: Originality, Producibility and User-Value (OUP-P1 to OUP-P*n*). For the sake of brevity, a detailed description of these experiments can be found in a previous paper (Manhães et al., 2013).

What these experiments are showing is that the highest perceived innovativeness levels (OUP-P1 to OUP-P*n*) are obtained by groups within a specific range of NFC's levels (NFC-G1 to NFC-G*n*) and NFC's coefficient of variation. The resulting correlations between the perceived innovativeness of the products and the NFC levels of the

groups (C2) are above 0.8, and probabilities values (p-value) are below the level of significance of 5% (0.05). The groups within specific ranges of NFC levels had their products (P1 to P*n*) perceived innovativeness (OUP-P1 to OUP-P*n*) rated up to 64,38% higher by the independent panel of judges (IPJ-E1 to IPJ-E*n*). The correlation analysis between the judges' personal product rankings (OUP-J1RE1 to OUP-J*n*RE1) and the resulting experiment's panel ranking (OUP-RE1) also suggests that there are particular NFC levels that can consistently produce personal products rankings close to the panel ones.

The numbers presented in this paper are the result of analyzing data sets from 4 runs of the cited experiment, involving 58 workshops' participants (forming 12 valid groups from Germany, Brazil, India, Italy and Poland) and 15 judges (5 judges for each panel, coming from Brazil, Colombia, Germany, Italy, Sweden and United Kingdom).

NFC and Intergroup Contact

Several studies of organisations, regions and nations indicate a connection between economic success and human capital diversity (Florida, 2003). Østergaard, Timmermans and Kristinsson (2011) explain that, as social context becomes more diverse, "...this creates possibilities for new combinations of knowledge." And their research also indicates that there is a positive relationship between human diversity and the organisation's likelihood to innovate. More precisely, diversity of backgrounds should give "groups a larger pool of resources that may be helpful in dealing with nonroutine problems" (van Knippenberg & Schippers, 2007). But, at the same time that diversity presents possibilities of innovation, it strengthens the need for intergroup interaction and communication and "might lead to conflict and distrust" (Østergaard, Timmermans, & Kristinsson, 2011). At this point the work of Allport supply an actionable approach to intergroup contacts negative perspectives (Roets & Van Hiel, 2011a).

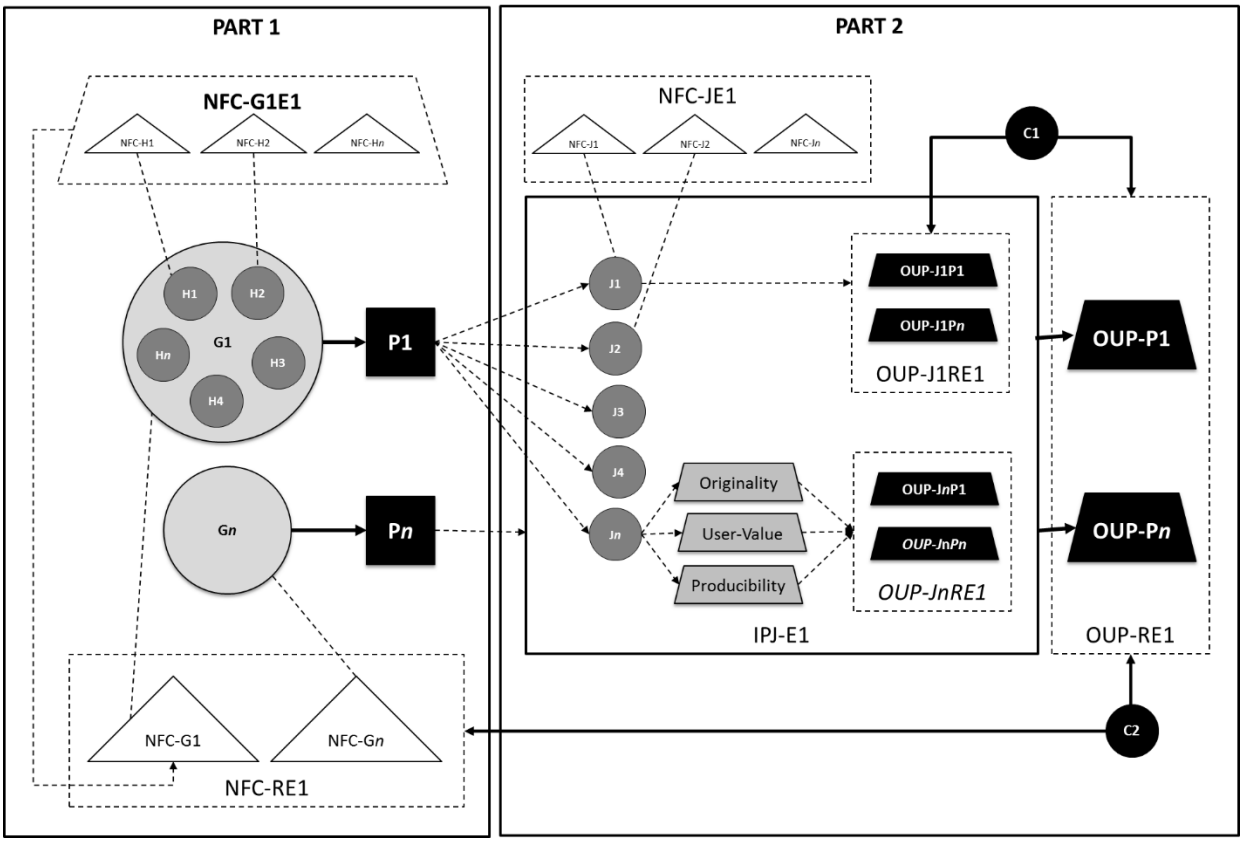

FIGURE 3: Structure of the NFC/OUP Experiments (Source: Autors)

Negative Intergroup Contact

The experiments that subsidize this present text, offered four different opportunities to witness what can happen when different NFC levels individual are asked to work on a same group. Coincidentally, in all four cases, it happened that one of the participants abandoned his or her group before the completion of the activities.

Several streams of research also indicate that cognitive diversity "may be detrimental to team satisfaction, affect, and members' impressions of their own creative performance." And that diversity can just as easily "lead to negative as to positive outcomes" (Hennessey & Amabile, 2010). These kind of events, that occurred during the experiments of this doctoral reseach, and previous research indicatives lead to tapping into intergroup contact literature. Specifically, to the work of Gordon W. Allport and the Four Key Conditions for intergroup contact (Allport, 1979). As presented by Pettigrew (1998):

> positive effects of intergroup contact occur only in situations marked by four key conditions: equal group status within the situation; common goals; intergroup cooperation; and the support of authorities, law, or custom.

In some of the experiments these conditions were tested and, as described by the literature (Pettigrew & Tropp, 2006; Roets & Van Hiel, 2011a), the level of attrition between the members of the groups were significantly reduced. Which prompted to the suggestion that the design of *Bildung* prone organizational groups should have to take into account the implementation of these Allport's key conditions.

It is important to note that Allport's research presents a particular use of the word *prejudice* as "an antipathy based on faulty and inflexible generalization. It may be felt or expressed. It may be directed toward a group or an individual of that group" (Allport, 1979, p. 10). In a Gadamer's perspective, this definition would be related to its possible negative value and to the "discrediting of prejudice by the Enlightenment" (Gadamer, 2004).

As can be seeing in Figure 3, this text proposes a positioning between the NFC concepts and the definitions of Gadamer and Allport about prejudice from a hermeneutical perspective. From this stand point, the concept of Need for Closure can serve as a sensemaking discourse that fits into Gadamer's notion of prejudice (with both its broad positive and negative connotations) and encompasses partially Allport's description of prejudice, while avoiding relying exclusively on the outgroup perspective (i.e., racism, negative connotation).

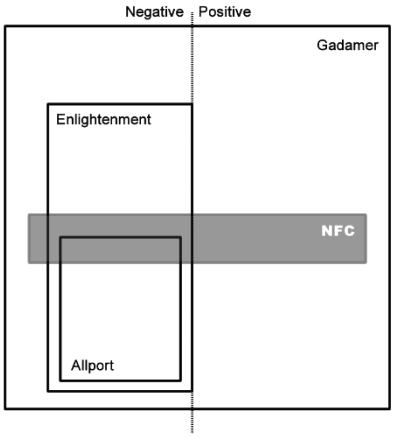

FIGURE 3: Proposed positioning between NFC and Prejudices (Source: Autors)

Although the concept of NFC originates from outside the literature on prejudice (both from Gadamer's and Allport's perspectives), it has a "striking similarity to the prejudice-prone cognitive style proposed by Allport" (Roets & Van Hiel, 2011a). The necessity for high NFC individuals to satisfy their "need for quick, easy, firm, and stable knowledge about the world" leads them to "resort to essentialist categorization and authoritarian ideologies, which represent some of the most powerful, proximal determinants of stereotyping and prejudice" (Roets & Van Hiel, 2011a).

IMPLICATIONS FOR ORGANIZATIONS

This singular approach to innovativeness efforts of teams can contribute to make sense of this important challenge facing organizations. At the same time that it maintains the innovativeness potential of teams – without relying on rule-based processes, it enables organizations to act by providing a scientifically supported metaframework. This action would be divided into simple steps like:

1. Assess the NFC levels of the potential individuals to be involved;
2. Design groups based on specific sets of diverse levels of NFC to lead the innovative effort and/or to evaluate it;
3. Adopt the Allport's 4 key conditions of intergroup contact through governance policies;
4. Define a time frame and available resources;
5. Provide organizational autonomy for the designed groups.

The above-suggested metaframework should enable organizations to create *Bildung* prone groups where the imaginative productivity is richest because it will not be merely free. The specific horizons where those groups will stand, "as in the convolutions of the arabesque," should provide "a field of play where the understanding's desire of unity does not so much confine it as suggest incitements to play" (Gadamer, 2004, p. 41).

CONCLUSIONS

The sense making discourse that supports this metaframe, preliminarily named Prejudice Related Innovativeness Determinants – PRIDe (Manhães et al., 2013), can be summarized as: *organizations that are aware of their prejudices are probably more likely to have better performance.* Thus, it follows that whenever people from a social context have to open themselves up to the new, they will need to do it in terms of the 'fore-structures' of understanding that they already possess. At the same time that a team's prejudice can distort understandings, it also plays an important role in opening up what it is to be understood. Based on that proposed understanding, this text advocates that by being aware of the impacts of prejudice, tradition and the interplays between pre-understandings and understandings, organizational teams should have better possibilities to innovate, i.e. to create new propositions that will be perceived as valuable by a determined social context. Which, then, will generate a better organizational performance. This metaframework is reinforced by discourses like this one (Amabile, 1996):

> Finally, management practices for creativity include the ability to constitute effective work groups that represent a diversity of skills and are made up of individuals who trust and communicate well with each other, challenge each other's ideas in constructive ways, are mutually supportive, and are committed to the work they are doing […].

Innovation, taken as a social phenomenon that "contains the possibility of dialogue aiming to arrive at mutual understanding and agreement" (Alvesson and Sköldberg 2009, p. 150), can only arise "if and only if, for all participants, there is a symmetrical distribution of chances to choose and to apply speech-acts" (Habermas, cited by Alvesson and Sköldberg 2009, p. 152). The critical relation between prejudice and innovation, as a perspective, permits to view the ability of organizations to create new products in the light of the totality-subjectivity combination. At the same time, the PRIDe metaframework tries to avoid both (a) the constraints of a "method" for innovation and (b) proposing 'tyrannies of structurelessness'. This 'middle way' takes into account the hermeneutic experience and invites those involved to play with the prejudices at stake. And, as a sense making discourse, a 'play' is precisely what innovation is: there is a risk that it "will not 'work,' 'succeed,' or 'succeed again,' which is the attraction of the game" (Gadamer, 2004, p. 106).

What seems to be a necessary consideration of the proposed metaframework is the fact that, at the same time that it proposes a non-ruled based solution for innovativeness efforts and enables organizations to act, it reinforces the

argument for diversity in organizational teams. At its core, this research reinforces with experiments and numbers the importance of members' diversity into innovativeness-driven teams. It is from that particular vantage point that this text advocates the central aspect of prejudice on innovation processes; specifically on the design of effective work groups that are composed of individuals who should be enabled to trust and communicate well with each other.

AKNOWLEDGEMENT

The development of the PRIDe discourse is a result of an "open attitude to the vital importance of the interpretative dimension to social phenomena" (Alvesson and Sköldberg 2009, p. 304). All texts cited integrate the prejudices and horizons of the authors of the present one about the organizational context.

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Transformative Service Design: From Technology to Dechnology

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ABSTRACT

In recent years, the development of service design has increasingly focused on the issue of "transformation." Design can not only be treated as a driver of user-centered and demand-oriented innovation, but also plays a key role in the business innovation process, value co-creation by multi-functional teams, and the derived business transformation. This study focused on Taiwan's largest R&D organization – the Industrial Technology Research Institute (ITRI). Since 2010, the ITRI has adopted "design" in innovation processes through the Dechnology (Design + Technology) project, gradually transforming the R&D process revolved around technology, into a value co-creation model through design, technology, and business. Meanwhile, during the transformation process, ITRI has strived to make changes in knowledge transfer and behavior patterns so that organizational capabilities can be enhanced. Through in-depth interviews, non-participant observation, and literature reviews, this study explores the critical success factors for multidisciplinary value co-creation during the process of change. Finally, this study proposes a Dechnology conceptual framework integrated with service design to serve as an important reference for businesses that undergo similar innovation projects and transformation management in the future.

Keywords: Transformation, Service Design, Value Co-Creation, Open Innovation

INTRODUCTION

In response to the rapidly changing market and global environment, most businesses generally recognize the important role of "innovation" in creating customer value and improving organization competitiveness (Rowley, Baregheh, and Sambrook, 2011), while some businesses are committed to finding a model that can maximize innovation management effectiveness (Christiansen and Overdorf, 2000). Past research indicates that in order to obtain more opportunities for commercialization, the era when companies solely rely on technology push (Schumpeter, 1934) or market pull (Schnookler, 1966) to carry out innovation has gradually receded; instead, different stakeholder engagement (Gummesson, 2008; Mele, Spena and Colurcio, 2010; Rothwell, 1994), user-oriented design thinking, and taking the standpoint of open innovation (Chesbrough, 2003; Schenker-Wicki, 2012) are required. However, how to effectively attract shareholders to participate in value co-creation during the process of change is a major challenge for businesses in terms of organization operation and management (Gould, 2012).

In general, the main objectives of service design are not only to consider user-centered design, but also explore how different stakeholders can co-create value in the service process (Frow and Payne, 2011; Sangiorgi, 2010). Service design has increasingly focused on the key issue of "transformation" in recent years (Sangiorgi, 2010); however, when carrying out change in innovation models, there is not much exploration regarding what challenges might arise or the key success factors the organization should have. For this reason, this study will focus on Taiwan's largest R&D organization - the Industrial Technology Research Institute (ITRI). Due to the rapid changes in industry structure and market demand, ITRI faced the "technological valley of death" that many other R&D organizations have currently encountered. In 2010, with the support of Taiwan's government, ITRI imported the notions of *"multidisciplinary design"* and *"value co-creating"* in the R&D process through the Dechnology (Design + Technology) project. Therefore, ITRI's R&D strategies, which were originally mostly technology orientated, went from value up technology (T) through design (D) in the first stage (2010 -2012) to the second stage (2012-2013)

transformation process where stakeholders from multiple-forces – the technical aspect (T), design aspect (D), and business aspect (B) participate in value co-creation.

Based on past research, this study will explore the challenges faced by R&D organizations when they progress toward open innovation. Furthermore, it will also focus on the two innovation models developed in the second stage (2012 - 2013) of the Dechnology project, including: 1) multidisciplinary commercialization design workshops and 2) thematic user-oriented design. Through in-depth interviews, non-participant observation, and data analyses, this study will analyze the challenges faced during implementation of the two types of innovation models. Finally, as for design (D), technical (T), and business (B) stakeholders in the value co-creation process this study will present the key success factors that include: 1) breakthrough ideas searching and importing, 2) technology screening and translation, 3) concrete incentives for multidisciplinary stakeholders, 4) multidisciplinary communication, and 5) continuing thematic exploration of innovative ideas. Moreover, as for technology-orientated businesses or businesses that want to advance from an OEM model, this study proposes a conceptual Dechnology innovation model as important references for businesses that undergo similar projects in the future.

LITERATURE REVIEW

Three Forces of Innovation

Some studies (Schumpeter, 1934; Trott, 2005) highlighted that innovation is the process of transforming ideas into commercial value, and is an important means for businesses to create customer value and improve competitiveness as well. Yet, how to drive innovation to create market value remains in question that the academic field and businesses are concerned with. Past studies (Khilji, Mroczkowski, and Bernstein 2006; Rothwell, 1994; Saidi, 2011) advocated a transformation from a linear model to a non-linear model; simply put, innovation does not rely on a single resource and direction, it relies on the mutual stimulation of "technology push" and "market pull" to search for future possibilities.

However, past research (Verganti, 2009) indicated that technology substitution through technology push, or innovation purely from the point of view of customer demand is often incremental, and rarely results in radical innovation. Meanwhile, with the advent of the knowledge economy and experience economy eras, consumers are increasingly focused on emotional and socio-cultural products (Verganti, 2009). Therefore, more and more companies focus on semantic dimensions and employ design, symbols and emotional messages to guide the new meaning of things (Battistella et al., 2012; Dell'Era & Verganti, 2009). And, Verganti (2003) proposed a third innovation model called "design-driven innovation" that stresses that design is making sense of things. In order to create new meaning or radical innovation, businesses should not only use market/technology research, but also deeply observe social context and people's needs from design viewpoint to obtain innovation knowledge design ideas.

In terms of the innovative drive created by technology, market and design, it is consistent with the Design Thinking proposed by the famous design consultancy company IDEO. Brown (2009) considers that innovation should emphasize technology feasibility, business viability, as well as human value and desirability. Therefore, this study believes that when organizations are undergoing innovation, they should also consider technology push, market pull, and design drive, and create usable, desirable, and feasible products or services through multidisciplinary interaction. Nonetheless, especially for R&D (technology-oriented) organizations, what management methods should be imported to successfully introduce different external innovative resources and create multidisciplinary cooperation possibilities are the main challenges (Brem and Voigt, 2009; Panne, Beers, & Kleinknecht, 2003).

The Challenges of Open Innovation and Value Co-Creation

In general, most technology-oriented companies usually focus on technical units or related expertise and lack market and design energy. Therefore, it is crucial for them to effectively use technology push, market pull, or design-driven forces to improve innovation performance is to import "open innovation" in the R&D process (Inauen and Schenker-Wicki, 2012). Chesbrough (2003) defined open innovation as a model that companies should utilize internal and external ideas or resources to search for ways to enter the market. He further proposed two main models, including: 1) "outside-in" – where businesses search for new ideas, technology, or knowledge from outside, and; 2) "inside-out" – where businesses take internal ideas and technology and go out to find opportunities for commercialization (Chesbrough, 2003; Inauen and Schenker-Wicki, 2012).

Inauen and Schenker-Wicki (2012) argued that the open innovation model is based on an assumption that innovation does not have to occur at the same location or organization. Binder, Löwgren, and Malmborg (2008) highlighted that businesses must break organizational boundaries to pursue multidisciplinary or cross-organization value co-creation. In addition, Sander and Stappers (2008) emphasized that "value co-creation" means any two value co-creation members undergoing co-creation activities, and members may include experts with relevant experience, such as customers, designers, and other stakeholders, etc. Finally, past studies (Hoyer, Chandy, Dorotic, Krafft, and Singh, 2010; Kristensson, Matthing, and Magnusson ,2002) suggested that value co-creation can not only enhance the value contributions of customers or other stakeholders, but also improve business implementation efficiency and effectiveness and plays an important role in the process of business product and service innovation.

Generally speaking, now value co-creation through open innovation is an important issue in transformation management. In the same time, open innovation might also bring challenges and potential risks (Gould, 2012). First, because value co-creation is built through multiple network relationships, how to construct appropriate co-creation relationships, cooperation models, and incentives to satisfy the needs of different stakeholders is very crucial (Prahalad and Ramaswamy, 2004). Moreover, Hoyer et al. (2010) proposed other risks of co-creation including weakened project control due to the introduction of external forces or heightened project complexity. The above may all increase additional communication costs when organizations are undergoing innovation, and requires new management skills and methods to respond. Therefore, in open innovation and multidisciplinary value co-creation, whether there are other corresponding key success factors is an important issue this study hopes to explore.

CASE STUDY

ITRI with the Dechnology Project

The Industrial Technology Research Institute (ITRI) was founded in 1973, and is not only Taiwan's largest R&D organization; it is a pioneer in building Taiwan's semiconductor industry as well. It has spawned world leading semiconductor manufacturers including UMC, TSMC, and Taiwan Mask, etc., and has laid the foundation for Taiwan's IC industry. Since its foundation (40 years), it has cultivated 70 CEOs of large enterprises, 225 companies, and has accumulated more than 19,000 patents. It is without saying that ITRI is one of the business representatives in technological innovation in the world. However, in recent years due to rapid changes in external market demand, and the desire to put behind the traditional manufacturing and the OEM way of thinking, the innovation demands of businesses have started to lean toward demand-orientated application innovations instead of simply considering technology, efficiency, and low costs. The ITRI's past methods of supporting innovative energy with "technical push" has reached a bottleneck, including the lack of patent commercialization and misplaced human and organizational resources, so it began to seek for change through innovative thinking and strategies.

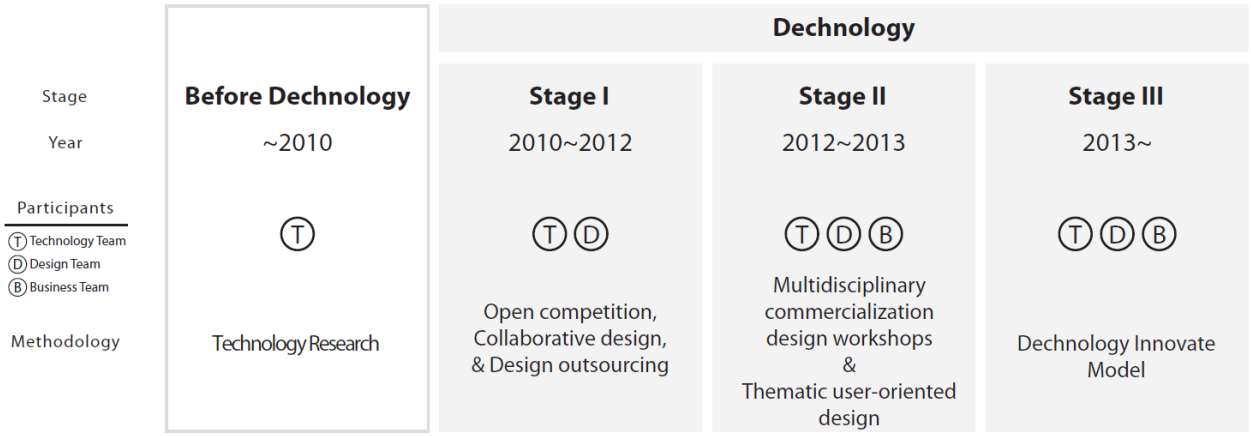


Figure 1 ITRI's three stages of innovative transformation through the Dechnology project

Since 2010, ITRI initiated the "Dechnology" project with the support of Department of Industrial Technology. This project aims to combine Taiwan's abundant local design and the advanced technology of ITRI (total eight R&D institutes) to develop products and services. The term "Dechnology" was created to represent this project. During 4 years, over 120 technologies have been included in this plan and it has cooperated with over 300 designers and 40

businesses. Moreover, it also won 23 iF International Design Competition awards, and produced numerous innovative designs successfully commercialized. However, in a traditional technology orientated R&D institution like ITRI, the technical aspect often controls resources and the right to speak, and it is difficult for non-technical fields to influence R&D or to lead innovative directions. Therefore, in the implementation of Dechnology's first two stages, ITRI has tried different multidisciplinary and co-creation models (as Figure 1) to find possible answers to improve open innovation or value creation efficiency.

The Dechnology Project - the first stage

In the implementation process during the first stage of the Dechnology project (2010~2012), through value up ITRI technology (T) by design (D), it established three innovation models including: 1) open competition; 2) collaborative design; 3) design outsourcing. Related content is described as below:

Open Competition

As for the technologies in ITRI with low maturity or those still searching for innovative application possibilities, these types of technologies were arranged into the " IP^{id} – open competition" of Dechnology project. Through the competition, the ITRI technology teams were asked to openly explain technical content and provide related information online. In addition, by cooperating with local design organizations, external designers could understand specific technology projects and propose design concepts, and finally, multidisciplinary specialists selected the proposal with the most development potential. ITRI technology teams then collaborate with these competition winners.

On one hand, the advantage of open competition is that a lot of different innovative concepts could be collected in a short time, and even new ideas for R&D could be provided (Surowiechi, 2004). On the other hand, because designers and the R&D teams lacked in-depth and two-way communication, even if the designers read the technical information, they sometimes were unable to fully understand the technical application limitations and content. Consequently, in the design process, they only depended on their own interpretation of technical knowledge and contents, and often resulting in technical misuse or misunderstanding. Furthermore, the competitions' judges could only make assessments from images and brief explanations by designers, and frequently lacked market validation or user's feedback. Therefore, even if concepts won awards, the probability of success in follow-up commercialization was still not high.

Collaborative Design

Furthermore, the "collaborative design" of Dechnology recruited external designers to ITRI to participate in a new product development projects. The project provided a longer project cooperation time (around six months), similar to "stationing" in R&D teams, and was aimed at providing an in-depth co-creation environment to search for technology innovation design opportunities. Thus, designers could work together with the technical units to select suitable technology topics and have adequate discussions and exchange in the process with their respective design and technical knowledge. Therefore, the R&D team could better understand the innovative thinking of designers, and similarly the designers could also deeper understand the core technical content and application limitations. This kind of arrangement didn't only overcome many difficulties in multidisciplinary collaboration, but increase the opportunity of finding innovative possibilities as well. To sum up, the success rate of commercialization after transferring to businesses was higher than the open competition.

However, when designers entered into R&D teams, some technical specialists often already established certain technology development ideas or direction, and the designers were limited in selecting technology or undergoing creative thinking (such as only positioning designers as working on exterior design); or when the designers had innovative ideas, technology maturity was not high enough, or more resources and time were required to conduct corresponding research and development, leading to the inability to further implementation of good ideas. Finally, under this model, whether the innovative ideas could be commercialized was dependent on if it could be combined with business and market considerations.

Design Outsourcing

Due to the lack of internal design resources and manpower in ITRI; therefore, for the technology aspect, if there

were types of technology with clear development direction, they would conduct "design outsourcing." According to Venkatraman's argument (2005), when investigating the reasons general companies use design companies for development, they found that reasons mainly include: 1) design prototypes to demonstrate technology; 2) enhance product value through design; 3) understand if there are new product application possibilities from the perspective of design through outsourcing design. However, for R&D units, how to choose suitable design companies to cooperate with among the large number of design companies with different expertise and services, and to play out the true value of design in innovation (not just the exterior or packaging design) is the challenge of this model.

The Transformation of the Dechnology Project

With the implementation and verification during the first stage of the Dechnology project, there was an output of over 300 innovative design concepts in 2 years, but it also faced the challenges of further "commercializing" creativity and how to attract different stakeholders to continue participation. Furthermore, through another internal study (Hung & Huang, 2013) we had discovered that technical screening and translation, importing business perspectives, user-oriented design, and incentive plan were important keys in the sustainable development of the projects and the success in commercializing results. Based on this, through importing Design Thinking and Service Design's 4Ds Process (Discover, Define, Develop, and Deliver) in 2013, Dechnology project further advanced from the original interaction between external designers (D) and internal technology teams (T), and added external business teams (B) to the ranks of co-creation. That led to the second stage of Dechnology project (2012 to 2013), establishing: 1) multidisciplinary commercialization design workshops; and 2) thematic user-oriented design models.

The Dechnology Project - the second stage

Multidisciplinary Commercialization Design Workshops

To improve the lack of understanding and close communication between designers and the technology teams, as well as the essential combination of business/commercialization knowledge in the innovation process, in the second stage of Dechnology project, Design Thinking was imported into *multidisciplinary commercialization design workshops* (the process is as Figure 2) .

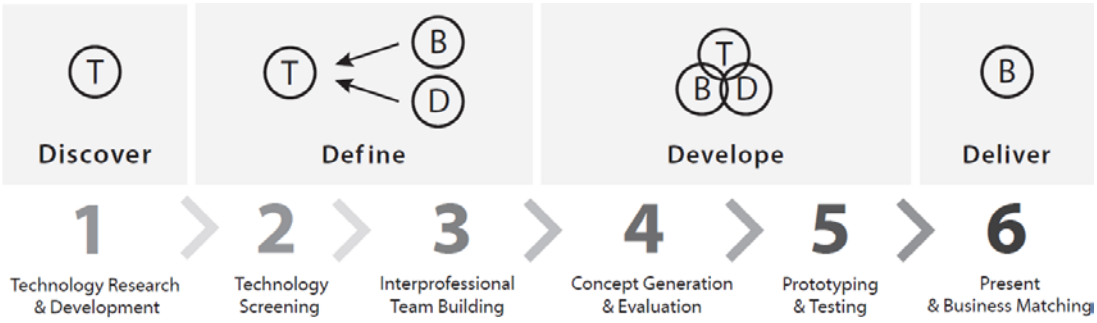


Figure 2: the conceptual model of multidisciplinary commercialization design workshops

The workshops started from the technology (T) with high readiness level, and aimed at seeking most innovative and valuable applications. Besides, Compared to the previous models in stage 1, the workshop introduced the business aspect of knowledge (B). So in the co-creation process, not only was technical feasibility (T) or user-centered thinking (D) in design considered, a broader exploration from a business aspect (such as marketing, cost, etc.) could be implemented. In addition, direction could be established according to financial analysis and market positioning to create a complete business plan. Finally, the technology researchers (T), designers (D), and business specialists (B) had four months of intense discussions and close interactions in the workshops. In 2013, a total of eight groups entered this model for trials, and the relevant implementation content is as table 1.

Table 1: Implementation content of multidisciplinary commercialization design workshops

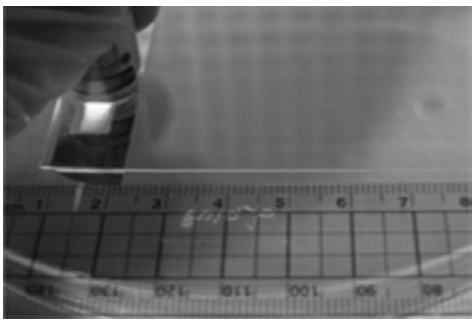
Group	Technical Project	No. of multidisciplinary team members		
		Technology Researchers	Designers	Business Specialists
1	Rapid prototyping high heat polylactic acid material	3	2	3
2	High color rendering adjustable color temperature LED display lighting	1	2	1
3	Rewritable electronic paper and writing techniques	3	2	3
4	LED human factor lighting technology application services and situations	2	3	2
5	Resistance heating technology	2	1	2
6	Atmospheric plasma technology	2	2	2
7	Flexible CIGS thin film solar cells	2	2	2
8	Photoconductive Film	2	2	3

Case: Alluring Lighting Mask

For the "Alluring Lighting Mask" case, the technology originates from the ITRI Material and Chemical Research Laboratory's technology - *photoconductive film*. Including the ITRI technical team, a 7-person multidisciplinary team that covered technology, design, and business was established by the workshop. In the concept generation stage, every team member proposed various conceptual ideas according to the technology. After numerous divergence and convergence processes, the team members finally focused on the concept of "facial mask" via technical feasibility, commercial viability, as well as design-oriented attractiveness, etc. Because among the many design concepts, the team believed that they should focus on the areas those consumers willing to proceed with high consumption, such as in health, beauty and so on. After focusing on medical skin care, the team members started to discuss and evaluate possible facial mask design.

In the co-creation process in the workshops, because designers and business specialists joined together, that could lead the team to face the market viability and consumer behavior early on. The business specialists said, *"We found from market information that 25 to 35 -year-old women are willing to spend money to invest in beauty care."* On the other hand, the designers of this project said, *"in the use of this product, you need to consider three major characteristics, including comfort, breathability and mobility."* For this reason, the design used the eyeglass structure concept that most consumers are familiar with so the product could be more accepted by the market and consumers. Finally, the multidisciplinary team offered a final product concept as well as a precise business model and market strategy. Consequently, after the project was produced, it quickly found a business willing to cooperate. Now this product will be launched in 2014, and successfully took technology originally used in the optoelectronics industry and applied it in medical beauty care, finding an innovative application business opportunity for photoconductive thin film technology (as below Table).

Table 2: Comparison of photoconductive film before and after design by workshops

Technology - Photoconductive Film	
Before design : the technology is used in the field of optoelectronic display backlight	**After design :** the technology is used in the field of medical beauty care
	

However, because this innovation model was still highly based on technology, how to select suitable technology for development so that co-creation value can be optimized is the main challenge. Secondly, in order to promote long-term multidisciplinary project cooperation, this research discovered that designing "incentives" according to the needs of different stakeholders and finding appropriate participants for the multidisciplinary team were another challenges. Finally, how to input new ideas in the innovation process and find an appropriate business to continue promotion, are important factors in allowing this model to be successful.

Thematic User-Oriented Design

Unlike multidisciplinary commercialization design workshops, the Dechnology project in stage 2 also attempts to drive innovation through design force and market push. It differs from the aforementioned technology driven innovation model; *thematic user-oriented design* used service design methods and the 4Ds process (as Figure 3).

Figure 3: the conceptual model of thematic user-oriented design

Thematic user-oriented design firstly focused on specific service field themes and the potential users. Designers (D) undergo design and research and find innovation opportunities that can offer people new meaning and experiences through trend analysis, field research, user research, and expert seminars. In addition, Designers also constructed development blueprints and usage scenarios for various fields through visualization. Secondly, in order to matching innovation opportunities with interested businesses (B), design teams then published innovation opportunities by the open platform and seminars. Through considering core strategies of the business, the design aspect (D) and business aspects (B) can have deeper discussions about the concrete proposals, required technical specifications, and then return to the ITRI or external companies to find necessary technical solutions (T). In 2013, the thematic user-oriented design model chose four themes for trials, including: 1) future living; 2) future traveling; 3) future health caring; 4) future learning, and relevant Implementation information is as the following table:

Table 3: Implementation content of thematic user-oriented design

Group	Theme	No. of multidisciplinary team members		
		Technology	Designers	Business
1	Future Living	40 Technologies	5	36 Companies
2	Future Traveling		4	
3	Future Health Caring		4	
4	Future Learning		3	

Case: Green Kitchen

In the "Green Kitchen" case, because the designers discovered people's demand for healthy and safe food in the field of future living, they proposed the innovative opportunity of a small-scale indoor plant factory, so that people can plant and harvest plants in their future living environment and recreate household food experiences. After the open platform and seminar announced this innovation opportunity, it successfully matched the design aspect and a company that mainly produces kitchen appliances. After in-depth discussions, a concrete design direction and the required technical specifications for a "Green Kitchen" opportunity was gradually developed. When the external designer completed concept sketches, he began to communicate the technology behind this opportunity with the ITRI technical team, and the technical team followed by technical screening. After finding matching technologies (plant factory and LED technology), the business internal co-creation workshop was initiated so that the business representative, designers, and technical team could design together. One business representative said, *"In the past, the company's internal staff also proposed similar ideas but because we totally do not understand plant factory*

technology, and we lack related mechanical and electrical integration technology, it was impossible to implement." Currently, through this mechanism, the "Green Kitchen" prototype has been completed. Next, a concrete implementation plan will be drawn out, and the commercialization stage in the company will begin in 2014.

However, although the business aspect joined the innovation process early on, it could bring the perspective of future service providers in advance and propose precise technical requirements. On the other hand, businesses often pursue concrete and feasible design options and hope they can be implemented in the short term, so it sometimes hinders the possibility of breakthrough innovation. Therefore, how to select the appropriate innovation direction/ goal; establish long-term relationships and trust of the multidisciplinary team are the key challenges of this model, especially the companies join the co-creation process. Secondly, since the related technology used to integrate the innovative proposals by this model may not be from ITRI, so it requires an efficient technology matching mechanism to integrate internal and external technology to improve the possibility of implementation.

Table 4: Green kitchen design concept

Needs - healthy and safe food	
Before design - large plant factories	**After design -** small indoors farms

DISCUSSION

This study mainly introduced two innovation models during the second stage of the Dechnology project: 1) multidisciplinary commercialization design workshops; and 2) thematic user-oriented design. Although adjustments have been made in response to the practical difficulties in the three main models in stage 1, certain challenges still exist. Through this study we found five key factors that would affect the innovation performance, including: 1) breakthrough ideas searching and importing, 2) technology screening and translation, 3) concrete incentives for multidisciplinary stakeholders, 4) multidisciplinary communication, and 5) continuing thematic exploration of innovative ideas.

Key Factor 1: Breakthrough ideas searching and importing

The first challenge of the Dechnology project is *"breakthrough ideas searching and importing."* In the past, ITRI employed technical R&D as its main innovation direction, but because it lacked connection with the inner desires of users or market demand, it gradually encountered a bottleneck. Through the Dechnology project co-creation model combining the technical aspect, design aspect, and business aspects, although there is an improvement from insufficient technical push; how to input more factors in the innovation process so that the three teams can have more breakthrough and innovative ideas is still a major point. Past research pointed out that innovative breakthrough should have high style, high tech, and high value, and the new opportunities/ideas should be found from society, the economy, or technology (Cagan & Vogel, 2003). Similarly, Verganti (2009) also mentioned that technological innovation can create new user behavior. However, if the companies want to maintain the leadership position of innovation, they should propose innovative and valuable new meaning of things by analyzing socio-cultural development, lifestyles, and user behavior. For this reason, Dechnology project in the following phase (stage 3) will keep introducing external design research resources, and to search for breakthrough and innovative opportunities through trends and socio-cultural context.

Key Factor 2: Technology screening and translation

Because ITRI is a highly R&D-orientated organization, *"technology screening and translation"* has always been a challenge in the co-creation process. The designers that participated in the Alluring Lighting Mask mentioned: *"selecting suitable technology has key influence on the output of co-creation. If the technology has a specific application direction; it is difficult for the multidisciplinary team to be effective. In addition, if technology maturity is not high, then the prototype cannot be built later on, causing many design concepts to fail and co-creation value to decrease."* In terms of the understandability of technology for non-technical team members, this study discovered that for the two innovation models at the second stage of the Dechnology project, because the formal mechanisms for discussion were established (Sung & Wu, 2011), all the team members could undergo face to face in-depth interaction. Furthermore, the project cooperation time was extended, so the knowledge of the team members was fully exchanged and transferred, reducing the risk caused by misunderstand about high technology contents. In addition, another internal study (Hung & Huang, 2013) also pointed out that if the technology can use metaphors or visualization to convey technology characteristics and limitations, it would promote the transfer of technical knowledge. In summary, this study suggests that technical screening can be allocated according to technology maturity and if the R&D teams desires to find an innovative application opportunity. In terms of the understandability of technology, relying on metaphors or visualization to provide preliminary knowledge would reduce probability of misuse. For more in-depth knowledge, a interaction mechanism needs to be set up to provide a longer period for face to face discussions.

Key factor 3: Concrete incentives for multidisciplinary stakeholders

First, past research pointed out that "people" are the core source of innovation (Cagan & Vogel, 2003). Besides, when team members are more willing to try to think from different perspectives, they could not only learn and use multidisciplinary professional knowledge in their work, but also could enhance the team's creativity and productivity (Seelig, 2012). In this study, we discovered the dedication level of the multidisciplinary team members is closely related to the quality of the resulting innovation. Therefore, when the design, technology, and business teams participated in the Dechnology project, how to establish *"concrete incentives"* to satisfy the demands of different stakeholders are key factors in the innovation process. As said by the Dechnology project coordinator: "in order to allow the multidisciplinary team to interact closely, it is necessary to establish performance reward mechanisms in the original organization. Then high-quality talents would be attracted and truly implement multidisciplinary innovative thinking without related concerns (including intellectual property rights and the future distribution of benefits). In addition, past research also pointed out a "value alignment mechanism" could also help stakeholders cooperate and co-create together. The stakeholders would establish core value and goals, and come to a consensus and have stable cooperative relationships (Frow and Payne. 2011).Therefore, this study suggests that innovation models in the future should focus on different needs of stakeholders, and provide different value propositions and service design in the co-creation process.

Key Factor 4: Multidisciplinary communication

In the Dechnology innovation models, we found the *"Multidisciplinary Communication"* is an important factor that leads to project results having varied quality. Moreover, past study also points out that a multidisciplinary team is not a panacea in every innovation project (Ainamo, 2007). A lot of literature mentions that the multidisciplinary cooperation process requires formal and informal interaction, or visual tools to assist multidisciplinary co-creation (Citworthy, 2011), reducing the difficulties caused by expertise and terminology, and to help the team quickly exchange opinions (Adderio, 2001; Cagan and Vogel, 2003; Griffin and Hauser, 1996; Sung & Wu, 2011; Webber, 2001). For example, in the two types of models in Dechnology stage 2, they all create opportunities for the technical team, designers, and business team to have more in-depth and longer face to face discussions. Team members could have more opportunities to use different methods to enhance communication, such as drawing or fast prototyping. Compared to the models of stage 1, the projects in stage 2 have better results for commercialization (Seelig, 2012, p.73-91), and the quality is more likely to fulfill expectations. Therefore, this study points out that besides formal interactive mechanisms, informal interactive mechanisms should also be established. Furthermore, the innovation resources should also be systematized and developed into physical or visual tools for multidisciplinary co-creation.

Key Factor 5: Continue thematic exploration of innovative ideas

Finally, because the Dechnology project is an annual project, and did not lock into a certain theme to continue development, it resulted in ideas being too scattered. Consequently, the ideas produced each year often stop in the initial stages of development and are unable to continue development in different dimensions for commercialization.

For instance, a designer who participated in Alluring Lighting Mask project mentioned: *"In the beginning, introducing different professional knowledge could provide a lot of help; however, innovation requires digging continuously. There should an opportunity to take design concepts form last year with good potentials to different models instead of restarting topics every year."* The literature (Verganti, 2009) also emphasizes that a breakthrough product concepts with innovative meaning and new technology should continue focusing on different professional fields to create usable, useful, and desirable products. Therefore, his study recommends that when initiating the Dechnology project in the future, it could connect with the outcomes of "thematic user-oriented design" model. Then the team member could accumulate innovative know-how through systematic exploration of demand and opportunities. Besides, the concepts which generated in the innovation process should be appropriately arranged according to its maturity and quality. The concepts that can be immediately commercialized can be transferred to related businesses. On the contrary, other concepts with potential but need more refinement can go an *"idea pool"* mechanism (Bream & Voigt, 2009), to serve as reference for innovative topics or technological R&D improvement direction in the next stage.

The Dechnology Project - the third stage

Finally, based on the implementation experience from the past two stages of the Dechnology project, this study proposed a conceptual Dechnology innovation model (as Figure 4). Now the model is also implemented during the third stage (2013~) of the Dechnology project.

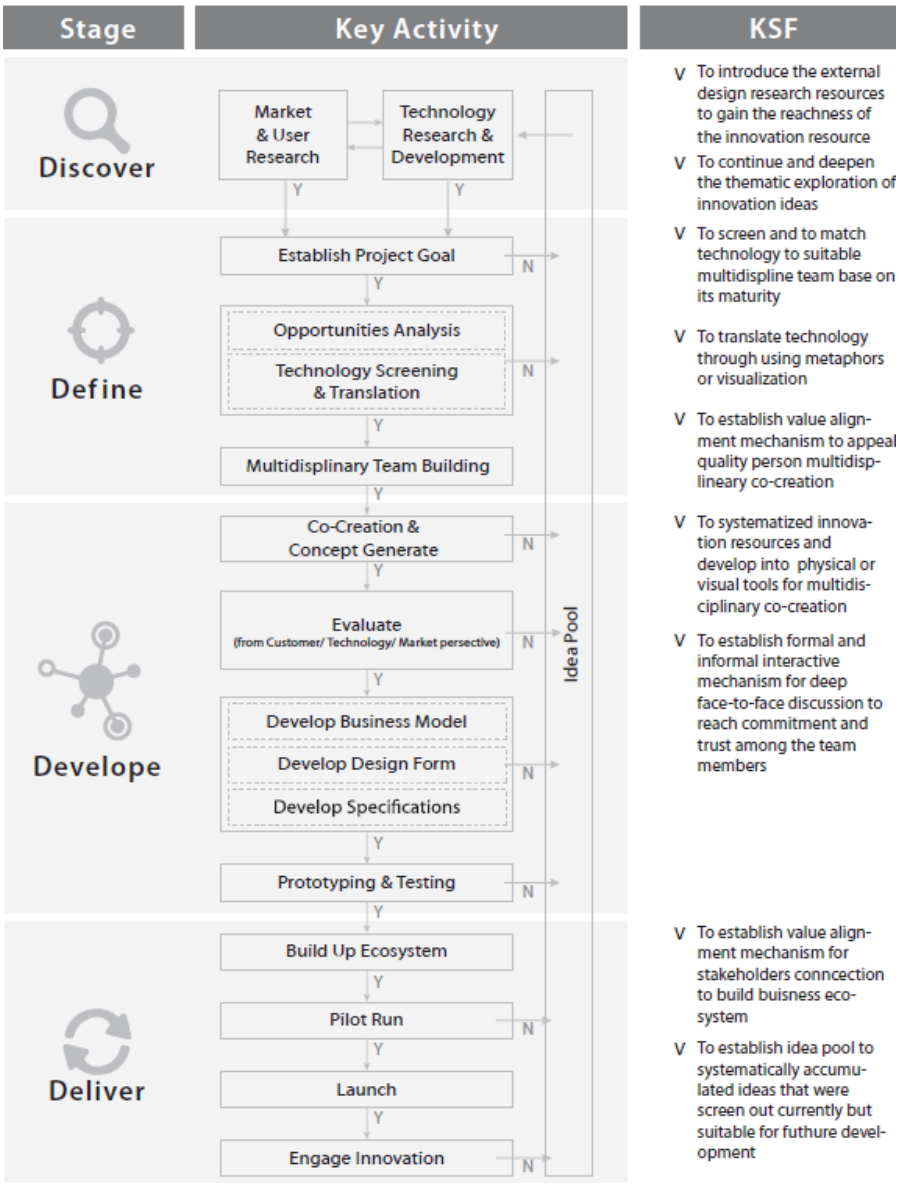


Figure 4: The conceptual Dechnology innovation model

CONCLUSIONS

Innovation plays an important role in creating customer value and enhancing the competitiveness of the organization. Because of changes in the market and industry, the resources required for innovation have become increasingly diverse. For traditional technology-oriented companies, it is very crucial to breakthrough original thinking and culture, and then integrate related multidisciplinary knowledge and resources externally. That is the one of main challenges in current innovation practice and organization transformation. Therefore, how to adapt open innovation in the R&D process and sustainably bring multidisciplinary stakeholders co-create value together is the major issue of this study. Though focusing on the Dechnology project in ITRI, the study introduced on the two types of innovation models, including: 1) multidisciplinary commercialization design workshops; and 2) thematic user-oriented design models, and then compiled the five key success factors, including: 1) breakthrough ideas searching and importing, 2) technology screening and translation, 3) concrete incentives for multidisciplinary stakeholders, 4) multidisciplinary communication, and 5) continuing thematic exploration of innovative ideas. Furthermore, the research also proposed a conceptual Dechnology innovation model integrated with service design to serve as an important reference for businesses that undergo similar innovation projects and transformation management in the future. Finally, in terms of future research direction recommendations, the conceptual model should be further verified or come up with additional key success factors by other related multidisciplinary and cross-nationality cases.

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Supporting Decision Making and Policy Through Large Scale Pilots

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ABSTRACT

Under the European Commission's ICT Policy Support Programme (ICT-PSP) so-called Large Scale Pilots (LSPs) have been launched to advance cross-border interoperability in key policy areas like eID, eHealth, eProcurement, eJustice or the Services Directive. Member States (MS) collaborated to make their existing services interoperable. The first LSPs started in 2008 and impressive results have meanwhile been achieved. Although being technical projects, key hurdles that had to be overcome wasn't technology, but legal and operational issues, understanding the legacy and administrative cultures in the participating states, or governance of results. This paper will focus on those aspects. Taking the LSP STORK as an example, the experience made on decision making in such complex initiatives is discussed. The paper will discuss what activities preceded the piloting, like the ministerial declaration that expressed the political will, how the LSP was set up to implement it, and how it led to policy initiative like the upcoming Regulation on electronic identification and trust services for electronic transactions in the internal market (eIDAS).

Keywords: Large Scale Pilots, e-government, Electronic Identity, STORK

INTRODUCTION

With the emergence of the Internet to a mass phenomenon, governments started to bring their services online. First as sole information services in the 1990s, soon transactional services appeared. The eGovernment benchmarks carried out by the European Union (EU) showed as online availability trend, that citizens services grew from less than 20% availability in 2001 to about 80% in 2010, business services grew from about 30% to almost 90% (European Commission, 2010). In this 2010 benchmark report, the top six countries assembled at 100% online-availability of benchmarked services and at a 99-100% sophistication rating. While such availability figures may sound impressive, it is limited to national use, lists services that may be isolated islands that do not need to collaborate, and an Internal Market asks for more: The 2013 follow-up report emphasized that "*Services must be far more integrated across government entities, and indeed across borders.*" (European Commission, 2013). This has not been recognized just recently, the need for providing services for citizens and businesses across borders has e.g. been stated already in 2002 in the eEurope 2005 Action Plan (European Commission, 2002).

The provision of online public services cross-borders is however complex. It by far cannot be seen solely from a technological viewpoint. Legal and operational aspects are to be considered. National systems inherit legacy and administrative culture that may not easily be transposed to other states. In order to advance to interoperable public services, the European Interoperability Framework (EIF) defines Political Context, Legal Interoperability, Organizational Interoperability, Semantic Interoperability, and Technical Interoperability as the levels to take into account (European Commission, 2010):

- Political Context claims that each European public service is the result of direct or indirect action at political level.
- Legal Interoperability refers to each public administration working within its own national legal framework. Incompatibilities can make collaboration complex or even impossible.
- Organizational Interoperability covers business process alignment, organizational relationships, and change management.
- Semantic Interoperability allows to process information in a meaningful way. This can be easy in highly regulated sectors or where de-facto standards exist. It however can be hard in cross-sectorial communities.
- Technical Interoperability finally covers the linking of services and information systems.

Even if each layer above gets well considered, there is no such thing as a success guarantee. This holds in particular true, if complex policy areas get addressed. Piloting in real-world environments is advisable so that barriers can be identified through lessons learned. The European Commission therefore initiated Large-Scale Pilots (LSPs) that are driven by Member States (MS) to develop cross-border services in key policy areas.

This paper discusses how such LSPs can successfully support policies. It takes electronic identity (eID) and a LSP "STORK" on European eID interoperability as an example. This as eID is a sector-independent service and as approaches taken by European MS on eID vary significantly. Thus, the chosen example is well suited to illustrate how piloting can support policy. For eID this LSP's lessons learned showed that lacking legal basis for mutual recognition is the main barrier. This culminated into input to a European Regulation – the eIDAS Regulation (European Commission, 2012). Thus, the LSP can be argued as an initiative that supported policy making.

The remainder of this paper is structured, as follows: First the LSP family is introduced. This to give the reader some insight on what policy areas have been addressed and supported by LSPs. As eID has been picked as an example to illustrate how the LSP process works, issues related to cross-border use of eID are discussed. This includes discussion on what initiatives existed before an LSP on cross-border eID has been launched. This LSP has been STORK – its objectives and main results are discussed in the subsequent section. The process of how decisions have been made in STORK are described and the lessons learned are given from the author's personal perspective. The author has contributed to the STORK LSP, did lead a pilot, as well as had he honor to serve as co-chair of the Member State Council. The Member State Council was the governance body responsible of STORK's strategic orientation. Finally, conclusions are given.

THE LSP FAMILY

The idea of Large Scale Pilots to support European key policy areas has been introduced with the ICT Policy Support Programme (ICT-PSP) which is part of the European Commission's Competitiveness and Innovation Framework Programme (CIP). CIP has been established as a funding programme in 2006 (European Union, 2006). First calls for grants have been launched in 2007. CIP ICT-PSP addressed the themes "ICT for health, ageing well and inclusion", "Innovative government and public services", "ICT for a low carbon economy and smart mobility", and "Open innovation for internet enabled services".

In the two first themes "ICT for health, ageing well and inclusion" and "Innovative government and public services", this paper gives particular attention to so-called "pilot A" LSPs. A pilot A is "*Building on initiatives in Member States or associated countries to ensure the EU-wide interoperability of ICT-based solutions. The large-scale pilot projects fall into this category and embrace at least six Member States, with potential for further extension to all Member States;*" Six such pilot A LSPs have been launched and are briefly sketched in the following sub-sections.

e-CODEX

The objective of e-Justice Communication via Online Data Exchange (e-CODEX, 2010) is to "*improve the cross-border access of citizens and businesses to legal means in Europe as well as to improve the interoperability between legal authorities within the EU.*". The project started in 2010 and will run until 2015. More than 20 European states

collaborate. The pilots aimed are:

- Small Claims
- The European procedure for Payment Order (EPO)
- The European Arrest Warrant
- Secure cross-border exchange of sensitive judicial data
- Mutual Recognition of Financial Penalties

epSOS

The aim of European Patients Smart Open Services (epSOS, 2008) is to "*design, build and evaluate a service infrastructure that demonstrates cross-border interoperability between electronic health record systems in Europe*". epSOS started in 2008 and is still running. It gathers twenty-five European states. To demonstrate meeting the objectiveand to test the results, two pilots have been defined: Patient Summary and ePrescription,

PEPPOL

The LSP Pan-European Public Procurement Online (PEPPOL, 2008) did run from 2008 to 2012. The overall objective was to "*enable businesses to communicate electronically with any European government institution in the procurement process, increasing efficiencies and reducing costs.*" Eleven MS participated and piloted by interconnecting existing eProcurement solutions. PEPPOL developed specifications such as a Virtual Company Dossier (VCD) that allows suppliers to submit company information in a common format. Further results have been eCatalogue, eOrders, and eInvoice specifications and an e-signature validation service.

SPOCS

Simple Procedures Online for Cross-border Services (SPOCS, 2009) was driven by sixteen European states and did run from 2009 to 2012. It did facilitate the creation of businesses and providing services cross-borders under the Services Directive (European Union, 2006b). SPOCS did four pilots on professions typically providing cross-border services. The four pilot professions were Travel Agent, Real Estate Agent, Architect, and Master Builder.

STORK / STORK 2.0

The LSP Secure idenTities acrOss boRders linked (STORK, 2008) was operational from 2008 to 2011. It provided a framework on eID federation for natural persons. This is discussed in detail in the remainder of this paper. A follow-up project STORK 2.0 (STORK, 2012) extended on eID for representation, such as a natural person representing a legal person, and extended from e-government to eID in private sector services like Internet banking. STORK and STORK 2.0 gathered both about 20 European states. STORK 2.0 will run until 2015.

eSENS

Given the results of the LSPs mentioned before, twenty European states gathered to the Electronic Simple European Networked Services (eSENS, 2013) LSP that has been launched in 2013. The objective is to build upon the results of other LSPs and to consolidate their results. Building blocks like eID, eSignature, eDelivery, and eDocuments shall get piloted in a way to demonstrate maturity and sector-independent applicability. The piloting areas are Business Creation, eJustice, eHealth, and eProcurement. By advancing to mature sector-independent building blocks, a sustainable infrastructure shall be demonstrated. This shall be a basis for the Connecting Europe Facilities (CEF) meant to provide such an infrastructure on the longer run. (European Union, 2013).

Each of the six LSPs mentioned above was meant to support policy. Among those, STORK is the LSP that has the most sector-independent characteristic, as eID and authentication is generic and needed by many service. This paper thus uses STORK as an example to illustrate how LSPs can support policies and their decisions making.

ELECTRONIC IDENTIFCATION AND ITS CROSS-BORDER ISSUES

Secure authentication is a starting point for Web applications that process sensitive or personal data. States started to issue eID as credentials to provide such secure authentication in the late 1990s. To give a definition what eID and authentication aim at, the draft eIDAS Regulation states (text taken from the Regulation proposal (European Commission, 2012). For the changes on these definition out of the Council and Parliament legislative process, that hasn't been completed at time of writing this paper, see the final Regulation, once published):

- *'electronic identification' means the process of using person identification data in electronic form unambiguously representing a natural or legal person;*
- *'authentication' means an electronic process that allows the validation of the electronic identification of a natural or legal person; or of the origin and integrity of an electronic data;*

In order to highlight the challenge when aiming at interoperability between eID solutions, the following sub-sections give a few examples where national eID systems differ. These differences are shown to highlight why decision making needs a proper process in order to on the one hand not reinvent the wheel, but on the other hand still consider national differences. To structure where such differences exist, the categories EIF (European Commission, 2010) defines as levels of interoperability are used (cf. Introduction of this paper). A comprehensive comparison of national eIDs is beyond scope of this paper. For such comprehensive comparisons, the reader is directed to studies like the IDABC eID Interoperability Study (European Commission, 2009).

Political

Defining the political context as "*each European public service being the result of direct or indirect action at political level*", most eID systems in Europe origin from a political decision to facilitate citizen services online. Where the solutions that emerged however differ, is the level on which such eID means are provided:

- Some states went for a national solution by issuing a mandatory eID card to each citizen. This as a homogeneous single authentication means – often amending an existing ID card by a chip. Examples are the BELPIC card in Belgium or the ID-kaart in Estonia (Estonia later complemented by a mobile eID).
- Some states introduced ID cards on the national level, but also on the regional level. An example is Italy where a national identity card CIE is issued, but some regions also issue a citizen service card CNS.
- A technology-neutral approach has been taken by Austria where citizens can choose from card solutions by both the private sector and the public sector (that includes bank cards, health insurance cards, student cards, profession cards, etc.), but also mobile eID got seamlessly integrated.
- The situation in the Netherlands is different with DigiD: no electronic ID card has been issued, but an authentication portal is provided for username-password authentication, username-password-SMS multifactor authentication, respectively.
- Other states piggybacked on existing authentication solutions by the private sector, like Internet banking systems with BankID in Norway and Sweden.

The political intention has been the same in many MS – providing secure means of authentications. The approaches however differ in various dimensions: in making eID mandatory or a voluntary citizen's choice; in issuing eID by the government or relying on the private sector; in allowing multiple means and technologies or relying on a single token; and given the different technologies and issuance processes applied, in the security levels and the assurance provided.

Legal

Where eID has been state issued, it usually is based on an explicit legal basis. This can be a law solely on eID, like the Law on ID cards and electronic identification means in Germany, or a comprehensive law covering various aspects like the e-government Act in Austria.

Differences in the legal basis exist in particular in the use of personal identifiers. In some states it is allowable to use a single personal identifier like a population register number or a tax identifier across sectors. The identifiers are persistent, i.e. do not change during the citizen's life. This is for instance the case in Estonia, Italy, Spain, or Sweden. Such unique and persistent identifier then often get included in digital certificates. Other states have persistent identifiers, but do not include them in digital certificates for data protection reasons. That was the case in Finland. In other states a persistent identifier used across sectors is even unconstitutional, like in Germany. Identifiers in the German eID are bound to the physical ID token and change whenever this token get replaced. Moreover, the eIdentifier is cryptographically derived differently for each application so that cross-relating sectors or between applications is not possible. Some states continue to maintain sector-specific identifiers in parallel, such as social insurance numbers, tax numbers, student numbers, etc. Austria combines the approaches, as while a unique persistent identifier exists via the Population Register, these however get cryptographically derived to sector-specific or application-specific identifiers in online authentication.

These differences are major, like a unique identifier used cross-sectors being normal in some states, violating the constitution in others. The differences also root deeply in administrative processes. I.e. when cross-relating sectors is legal, application may relate citizen dossiers by matching the identifiers in the backend. If such identifiers do not exist, this may not be possible and only the citizen may establish the link.

In many states identifiers are also defined nationally, usage across borders is disallowed. A reason is that under the Data Protection Directive (European Union, 1995) article 8.7 defined particular attention for identification numbers by stating that "*Member States shall determine the conditions under which a national identification number or any other identifier of general application may be processed*". Such conditions are often defined nationally, inhibiting its cross-border use.

Organizational

Differences in the business process exist in particular in the issuance process. Some states rely on handing credential physically to the person, others have online processes and validation in the backend processes. Both may reach comparable security mechanisms, but often are hard to compare without knowing the details.

In organizational relationships the main differences exist on who is responsible for and who issues eID. While usually (but not necessarily) a link to government responsibility exists, some states keep issuance under their sole responsibility, such as Germany and Estonia (which still may involve private sector organizations in the process), other states rely on the private sector like bank identification in several Nordic countries. A public-private collaboration exists in other states like Austria, where the government is responsible for the identity base (Population Register), but eID tokens can be issued either by private or public organizations and certificate issuance is in the private sector.

Where government responsibility is given, a difference may also be in the government level involved. It may by the federal level in some states, the regional and local in others, or a combination.

The organizational integration on eID can also differ in the sense that some solutions have the service provider delegate authentication to a third party, like to an Identity Provider (IdP). Other approaches rely on each service provider having the eID tokens integrated into their applications. The difference is technical, but has also legal consequences, as delegating responsibilities gives a shift of liability and data protection responsibilities.

Semantic

The semantic differences are in the personal identifiers and the personal attributes associated with it.

The identifier usually is some alphanumeric value, that easily can be used across applications and cross-borders. As however indicated in the section on legal differences, the identifier may be persistent in some countries, or bound to a physical token or application in others. An application assuming the former, like a citizen always having the same identifier when authenticating, may need processes to cover cases where hat does not hold true.

On attributes the differences can be in the meaning, but also sector specific. To give an example, some sectors or legislations may assume two genders "male/female" as the only value set, other legislations or the health sector may distinguish further like ASTM E1633 having nine and DICOM eleven values (Male, Female, Hermaphrodite, …).

Technical

Technical differences exist in the token types and how these get integrated in service providers.

Token types range from smartcards, mobile ID, software certificates, one-time password (OTP) generators, or username and password. Some states have just one token, others use various types.

Integration into services provider applications usually follows one of two options: The first is that authentication can be delegated by the application to an authentication portal. The portal can be central or it can be a federation with several portals. Such delegations are also referred to as a "proxy model". An example Netherlands with DigiD authentication. The second option is that the authentication token gets integrated by the service provider. Usually some integration software or middleware is provided. The model is also referred to as a "middleware model".

EFFORTS ON EID INTEROPERABILITY

The political will to advance to an eID ecosystem that can be used across Europe was expressed in the Manchester Ministerial Declaration (European Union, 2005) as "*By 2010 European citizens and businesses shall be able to benefit from secure means of electronic identification that maximise user convenience while respecting data protection regulations. Such means shall be made available under the responsibility of the Member States but recognised across the EU*". This was an enabler that started a number of initiatives, but also settled the scene in a sense that no harmonization or EU-wide eID token is aimed, but the responsibility remains with the states; interoperability and recognition of national solutions is the goal.

The Ministerial Declaration was preceded by work in eEurope 2005 subgroups. One of the subgroups was on eID that settled the scene and provided a timeline. It defined a number of actions like defining terminology or a common framework, as illustrated in figure 1.

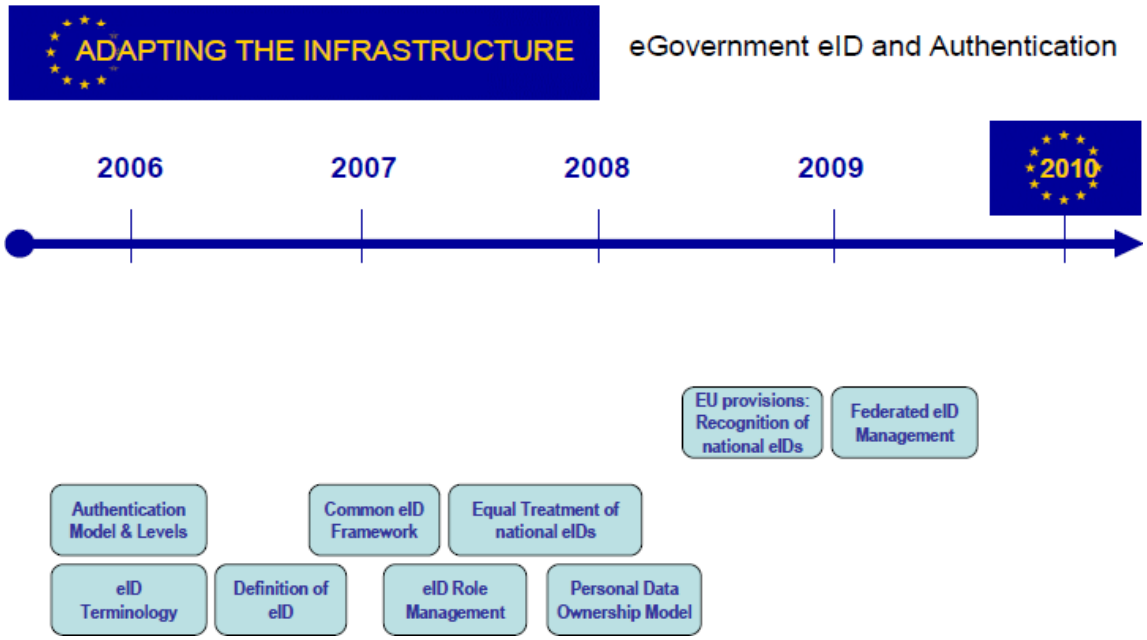

Figure 1. eID initial timeline (from European Commission, 2005)

While its overall timeline hasn't been met, the Manchester Declaration lead to several initiatives. To take stocks, studies of the eID landscape have been launched, like (MODINIS-IDM, 2005) or (European Commission, 2009) that initially got published in 2007 and got amended in 2009. The eID subgroup (European Commission, 2005) already indicated the importance of piloting, given the complex area eID is. This suggestion of pilots was one of the initiatives that finally lead to the STORK LSP.

THE STORK LSP

The STORK project started in May 2008 with an original duration of three years. As a "pilot A" it had been driven by MS. The project started with 14 EU and EEA states (Austria, Belgium, Estonia, France, Germany, Iceland, Italy, Luxemburg, Portugal, Slovenia, Spain, Sweden, The Netherlands, and United Kingdom). It had an original budget of € 20 million. In 2010 an extension by four further MS (Finland, Greece, Lithuania, and Slovak Republic) and to a budget of € 26 million took place. Under the CIP ICT-PSP co-funding regime, 50% of the project costs have been co-funded by the European Commission, 50% is borne by the project partners.

The overall idea was to define a framework that does not change the existing national eID infrastructure, but does define an eID interoperability layer on top of the national systems. The technical model was eID federation based on the Security Assertion Markup Language version 2.0 (SAML 2.0). It is described in (Leitold, Zwattendorfer, 2010).

In a nutshell, the project has been structured in three phases:

- In the first project year, common specifications for the eID interoperability framework have been developed.
- In the second year, the common specifications have been implemented and deployed into the national pilot systems.
- The third year was devoted to piloting the framework.

The target was to deploy and pilot in production systems. This to maximize lessons learned, as less compromise or weakening requirements under pilot assumptions is expected, once service providers have to deploy in their production environment. The assumption was that service providers rather will ask for close-to production quality, which increases confidence in the general applicability of pilot results.

The STORK cornerstones are thus the six pilots, each having specific requirements:

- The first pilot *Cross-Border Authentication Platform for Electronic Services* aimed at integrating the STORK framework to e-government portals, thus allowing citizens to authenticate using their eID. The portals did range from sector-specific portals such as the Belgian "Limosa" application for migrant workers to regional portals serving various sectors such as the Baden-Württemberg "service-bw" portal or national portals as the Austrian "myhelp.gv" for personalized e-government services.
- In the *Safer Chat* pilot juveniles could communicate with peers within their age range safely. The pilot has been carried out between several schools. The specific requirement was that in the authentication process the age group delivered by the eID is evaluated to grant access. Unique identification that is the basis of the other pilots is less important, this pilot was on pseudonymous access bases on age ranges.
- *Student Mobility* supported exchange of university students, e.g. under the Erasmus exchange program. As many universities nowadays have electronic campus management systems giving services to their students, STORK could be used to allow foreign students to enroll from abroad using their eID and to access the campus management system's services during their stay. The prime requirement is authentication, as in the first pilot on cross-border authentication.
- The fourth pilot's *Electronic Delivery* objective was cross-border qualified delivery, replacing registered letters. On the one hand, delivering cross-border requires protocol conversions between the national delivery standards. On the other hand, qualified delivery usually asks for signed proof of receipts. The latter – signed proof of receipts – is the specific requirement in this pilot. This enabled cross-border tests of signature-functions that most national eIDs have.
- To facilitate moving house across borders, the pilot *Change of Address* has been defined. In addition to authentication, the pilot had transfer of attributes, i.e. the address, as a requirement. An interesting aspect was that – in addition to the population registers – further authorities could be connected and automatically be informed of an address change. Examples are employment centers or billing addresses for the electrical supply companies.

- The European Commission Authentication Service (ECAS) is an authentication platform that serves an ecosystem of applications that are operated by the European Commission. Member States use these services to communicate among themselves and with European institutions. Piloting administration-to-administration (A2A) services with national eIDs was an STORK objective. The pilot *A2A Services and ECAS integration* serves this objective by linking up STORK to ECAS.

DECISION MAKING AND LESSONS LEARNED

In this section the internal operation of the LSP STORK is discussed. The decision processes are described and lessons learned are given. The lessons are solely described from the author's perspective. Thus, the author is the only to be blamed on his opinions on the project outcome.

Structure to allow both project management and strategic orientation

A Large Scale Pilot is a complex undertaking. STORK started off in 2008 with 29 partners representing 14 states. The project volume was more than 1.000 person-months. After a year STORK got extended to 18 MS, more than 40 partners and 1.800 person-months.

The project can thus be seen as a big IT project that aims to deliver a result, which is cross-border federation of eID as technical systems, and to set this in production. This requires proper project management. With many partners this may need strict management and its enforcement in order to meet deadlines and to achieve the quality needed.

The project however can also be seen as collection of MS that operate towards a higher policy objective. Each MS has undergone own eID deployment and made own experience. More importantly, national eID infrastructure often represent huge investments that need to be protected. This requires consensus to make sure each MS gets embraced and to avoid a risk of the project falling apart, if MS see their interest not well represented. A strict project management structure putting focus on deadlines and getting the job done may contradict such a requirement of getting MS interest considered. Some diplomacy and sensitivity is needed on where substantial objection exists.

STORK has considered that already in the management structure that is illustrated in the following figure 2. In the bottom part, a management structure consisting of Work Packages (WPs) represented by its respective WP leaders is shown. WPs are defined content-wise, like developing common specifications and developing the software implementing it. To do management and to coordinate between the WPs a Programme Director and an Executive Board consisting of WP leaders does the day to day management. A similar structure is seen in many IT projects.

To avoid unbiased management, the Project Coordinator / Project Director has not been selected amongst the MS involved, but a company being independent from those has been chosen that has no own stakes in the main project content, e.g. that is no IdP issuing eID itself. (Project Coordinator of STORK and STORK 2.0 is ATOS Spain).

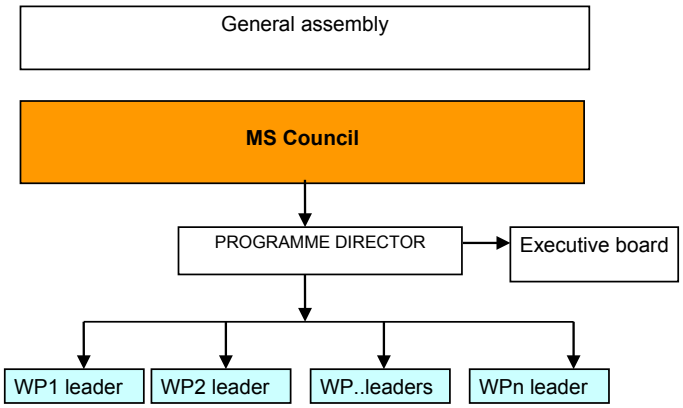

Figure 2. STORK Management Structure (from the LSP STORK contract)

The WP leaders, Project Director, and the Executive Board give a conventional management structure. The control functions are taken by two boards: The General Assembly comprises all project partners and is responsible for

contractual aspects. Key on the strategic orientation of the project and for finding a consensus between MS is the Member State Council. It gathers one representative of each MS participating in STORK. It has been defined as the ultimate decision making body on all aspects that touch MS interests. If a substantial issue arises in the day-to-day management of the project, it got escalated to the MS Council. Just if consensus was found and a decision was made, the issue could proceed. The MS Council can be compared to an advisory board in a company, the MS Council however has less of an advisory role, but clear decision responsibilities that also relate to operations.

The lessons learned (again being an author's opinion) is that this separation of duties between traditional project management and the strategic decisions worked out well. There is some potential for friction between the timely provision of results and issues that can get blocking on the Member State Council level. However, the fact that most members of the Member State Council also have been involved in the WPs and had responsibility in the operations, e.g. as WP leaders, resulted in direct communication to the Member State Council and in early escalation.

The relatively lean management structure of a Programme Director and an Executive Board needed some tightening in the coarse of the project: Each of the (originally five, later extended to six) pilots has been defined as a separate WP and each applied its own management and quality control means. While this sounded fine in the beginning with experienced project managers in charge that applied their preferred management measures, the pilots also serve a common goal to test the common infrastructure. The risk of drifting apart existed. In an external project review this e.g. has been expressed for quality management as "*Each participant is declared free to use their own QM method: this makes overall project quality heterogeneous and inconsistent.*" To tighten that up the Member State Council requested to install a new role – a Pilot Coordinator. Its main duty was to make sure that pilots get aligned and to act as a "whip" if pilots drift apart and to enforce alignment.

Core Decisions

The project structure was roughly one year defining common specifications, one year implementing them and one year (later extended to 1 ½ year) testing them in pilots. The critical project phase was to come to agreements in the first year. While many has been discussed and agreed already in project proposal preparation, two aspects needed to be managed that (again from an author's perspective) carried a risk of overall failure, if no agreement is reached:

- The first aspect was on the security and assurance associated with the national systems. The processes and technical security of the systems differ. While each MS is convinced of the own system, in STORK trust in the other MS systems is needed. Trust requires security, but heterogeneous systems cannot easily be compared on its security features.

- The second aspect is that there are substantial differences in national deployment models. With reference to organizational and technical differences discussed in the eID overview section above, some MS favored decoupling MS internal complexity by national gateways in a "proxy model", other wanted to keep and advance their deployed "middleware models". Reasons for that choice rooted in the nationally deployed infrastructure, but also in legal aspects like liability and data protection.

On the former bullet, a quality authentication assurance (QAA) model has been agreed that allows a relatively flexible mapping of national eID issuance and technical security to four levels from "*QAA 1 for no assurance*" to "*QAA 4 for high assurance*". This is comparable to Levels of Assurance (LoA) in (White House, 2003) and (NIST, 2006). In fact, this similarity is intended and origins from basing STORK QAA with (European Commission, 2007) that itself intended to be aligned as good as possible with similar initiatives.

On the second bullet on substantially different national models, a model was found so that both approaches "proxy" and "middleware" can be embraced. It first started as two different approaches "PEPS" (for Pan-European Proxy) and "middleware" using a so-called Virtual Identity Provider (V-IDP) that somehow competed. The consensus finding lead to a result where both can be maintained by the MS, even with using same technical components. Just the deployment differs with "centralized deployment" as national gateway or "decentralized deployment" at the service provider. This mitigated the risk of falling apart in two competing approaches. Each approach has its pro and cons, but enforcing one over the other might have led to major impact on some MS.

The lesson learned by the author was that the project somehow started in partners explaining the merits of the own system and trying to convince others by highlighting its pros, sometimes playing down its cons. This was in partly lively and controversial discussions that at the beginning even delayed the progress. In the author's view this discussion process was however important to get an understanding of the others' systems. This beyond the eID

system itself, as it roots deep in the states' administrative culture, processes and infrastructure. Once that got understood and that it was clear that the interoperability system may not interfere with MS situations – a LSP principle anyhow – consensus was found and progress could quickly be made on the common specifications.

Stakeholder Management

STORK covered 18 states which is a critical mass that allows to claim impact. It however does not cover the whole EU of 28 MS and EEA. It is important to inform also those states that are not project partners. Moreover, STORK has been implemented by the partners involved. At the end of the day it needs to get integrated into commercial products. This requires industry involvement. To achieve both, two information streams have been installed:

- A Member State Reference Group consisted of those states that have not been partners of the project
- An Industrial Group that market player could sign up to

Meetings with those groups have been organized about twice a year. The purpose was to inform those stakeholders on the progress and to get feedback. The stakeholder management is illustrated in the following figure 3 where the top shows the main project steps of specifying, developing and testing the interoperability building blocks. At the bottom the feedback loops with the Member State Reference Group and the Industrial Group is shown.

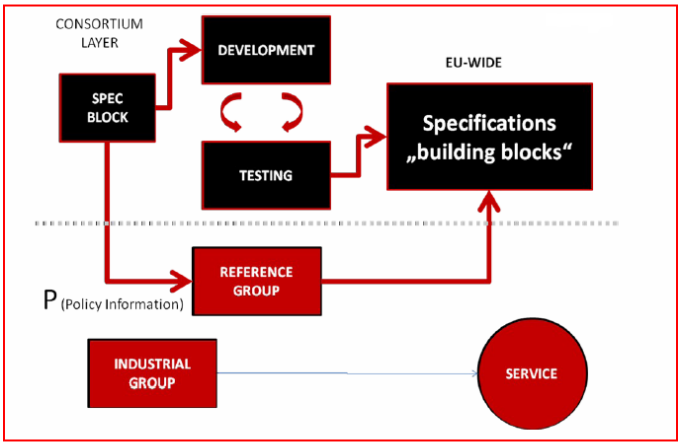

Figure 3. STORK Stakeholder Management (from the LSP STORK contract)

The lesson learned is that stakeholder management is important. The organization of a few workshop-style meetings alone however seems not enough to give sufficiently detailed updates of the progress of a complex project. It needs complemented by regular information via online media, newsletters, or alike. This was done by the project as well.

It is debatable whether industry involvement was sufficient. STORK did this via project presentations in Industry Group meetings. Other LSPs like epSOS had a tighter link with industry by establishing an Industry Team that got involved into the daily project work. Moreover some LSPs were active in standardization like PEPPOL and SPOCS. The approach chosen by STORK allowed MS partners in the critical first phases to establish the overall agreements without influence by industry interests. This may however be seen as a "closed club" that could benefit from more market consultation. No conclusion can be drawn on these aspects, pros and cons can be argued in either approach.

Sustainability

STORK was a project. This inherently means that it also has an end. For a sustainable infrastructure more is needed. It needs governance bodies, software maintenance, standardization or support. After discussion with the European Commission the STORK results have been handed over to Interoperability Solutions for European Public Administrations (ISA) programme that established a dedicated STORK sustainability action with a budget of about € 1,35 million. The sustainability action covers the period 2010-2014 to bridge the gap until the CEF Programme (European Union, 2013) and the eIDAS Regulation form a long-term solution.

CONCLUSIONS

The paper has discussed how Large Scale Pilots support decision making and policy in key areas. The LSP STORK on eID interoperability has been discussed in detail. STORK has started in 2008 and developed a technical model for eID federation between the existing systems of eighteen European states. It tested the results in six production pilots between 2010 and 2011, most pilots remained in production. Decision making that has been used in STORK got discussed. A balance was to be found between tight project management to lead a complex IT project to quality results, and the time it takes to get the consensus needed so that each state gets its interests considered.

The project was a technical success. It demonstrated federation of more than 100 different eID token types in production pilots. The main hurdle encountered was lacking legal basis and lacking mutual cross-border recognition of state's eID systems. This provided valuable input to the European Commission that then proposed a Regulation of the European Parliament and of the Council on electronic identification and trust services for electronic transactions in the internal market (eIDAS) (European Commission, 2012). At time of writing this paper, an informal agreement between the European Commission, the European Parliament, and the Council has been reached on this eIDAS Regulation. With its technical result, the LSP STORK could make some contribution to European policy making.

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Interactive System Design for Collaborative Case Management

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ABSTRACT

The success of knowledge work represents one of the most important aspects for businesses to date. Managers across all industries are searching for new ways to increase the productivity in this domain. Since traditional approaches, such as Business Process Management cannot provide the suitable context to support knowledge intensive workflows, the recent trend of Adaptive Case Management has set out to address this issue by providing a framework that enables an agile and dynamic environment for work execution. As this is a very young discipline, suitable software solutions are still rare. Therefore, the paper at hand consolidates the general principles behind this new approach and subsequently focuses on the aspect of user interface design covering innovative technologies and new methodologies of the Human Computer Interaction domain. In addition, this work also discusses possible solution approaches and presents a reference implementation based on the findings proposed. The presented solution aims at increasing employee productivity and creativity by providing a motivating way of collaboration.

Keywords: Adaptive Case Management, Business Process Management, Computer-supported Cooperative Work

INTRODUCTION

It is not a recent discovery that the role of knowledge-intensive work in a business environment has been growing rapidly over the last few years (Shepherd, 2010). Industrialized countries in particular, have experienced an increasing demand for workers in Research & Development departments and alike, and this trend is projected to continue in the future (Schmidt, 2009). As a consequence, increased productivity in these areas is becoming a major concern for companies that strive to realize long-term competitive advantages.

During the last decade, Business Process Management (BPM) has established itself as the traditional approach to increase business productivity (McCauley, 2010). By providing tools that enable companies to define and map their processes onto an IT environment, BPM primarily aims at structuring key workflows by automating highly repetitive, low-level, and administrative tasks. The result of this development becomes evident in today's sophisticated platforms, supporting major company processes, like e.g., enterprise resource planning (ERP), customer relationship management (CRM), and supply chain management (SCM).

While this approach has been successful in structured environments, traditional BPM faces a profound conflict in the context of knowledge-intensive work. On the one hand, BPM aims at formally defining static workflows in order to realize repeatability and automation. On the other hand, the very nature of knowledge work demands a flexible, unstructured framework that is driven by creativity, unknown events and empowers actors to adapt to unpredictable circumstances (Swenson, 2010b). This fundamental contradiction makes it difficult, if not impossible, to apply the traditional approach of increasing productivity in a knowledge environment.

The recent development of Adaptive Case Management (ACM) has set out to address these issues, by providing an infrastructure for knowledge-based work that focuses on the required flexibility, tools and dynamics associated with this obstacle. The basic principle behind ACM is to leave the general structure of a given workflow open to adaptation and changes, by combining the build-time and run-time phases of BPM into a single process.

Schematically, Figure 1 illustrates this comprehensive view of ACM: In a case a common goal is predefined and the involved humans contribute their individual knowledge bases. The interdisciplinary collaboration and co-work is characterized by a growing knowledge base over the execution time. At the same time corrective actions and adjustments of the process are possible for the parties involved in order to respond to external factors or unforeseen disturbances. One major characteristic of a case is that the way to achieve the desired output is not predictable.

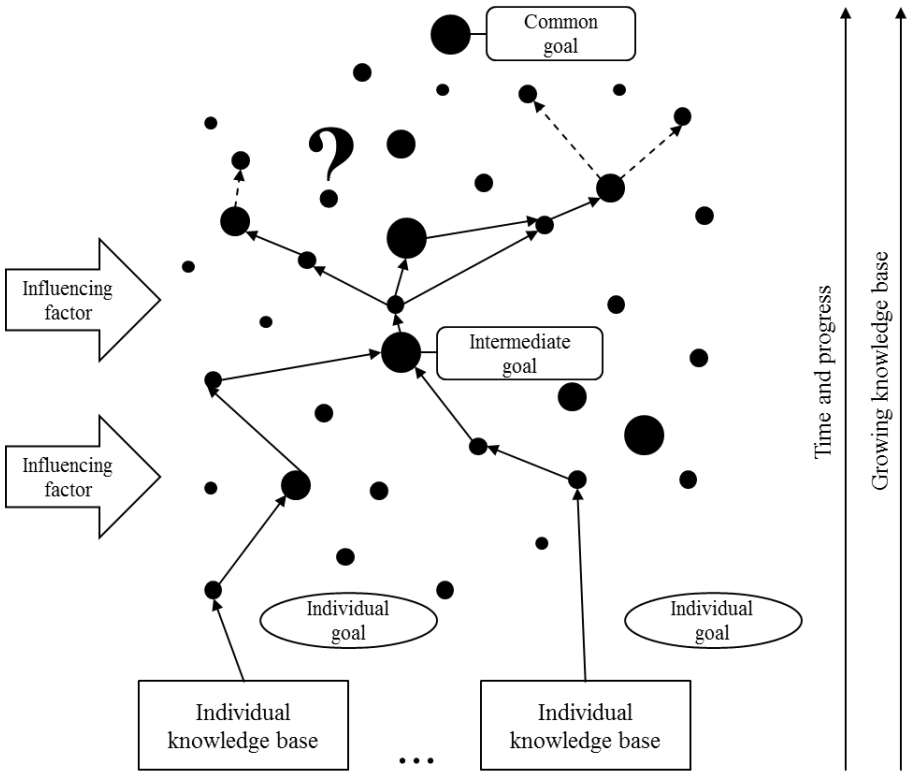

Figure 1. Overview of Adaptive Case Management

In order to meet this solution approach, which is also widely recognized in business practice for knowledge-intensive business processes, a paradigm shift can be observed in BPM (cf. Figure 2). So far, the traditional process and project management approaches are top-down oriented. This means, that initially the organizational and process structure of an organization is defined and deployed. Then the process instances or projects follow a strictly documented plan and their execution is usually monitored continuously. In contrast, cases focus on the interdisciplinary cooperation which implies that the approach is bottom-up and the work is done across the formal organizational structure as well as cross-functional. If available, cases can follow existing templates and best practices, which can be used from successful archived cases. The actual case execution is simultaneously dynamic and emergent. This means, that the classical planning and execution phases merge.

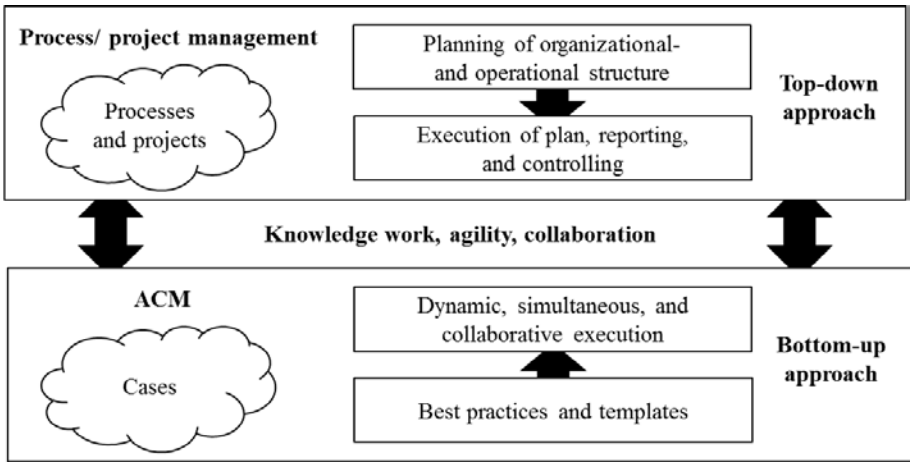

Figure 2. Paradigm-shift in Business Process Management

By empowering actors to shape their environment according to the respective circumstances, the overall process turns out to dynamically evolve during the actual execution, rather than being strictly defined in advance. As a consequence, knowledge workers are presented with a system that enables them to react to unpredictable challenges, while making adjustments based on their own expertise and preferences (Kraft, 2010).

With this claim in mind, ACM promises to fill in the gap left open by traditional BPM. However, while the general concepts and goals seem to be clear, there is still little consensus on how to unfold and implement the approach in a real-life business environment. In order for ACM to live up to its expectations, further research is required especially regarding the question on how to design such an application to optimally integrate and support the knowledge worker. With current technological developments, the application of innovative interaction approaches may additionally support collaborative work and consequently facilitate an increase in productivity and effectiveness.

METHODOLOGY

The research methodology follows a three-step approach: (1) based on a literature review, the general ideas and common principles of ACM are consolidated and depicted. (2) Then, the success factors of HCI input devices are derived applying a case study approach. (3) Finally, an IT-based solution approach is presented as well as evaluated using a prototype (Collaborative Case Management).

RELATED WORK

Central Principles of Adaptive Case Management

The actual term “Adaptive Case Management” was developed during an expert meeting in 2009, which resulted in the first and most prominent publication on ACM: “Mastering the Unpredictable” (Swenson, 2010a). In this collective volume, the authors describe a variety of individual ideas on how to realize and implement the new paradigm, which shows that the specifics for the implementation are still highly disputed. For example, Pucher (2010) suggests a very comprehensive, domain-independent approach, whereas Matthias (2010) supports a “slim” and specialized system that is tailored to the respective environment. Similarly, Hollingsworth, (2010) derives the ACM concept from a healthcare background, while Kraft (2010) relies on customer management, and de Henk et al. (2010) focus on their individual understanding of innovation management.

Nonetheless, all authors largely agree on main characteristics and define “cases” as the central entity that encapsulates the knowledge-intensive process in ACM. Huber et al. (2013, 2014) consolidate and describe the fundamental principles. The following enumeration focuses on the collaboration challenges implied:

1) Goal orientation: A case is defined by a specific goal, which needs to be attained during the process execution and within a predefined (but adjustable) timeframe (Kraft, 2010). As the goal describes what needs to be accomplished, and therefore guides the general stream of work, it replaces the traditional model that would outline how the process must be executed (Ukelson, 2010). This provides knowledge workers with the

necessary freedom and flexibility to constantly plan, prioritize, and reevaluate the structure of activities towards that goal. However, determining the case progress proves to be difficult, as the state of the case as a whole is determined by the combined state of all sub-goals, tasks, documents, other related business entities or even other related cases (Pucher, 2010). As ACM demands a flexible and adjustable environment, this claim needs to be carefully balanced with existing restrictions that are necessary for successful process execution. Managers and participants therefore need to be provided with the respective tools to define and enforce constraints, as well as to spot instances that are at risk of breaking them.

2) Emergence: ACM needs to provide the necessary means to support emergent processes and roll out solutions that empower knowledge workers to deal with the dynamic nature of the workflows they are engaged in (Shepherd, 2010). As the process is not dictated ahead of time, participants can control the order of steps, add new participants or change the type of information needed, effectively merging the traditional planning- and execution phases into a single step (Pucher, 2010). In order to support this degree of adaptability, processes are defined as and described by a set of dynamic tasks, rather than rigid flow charts (Shepherd, 2010). By allowing knowledge workers to shape and adjust their individual surroundings as they see fit, the presentation of a case or multiple cases can be optimized for each type of user and be designed around the way they will interact with it (Khoyi & Swenson, 2010).

3) Data centricity: Messages, documents, spreadsheets, etc., play an integral part in the context of knowledge work and is both produced and consumed during the actual execution of the process (Ukelson, 2010). Since ACM is characterized by a high degree of variability and lacks a predefined workflow, it is in fact the data that drives and shapes the case and its environment. The case is therefore aligned with the respective data and collects activities that are necessary for its goal-oriented transformation (Swenson, 2010b). Because content is the driver of knowledge intensive processes, ACM requires a comprehensive facility for creating, capturing, indexing, storing, finding, sharing, editing, versioning, and retaining a wide variety of data types (Pucher, 2010). All case documentation, including emails, meeting notes, correspondence, etc., must be organized and accessible to participants working on the same case. In addition, a typical knowledge-work scenario may transcend multiple departments or organizations and needs to draw information from many different sources. Content and case artifacts may reside on separate application systems, or even physical storage facilities (McCauley, 2010). Part of ACM's complexity is therefore represented by the workers' need for access to a variety of external and internal resources. So far, the challenge of bringing all these sources together in the context of managing a process has been too difficult or too expensive for many organizations to address (McCauley, 2010).

4) Collaboration: Knowledge-intensive work mainly consists of human interactions and therefore requires a high degree of collaboration (Ukelson, 2010). As multiple people take part in the process they need to be provided with tools to communicate, cooperate, and coordinate information and activities (McCauley, 2010). This also implies a high degree of transparency to allow all participants to put their actions into a greater context. ACM therefore needs to support social interactions and negotiations with a suitable set of tools that are integrated into the case environment. Collaboration must be easy, widespread, and productive (McCauley, 2010). To support this claim, current IT landscapes already provide a wide variety of tools such as wikis, blogs, chats, and decision support tools. However, no system can claim to incorporate all possible channels of communication. In order to avoid participants being overwhelmed or confused, information and data must be organized and presented in a useful way and assist their efficient and effective collaboration. A collaborative ACM implementation must know who needs what and when, and must not supply irrelevant information. Even complex collaboration data should therefore be structured and presented to caseworkers simply, intuitively, and in a context-sensitive manner (McCauley, 2010).

5) Transparency: One of the most important aspects of ACM is the concept of knowledge preservation and continuous improvement through templates. Even though case instances are not precisely repeatable, they often contain recurring elements and patterns that can be identified and made available for future usage and adaptation (Khoyi & Swenson, 2010). Knowledge workers may capture, share, and improve ideas and best practices through a community library and create new cases assembled from existing templates (Kraft, 2010). This case-spanning concept can have a big effect on productivity, as it provides guidance (not constraints) for future process iterations and makes knowledge transparent and available. Case templates provide the opportunity for knowledge preservation and continuous improvement. As similar problems often have similar solutions, workers can execute new case instances based on existing solutions or store current instances for future usage (McCauley, 2010).

Success Factors of Human Computer Interaction

The Human Computer Interaction (HCI) research discipline is not limited to studying the physical components of a system. Psychological elements, especially the experiential elements of interacting with computers increasingly gain practitioner's and researcher's attention (Zagel et al. 2014). The primary goal is to create positive experiences by selecting appropriate innovative technologies as a means for interaction. Studies prove that an increase in the perceived user experience may lead to an additional ascription of the functional value (Hassenzahl et al. 2009).

On the other hand, these psychological aspects also reflect on the respective mental models, which represent implicit knowledge like schemes, paradigms, perspectives and attitudes towards the perception and definition of the environment (Johnson-Laird 1983). A mental model can therefore be described as the cerebral representation of a system's functionality. Kilimoski and Mohammed (1994) state, that members of a team likely internalize multiple individual mental models. By approximating these models, it is possible to create a so-called "shared mental model", that is able to enhance a team's productivity and efficiency (Cannon-Bowers et al. 1993). The more intuitive the use of a system, the easier it is for the user to construct the respective mental model. While research was able to prove the effectiveness of shared mental models in collaborative work before, "much empirical and conceptual work remains to be done" (Payne, 2008). A key aspect is the impact of the HCI technology applied.

Within the scope of a HCI study the user-specific success factors in regards to traditional and innovative interaction possibilities are evaluated. A total of 150 subjects of different nationalities (50 Asian, 50 European, 50 American) are asked about their usage. Besides traditional technologies like mouse and keyboard interaction, also more recent methods like touch and multi-touch as well as contactless technologies like gesture and speech control are included in the survey. Focus lies on evaluating the perceived intuitiveness and fun during use. The respective technologies are rated on a Likert-type scale labeled at the end points (1 = "very good"; 5 = "very bad"). Previous experience with the technology is rated on a scale from 1 (no previous experience) to 5 (daily usage).

Table 1: Average rating of the interaction technologies

	Asia					**America**					**Europe**				
	T1	**T2**	**T3**	**T4**		**T1**	**T2**	**T3**	**T4**		**T1**	**T2**	**T3**	**T4**	
Experience	4,94	3,04	3,04	3,46	3,62	4,86	3,02	3,02	3,10	3,50	5,00	3,32	3,32	3,36	3,75
Rating	2,58	2,64	2,36	2,60	2,55	2,12	2,18	2,00	2,10	2,10	1,98	2,44	1,68	2,44	2,14

The results accredit the European subjects a higher experience with the respective technologies than the Asian or American subjects. At the same time, the technologies are rated more critical (cf. Table 1) [1]. Most of the subjects rate the technologies on a clearly rational level, assigning usability and reliability as the highest importance. Nevertheless, joy of use and intuitiveness seem to significantly influence the choice of an interaction type. Multi-touch interaction is rated better in comparison to traditional control methods (mouse and keyboard) in both criteria. Even though traditional technologies are used for completing daily tasks, more innovative methods are preferred if available. Both factors, intuitiveness and joy of use, significantly influence the perceived usefulness of a system. This psychological relationship can also be transferred to collaborative systems.

Table 2: Comparison of the interaction technologies

	Asia				**America**				**Europe**			
	T1	**T2**	**T3**	**T4**	**T1**	**T2**	**T3**	**T4**	**T1**	**T2**	**T3**	**T4**
Speed	2,14	2,78	2,46	2,94	1,88	1,72	2,12	2,38	1,40	2,18	2,04	2,42
Intuitiveness	2,52	2,40	1,94	2,34	2,44	1,90	1,76	1,72	2,00	2,00	1,82	1,82
Operability	2,06	2,58	2,32	2,54	1,78	2,02	1,84	1,92	1,84	2,28	1,94	2,30

[1] T1 = Mouse / Keyboard, T2 = Singe-Touch, T3 = Multi-Touch, T4 = Contactless Interaction

Reliability	2,20	2,80	2,74	3,12	1,72	2,40	2,22	2,16	1,46	2,70	2,46	2,80
Versatility	2,76	2,50	2,46	2,40	2,30	1,96	2,00	1,72	2,30	2,48	1,64	1,94
Mobility	3,26	2,84	2,28	2,52	2,60	1,82	1,82	2,38	3,20	2,42	2,06	2,48
Innovativeness	3,06	2,38	1,38	1,50	2,74	1,94	1,46	1,62	3,38	2,28	1,42	1,44
Appearance	2,86	2,02	2,36	2,42	2,36	1,76	1,66	1,68	2,94	2,28	1,84	1,92
Joy of Use	3,00	2,46	2,12	2,54	2,06	1,66	1,60	2,56	2,56	2,72	1,72	1,78
Accuracy	2,36	2,88	2,94	2,90	1,88	2,20	2,04	2,20	1,60	2,84	2,64	2,94

Current realizations of ACM systems are based on the following assumption: while multiple team members participate in working on a collaborative software platform, interaction with the system still happens through individual devices (e.g., the employee's personal computer). The concept proposed tries to increase the manifestation of the shared mental model by increasing intuitiveness and a better collaboration through a multi-user interaction tool. Multi-touch tabletop displays have been identified as a medium that supports the collaborative aspect of work (Dohse et al. 2008).

Within the concrete use case of ACM and based on the research presented, an increase of productivity is expected, by using a multi-touch tabletops as a common interaction medium, thus strengthening the shared mental model. The following chapter provides an overview about how an IT-based solution (so-called Collaborative Case Management) has to be designed to reflect the requirements for multi-user interaction technologies.

SYSTEM DESIGN FOR COLLABORATIVE CASE MANAGEMENT

Architecture

In order to evaluate the effectives of new input devices on collaboration, an initial prototype has been designed and implemented. Even though additional building blocks are part of this release, the subsequent presentation will focus on approaches that are backed by positive user feedback and evaluation data. The tentative design of the prototype is based on Jablonski's (2004) systematic approach, which separates the complexity of the architectural concept into platform and application layers, which are linked by technologies and standards.

The platform's architecture is represented by a web-architecture according to Jablonski (2004), and can therefore be divided into four separate layers, namely back-end, application server, web portal and client. The basis of the system is represented by the Linux Ubuntu operating system and a database instance of Oracle's MySQL service. This first layer provides the basic runtime environment and required data storage facilities. The application server is based on the GlassFish community server, which offers a framework for the development of JavaEE based applications and connects the prototype with the underlying infrastructure. In order to operate the actual application, clients merely require a traditional web browser. To further enhance the usability, the user interface relies on JavaScript and AJAX technologies, which provide a "desktop-like" look-and-feel for the final application.

The application architecture is organized according to functional criteria. Therefore, the prototype distinguishes the layers data management, business logic and presentation (Jablonski, 2004). This structure comprises the actual navigation tree of the entire system and provides a comprehensive overview of the available items and their respective position within the system.

Design

The following components are available across all case instances to provide the basic functionality of a collaboration platform:

1) Activities: This section collects all activities on the platform and visualizes them in different views. They can be searched, filtered, and commented. Moreover, discussions within the activity streams are possible as well (cf. Figure 3).

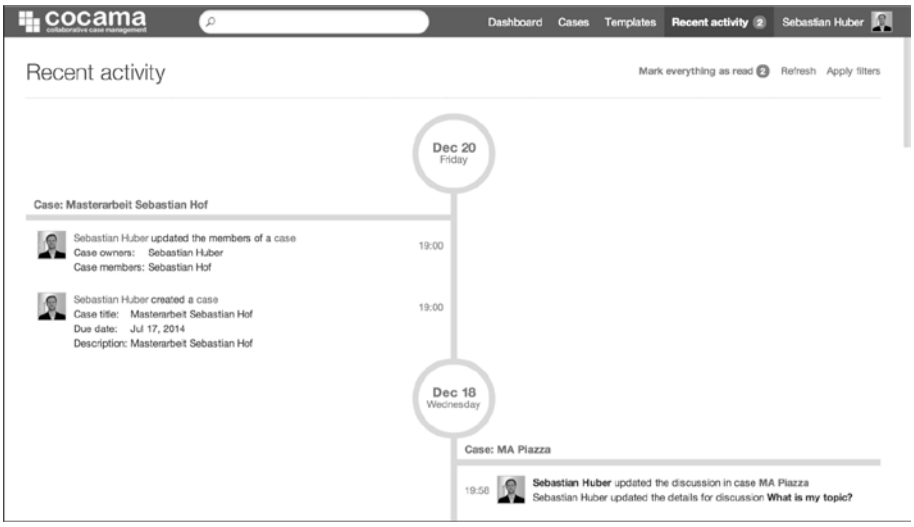

Figure 3. Case-spanning Activity Stream

2) Dashboard: The dashboard gives an overview for the knowledge-worker of all relevant business objects he is involved in. By using state-of-the art visualization techniques this information helps to improve the detection of cause-effect relationships and action needs (cf. Figure 4).

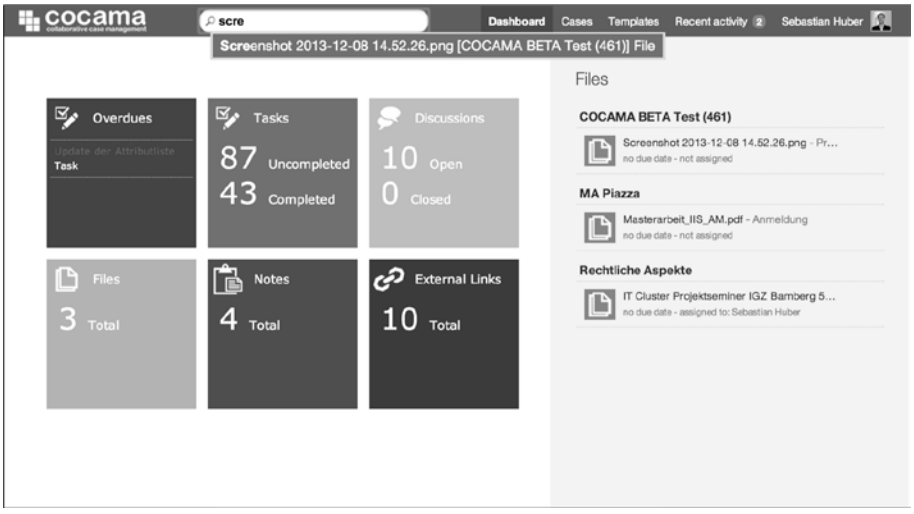

Figure 4. Knowledge worker's dashboard

3) Cases: The core of the platform is the case management system. This section shows all relevant cases, the user can work, edit, and proceed in different views (cf. Figure 5*)*. The actual collaboration in those cases is depicted later in this section.

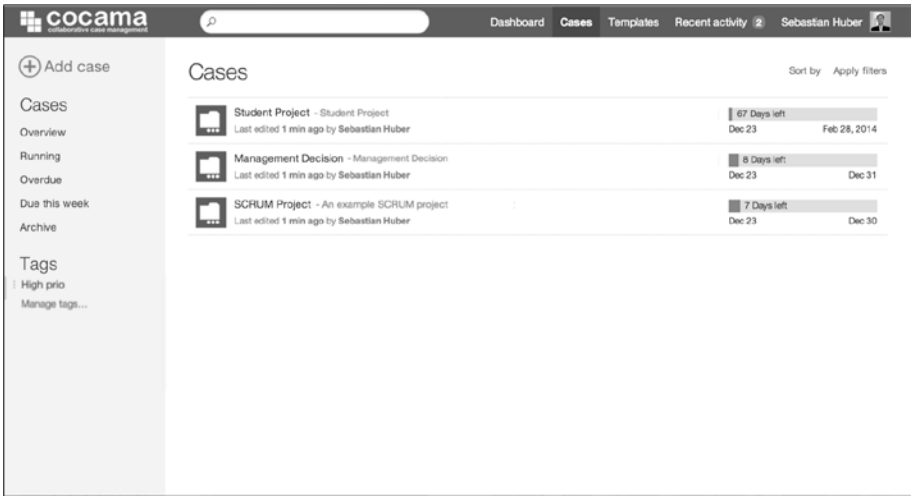

Figure 5. Case overview

4) Templates: This component manages the different patterns for cases. Templates contain best practices for the task execution and collaboration. They can be instantiated as new cases that need to be solved. The collaborative work in individual cases may also serve as a basis for the development of a common knowledge base by archiving those cases. The repository also provides the possibility to manage business services, orchestrated processes and technical services in a SOA-like approach. In addition, the templates can be exchanged with other participants and communities.

5) Organizations: This section extends the administration on a personal level (e.g., own profile, notification settings, tags, and embedded external applications) by adding functions to configure the visibility settings for templates and available functionalities (case extensions) for user groups. That way the system is multi-client capable and suitable for the deployment in a cloud computing environment.

The following functions are available within each case:

1) Case Dashboard: The dashboard is designed to implement the core principles of goal orientation and transparency. This component provides all the necessary features to define and control case goals, according to the management-by-objectives approach. Different views (e.g., Earned Value Charts and Motion Charts) provide adequate information retrieval and processing techniques (e.g., visualization of the entire history of a case).

2) Case Members: This component implements the integrated roles concept and manages the assignment of user rights. The prototype offers pure reading access for e.g., external partners as well as the possibility of an active membership of a case to collaboratively work on tasks. The case owner role enables users to make fundamental changes in the case structure.

3) Case Extensions: This functionality provides the possibility to enrich the collaborative work in cases with comprehensive case extensions that can be added or removed during runtime. The default setting of extension is limited to the fundamental components, required for task execution (e.g., task list, decision support system, and document libraries).

The key idea of case extensions is to provide a modular suit of collaboration functionalities that can be flexibly added during case execution. That way, the collaboration platform focuses on the fundamental components that are required for small projects. As a case grows over time new functions may be necessary and can be attached easily. Figure 6 gives an overview of the different case extensions by combining formal and informal collaboration for structured and weakly structured contents.

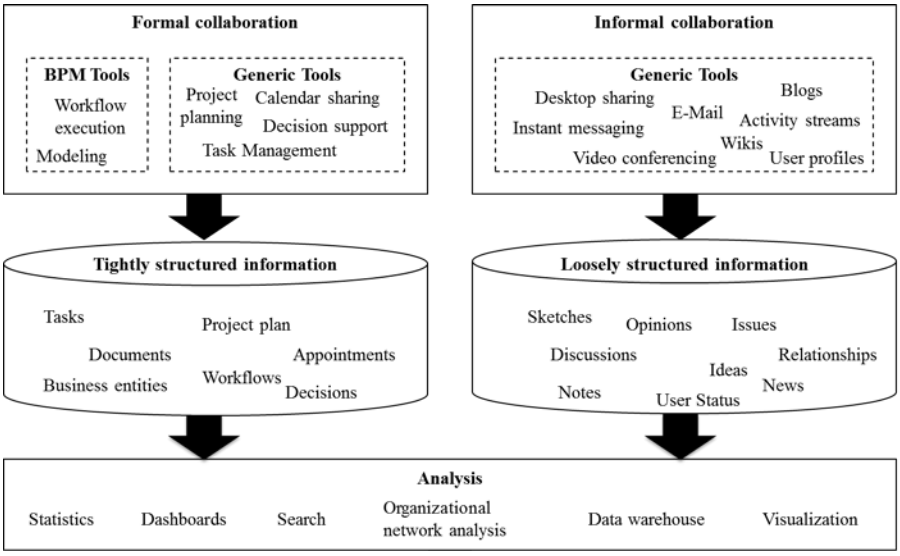

Figure 6. Overview of case extensions

Another important aspect is the collaboration on different business objects, like tasks, documents, and decisions. In typical software solutions these objects are treated in separate navigation views and functions respectively. The option to create relationships between those business objects is not provided. An innovative approach in that regard, which directly supports collaboration, is the case workspace. With an intuitive “drag and drop” behavior it is possible to create different lists and freely arrange all objects that are used in the case. That way hierarchical relationship between tasks (milestones, subtasks) or the assignment of documents to discussions, etc. could be realized. That functionality has been developed with multi-touch tabletops in mind. It increases the manifestation of the shared mental model, because the workspace view is common for all case contributors. In Figure 7 an example of a task board that is used in agile software development (SCRUM) is depicted. Another example could be a typical scheduling decision. Therefore, two lists are required: one list for the different decision outcomes (e.g., appointment date 1 and 2) and one for the participants. Now the case members could assign themselves via drag-and-drop to the different alternatives. The workspace serves as a flexible integrator for the business objects used in the different case extensions and is an innovative view to collaborate on them and to create semantic relationships between those objects.

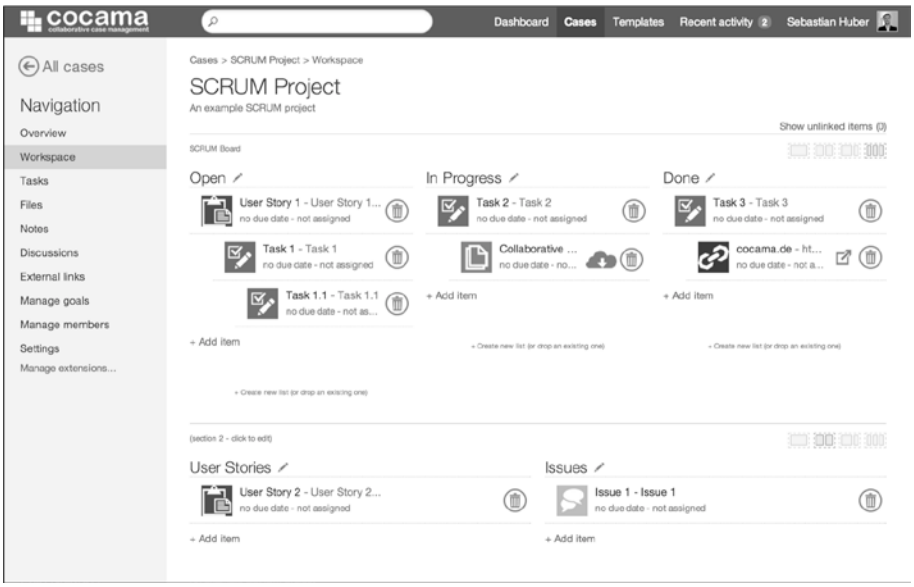

Figure 7. Case workspace

Evaluation

To test the implemented prototype, the collaborative nature of work has been simulated as part of a student case study (n=63). This scenario is based on real-world projects of a fashion manufacturer, which has to coordinate a large number of suppliers in order to design and manufacture a new fashion product. With new suppliers being integrated and existing suppliers being replaced, this process is knowledge-intensive, difficult to plan ex-ante and collaborative. As the supplier is responsible for coordinating the entire project, the case study comprises two major roles:

1) Managing role (case owners): This role is responsible for the entire management of the different group tasks and has to consolidate them as a final result.

2) Operational role (case members): In cases of other groups this role has to provide a specific task and is controlled by the case-spanning role.

During the case study every group (12 groups in total) fulfilled both roles and worked on five different tasks. For each tasks they had two weeks to coordinate and deliver the results. Table 3 summarizes the data that has been collected from the prototype during the case study execution.

Table 3. Quantitative evaluation data

Activity	***Amount***
Invited users	63
Created user groups	12
Collected events (clicks, etc.)	4.505.607
Discussions started	96
Cases created	74
Tasks created	883
Messages sent	911
Activity Stream Events	2.608
Documents uploaded	119

With more than 2.600 activity stream events, the prototype is intensively used for collaboration. One major challenge is to consolidate those events to prevent an information overflow for the user. For instance if a document has been changed several times in the last few minutes those events can be grouped together into one single activity without losing too much relevant information. Aside the technical data collection, the case study participants were also asked to rate the actual implementation based on the statements depicted in Figure 8.

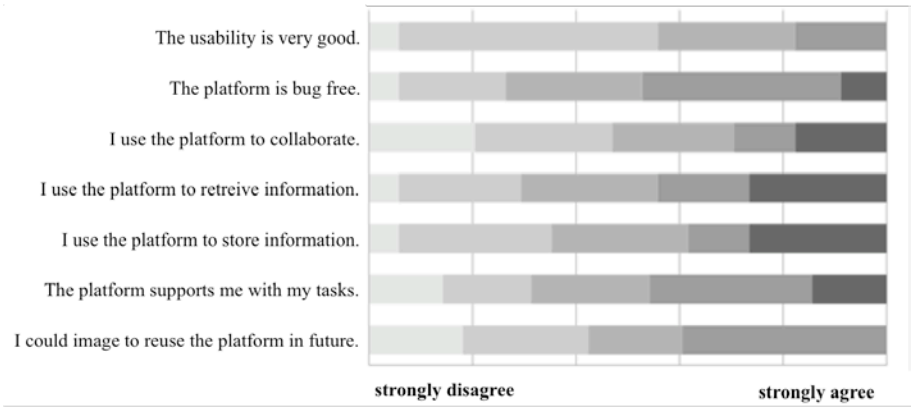

Figure 8. Qualitative evaluation data

The first results are promising, as the proposed solutions to handle collaborative tasks with the Collaborative Case Management approach seems to enable the user to fulfill the complex collaborative case study scenario.

CONCLUSIONS

This contribution outlined and discussed how the recent trend of ACM has set out to revolutionize the way knowledge work can be supported with IT. First, the general concepts and principles behind the new paradigm were introduced, and put into the broader context of BPM as a whole. Subsequently, the success factors of Human Computer Interaction were investigated, in order to illustrate the fundamental differences of an ACM implementation compared to other traditional IT systems for collaboration tasks.

By following the fundamental principles of ACM, this approach promises to master the emergent and unpredictable nature of knowledge work, which is often highly collaborative. As the new approach breaks with the traditional separation of planning and execution (and in fact merges both phases into one), workers are provided with a framework that supports the required flexibility and enables an agile and dynamic environment for teamwork.

Especially the case workspace is designed for team collaboration by utilizing new ways of interaction (e.g., multi-touch tabletop displays). By rearranging the different case elements, the contributors share their mental model. However, as the implementation did not encompass all suggestions of the new approach, additional research challenges have to be resolved in the future.

Further work has to be done in optimizing the collaborative user interface of the system. One major limitation is the screen orientation of the workspace that hinders free interaction of several users at once. An orientation-independent interface will be constructed that allows interacting with the system from all sides of a multi-touch enabled tabletop. Additional evaluations of the new interaction concept in a real life scenario will include the methodology's impact on joy-of use and productivity in collaborative process management tasks.

Additionally, the concept was only tested in a case study scenario with students. As they do not represent typical knowledge workers in the IT industry, more applications in further business scenarios and in different application domains could be used to enrich the solution approach as well as to improve the prototype.

Nonetheless, ACM has emerged as a compelling paradigm to manage the unpredictable. As the development of the technology is still at a very early stage, further research efforts are required to mature the concept. Understanding the specific design challenges however, will pave the way for ACM to realize its full potential.

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Section 6

Practice Based Innovation: Collaborate and Learn in Innovating

Interactive Technologies to Enhance Collaborative Practice for Innovation

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ABSTRACT

This study aims to provide a practice based view of collaborative innovation in order to contribute to the theoretical debate on collaborative innovation and to define a managerial practice to source and manage innovation. The context of investigation is the internet environment. It is recognized as powerful environment for enhancing collaborative innovation with customers, as well as, with the entire firm's network. The paper, adds value to the existing literature on innovation by framing the elements of the collaborative practice for innovation and their role in the resource integration process and in the value creation. The study fosters a shared understanding of what the collaborative innovation practice is in order to keep it workable and meaningful. It calls for a new, more holistic and strategic role of the collaborative practice and provides new insights to replace episodic and improvised activities to innovate with a structured, codified and recursive practice to enhance the ideas co-generation process and to create value for all the actors engaged.

Keywords: collaborative innovation, practice theory, community, network.

INTRODUCTION

It is widely agreed that innovation has a key role in sustaining firms' competitiveness (Mumford, 2000; Kanter, 1988; Schumpeter, 1939), as it is the life blood of corporate survival and growth (Zahra and Covin, 1984, p. 183). Innovation is a multi-dimensional and context-specific phenomenon. Indeed, as Adams et al. (2006, p. 22) state: "the term innovation is notoriously ambiguous and lacks either a single definition or measure". The terminological ambiguity reflects the variety of research traditions and perspectives - marketing, quality management, operations management, technology management, organizational behavior, product development, strategic management and economics - that address various aspects of innovation (Hauser, Tellis and Griffin, 2006).

Over the last two decades, there has been a radical change in the innovation landscape that affected both the way in which academics consider innovation (Russo Spena and Colurcio 2010) and firms develop innovatory activities (Zeng, Xie and Tam, 2010). "Innovation in information technology, institutions, and strategic reorientation of technological change has opened opportunity, and competition has put strong imperatives in play for collaborative innovation" (Weaver, 2008). As Coombs and Miles (2000) state, innovation relates changes in market relationships that are embedded within a technological dimensions instead of the mere artifacts and the technological innovation.

Thereby a shifting from a closed view toward an open view of innovation emerged (Chesbrough, H. W., 2006). The open view frames innovation as the outcome of an interactive process between the firm and its environment (Perks, Gruber, and Edvardsson, 2012; Mention, 2011), that requires the development of strong relationships among different parties (Trott and Hartmann, 2009; Chesbrough, 2006). This approach is based on the collective construction of value (Vargo, 2008; Vargo and Lusch, 2008) and on the topic of "collaborative innovation" that is

considered as the dominant perspective in the innovation literature in the last decades. Collaborative innovation focuses on the access to the resources of the crowd to enhance innovation efforts of companies. As stressed above, the recent and renovate interest for the relational approach to innovation is due to new possibilities for interaction and openness provided by the web based technologies. Indeed, internet can serve as a powerful environment for collaborative innovation with customers (Schau, Muñiz and Arnould, 2009; Sawhney, Verona and Prandelli, 2005; McAlexander, Schouten and Koenig, 2002), as well as, with the entire firm's network (e.g. experts, suppliers, etc.). Innovation doesn't depend on the discovery or creation of new resources or systems but it consists of the recombination of existing resources and ongoing efforts to maintain and develop new relationships, as well as new ways of creating value (Akaka and Vargo, 2013; Corradi, Gherardi and Verzelloni, 2010; Arthur 2009). Social interactions in a digital environment enable new combinations of previously disconnected and unrelated data and information (Kristensson, Gustafsson and Archer, 2004) that companies can lead and develop (Hargadon and Bechky, 2006) to foster innovation. Interactive technologies allow for a broad and continuous application of techniques to foster creativity and enrich the users' imagination (Piller and Walcher, 2006), by stimulating the continuous generation of new and valuable idea that are selected, developed and launched through the collaboration with the entire firm's network.

Despite of the prosperous and well-established debate on collaborative innovation and on the role of interactive technologies in fostering it, few studies investigated this topic as a practical phenomenon (Russo Spena and Mele, 2012; Schau, Muñiz and Arnould, 2009) as well as dynamics through which such practice emerges remain ambiguous. More generally, this is confirmed by the lack of contributions, within the practice literature, on the relevant topic of how to organize practice for strategic aims (Dougherty, 2004), such as innovation. Therefore, the strategic connection of the practice theory to the issues of innovation is still underdeveloped.

The route we choose to bridge this gap is to deepen the topic of collaborative innovation from a practice lens by stressing the role of interactive technologies in enhancing the innovation process.

The paper, adds value to the existing literature on innovation by articulating, through empirical examination, the elements of the collaborative practice for innovation and their role in the resource integration process and thus in the value creation.

The remainder of this paper is organized as follows. We review the literature discussing previous contributions on collaborative innovation and practice based theory. Then we present the research design and discuss the results. Finally, we draw the theoretical and managerial implications.

THEORETICAL FRAMEWORK

The theoretical framework we referred to concerns two theoretical streams of research: studies on collaborative innovation and studies on practice theory.

Collaborative innovation

In the last decades the debate on the collaborative innovation has received a considerable attention within the academic literature and beyond. This topic is characterized by many approaches and terminologies which stress many different and various aspects of collaborative innovation.

More recently, the innovation literature has emphasized the key role of interaction describing innovation as an information-creation process that arises out of social interaction (Trott and Hartmann, 2009). It is an iterative, cumulative and cooperative phenomenon, driven by processes of interactive learning (Lundvall,1992). According to this perspective, innovation is viewed as the product of networks of firms and other organizations (Freel and de Jong, 2009).

As Trott and Hartmann (2009) stated the topic of collaborative innovation is not new within the innovation management literature. It can be defined as a general concept that is rooted in the previous contributions on the network model of innovation (Rothwell and Zegveld,1985; etc), on open innovation (Chesbrough, 2003, 2006; Gassmann, 2006) and on open innovation user that includes firms users or individual users (von Hippel 1985, 2013).

The collaborative innovation approach calls for an open innovation paradigm that advocates the importance of

external agents for innovation (Chesborough, 2003; Laursen and Salter, 2006) and emphasizes the fundamental role of both external and internal networks of information and collaboration in fostering innovation (Hakansson, 1982; Freeman, 1991). It goes beyond the development of an inter-firm cooperation (Sivadas and Dwyer, 2000; Wuyts et al., 2004) by providing a network perspective. The network perspective encompasses from the firms perspective to a global perspective which integrates the views of the diverse network participants (Rampersad et al., 2010).

According to previous studies (Chesbrough, 2003; Chesbrough and Crowther, 2006) the collaborative, relational and interactive approach to innovation is critical to support the growth and the firm's competitiveness. It can be seen as a necessary organizational adaptation to the changes in the external environment (e.g. the increasing availability and mobility of knowledge workers, the widespread availability of internet and venture capital markets, the reduction of the product's life cycle, etc.).

Successful innovation requires sources of complementary competence that lie outside of the innovating firm (Freel and de Jong, 2009). The establishment of network relations can provide an avenue to address this problem allowing firms to ride out the limits and the barriers to innovation (Colurcio and Russo Spena, 2013). External partnerships provide firms with the stimulus and capacity to innovate (Zeng, Xie and Tam, 2010), by fostering the access to resources, complementary skills, capabilities and knowledge that are not internally available (Døving and Gooderham 2008). Furthermore, they can contribute to reduce time-to-market and enhancethe firm's ability to better utilize internal creativity as well as to better collect and channel external creativity (Colurcio et al., 2012).

Collaborative networks affect positively the innovative performance of firms, by impacting on the introduction of innovation, on the degree of innovation novelty (Nieto and Santamaría, 2010, Colurcio, 2009) – e.g. inter-firms cooperation pursues radical and incremental innovations (Sammarra and Biggiero, 2008) – and on both the product and process innovation (Whitley, 2002). Specifically, the innovative performance of firms is affected by the strength of the relationships ties (Freel and de Jong, 2009; Hansen, 1999). Strong ties, that depend on durable relations and involve a trust and emotional closeness, enable the transfer of complex knowledge; on the other hand, weak ties, are generally temporary and involve little emotional investment. They are a source of inspiration as provide new perspectives, novel information and opportunities. According to Freel and de Jong, 2009 both ties can generate value, by allowing firms to leverage on the novelty as well as on the trust necessary to innovate.

The main challenge for firms is to ensure the technological, strategic and relational alignment with the partners (Emden, Calantone and Droge 2006). The interaction between partners is the premise of resource integration and thus a precondition for creating a synergistic value: "through their interactions, partners transfer knowledge and other resources in developing organisational learning; […] knowledge, skills and other resources are integrated to put together a network of firms possessing a set of competencies capable of offering a value innovation that is an innovative value proposition which enable higher value co-creation" (Mele et al., 2010).

Collaborative innovation from a practice lens

The practice concept has a long tradition in philosophy and in sociology; it is an umbrella concept which covers a broad set of labels and interpretations (Corradi, Gherardi and Verzelloni, 2010).

In this study we referred to the label *practice lens* or *practice-oriented approach* (Corradi, Gherardi and Verzelloni, 2010) as we are interested in framing the macro and the micro dimension of a phenomena (Schultze and Orlikowski, 2004), such as collaborative innovation, by analyzing what people do, how people do and the consequences of their doing (Schultze and Boland, 2000).

The practice-oriented approach draws on a view that social reality consists of nexuses of practices (Schatzki et al. 2001) that make action and order possible (Bourdieu, 1977). By focusing on how something happens and which are the consequences (Fuglsang and Eide, 2013), practice has been a central approach in studies of various phenomena (Kowalkowski et al. 2012). Although studies on innovation from a practice oriented approach are still in an infancy stage (Russo Spena and Mele 2012), the practice lens is becoming a central notion for understanding innovation (Korkman et al. 2010).

According to Korkman et al. (2010), the practice-based view frames innovation as a set of innovative practice (actions) which depends on the interaction/integration of resources of customers and providers with different contextual elements (Reckwitz, 2002). Activities and actor, are focal issues in strategy-as-practice (Wikner, 2010). Actors interact through practical activities, such as actions or micro-processes for a strategic goal and expect an intended outcome. Over time, actors develop patterns of actions and routines that can be identified as strategic practices. The concept of practice is not synonymous with action. It expands the unit of analysis to the system that

fosters action (Dourish, 2001), involving the subject, the action, the tools and the context in which the integration of many resources occurs (Reckwitz, 2002).

Hence, investigating innovation through the practice lens implies the joint analysis of these elements, as well as, the idea that innovation emerges from an interactive process performed by many actors.

According to this, we address the topic of collaboration as a key theme for the development of innovation practice. Paraphrasing the notion of market practice (Kjellberg et al, 2012) and combining it with the topic of collaborative innovation (Trott and Hartmann, 2009; Chesbrough, 2006) we stated that collaborative innovation practices are enacted through – routine, micro-level inter-actions between multiple actors who integrate their resources seeking to create value for themselves and other by developing something new and better.

RESEARCH DESIGN

Aim

This paper aims to contribute to the theoretical debate on collaborative innovation from a practice based view (Korkman et al. 2010; Røpke, 2009; Korkman, 2006; Schatzki et al., 2001). Specifically, it aims to improve the understanding on how collaborative practice through online platforms can be set up by companies to source and manage innovation.
In order to fulfill the purpose we first try to clarify what collaborative innovation practice is and what are its core elements, second we frame role of interactive technologies in fostering collaborative innovation practice.

Research construct

In order to analyzed and interpret data we draw conceptual research construct (figure, 1). The research construct draws from previous practice research (Russo Spena and Mele, 2012; Korkman et al., 2010; Kjellberg and Helgesson, 2007) and from studies on collaborative innovation (Von Hippel, 2013, Trott and Hartmann, 2009; Døving and Gooderham 2008; Chesbrough, 2006). It identifies key elements to set collaborative practice to foster innovation: actors, roles, resources, activities and network.

Specifically, we define actors as generic entities, who have the capability to integrate resources (Vargo and Lusch, 2008). They are engaged in exchange relationship and act as resource integrators to carry out new practice (Reckwitz, 2002). Resources we focus on are mainly operant whichinclude knowledge, skills, effort, technology etc. (Akaka and Vargo, 2013; Vargo and Lusch, 2008). They act upon other resources to foster new way of creating value. Activities are the active doing that individuals carry out by integrating resources from multiple sources as the the focal firm and or other public and private sources (McColl-Kennedy, 2012.). Network relates to the dynamic relational system where all elements are embedded in.

As stressed above, the research construct identifies the resource integration process as the main condition to set the collaborative innovation practice and to create value for all the actors. Value is the potential outcome that actors can extract from the interaction. As Vargo and Lusch (2011, p.184) stated: "*the usefulness of any particular potential resource from one source is moderated by the availability of other potential resources from the other sources, the removal of resistances to resource utilization, and the beneficiary's ability to integrate them".* Accordingly, value is an abstract concept with specific meanings that vary according to context (Sweeney, 1994).

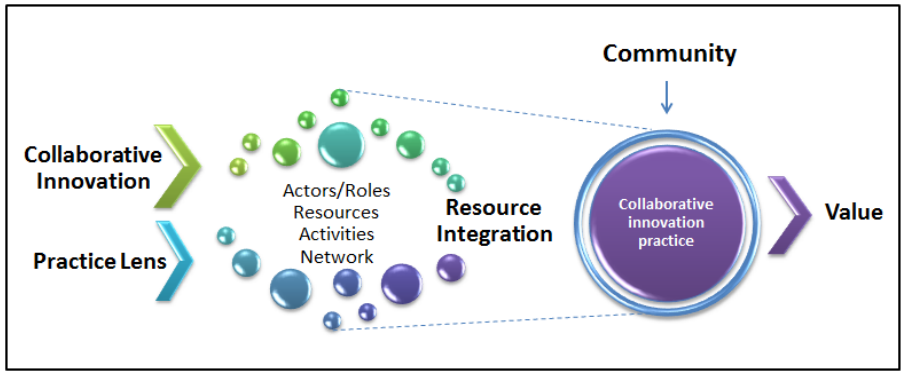

Figure 1: The theoretical construct (Our elaboration)

Methodology

We used a Social Network Analysis (SNA) based approach (Wasserman and Faust, 1994) as it is a suitable methodology for understanding complex patterns of interaction (Streeter and Gillespie, 1992) and allows to analyse different actors who are interlinked in the relationship of the network. As Otte and Rousseau (2002) observed, SNA is a broad and flexible strategy for investigating social structure where the focal priority to understand phenomena is given to the relationship between actors.
Specifically, SNA "conceptualises social structure as a network with ties connecting, members and channelling resources focuses on the characteristics of ties rather than on the characteristics of the individual members and views communities as networks of individual relations that people foster, maintain, and use in the course of their daily lives" (Wetherell et al.,1994 p. 645).
The study focuses on Formabilio.com, a network of designers, business partners (Partners) and supporters built up by an Italian furnishing startup who uses interactive technologies to source and give shape to designers' ideas by emphasizing the style, quality and tradition of the made in Italy

Data collection

Research activity has been carried out between September 2013 and February 2014.
Data has been collected in two phases. The first phase concerned the non-participant observation of the Formibilio community. The aim of this research stage has been the better understanding of the dynamics of interaction (analyses of posts, forum discussions, blog, etc). The second phase has been based both on primary and secondary data. Secondary data related articles and documents available through the web and other sources. Primary data were gathered through direct interaction with all actors of the network: designers, supporters, Partners, Formabilio. Information have been collected through an online questionnaire submitted to community members and trough direct interviews to Partners and Formabilio Managers. The interviews were tape-recorded and transcribed verbatim.

Data and information were selected according the SNA principle that relational data are the focus of the investigation and are fundamental for the understanding of social phenomena in order to explore and learn as much as possible about the set-up of the collaborative innovation practice within a digital context. Data analysis and interpretation have been based on the research construct we explained above.

Formabilio network

Formabilio is an Italian start up that produces furniture, lighting and home accessories designed by creative minds from all over the world in a participatory and eco-friendly way. It is a community of talented designers who propose innovative solutions with style, comfort and according to sustainability standards. Formabilio "is a contest provider" as the co-founder says, "it organizes call for ideas to gather through digital platform the most original and innovative ideas from the creative crowd of community". Ideas are chosen by a community of design enthusiasts, manufactured by small enterprises of the made in Italy and sold online on the web-platform Formabilio.com.

The architecture of the digital platform allows Formabilio to fit the users' needs with the designers' ideas and the know-how of Partners. Designers are the main actors engaged in the creation of a product as well as anyone who loves design; they are called to propose ideas and participate to idea contests. The entire community is called to evaluate, comment and vote ideas, while the Partners of Formabilio produce the winning ideas (see Figure 2).

Figure 2: The Formabilio community

Within the Formabilio platform, each designer can manage a personal page – "our designers" – where he/she can tell itself by introducing passions and experiences and the creative solution proposed to the community.

All submitted ideas are evaluated, commented and voted by peers and potential customers. The community judgment drawn from a formula that bond the number of votes, the average of the opinions (e.g. I don't like it, do it better; good, I like it and great) and the reputation of voters. The best ideas in terms of innovation, sustainability and appeal are selected and submitted to the evaluation of a jury of experts, composed by the Formabilio's staff, Partners, and experts.

The winning ideas are developed and transformed in products by the small craftsmanship companies partners of Formabilio in full compliance with the know-how and high quality of the made in Italy tradition.
Formabilio is the hub of the network of excellent manufacturing companies who produce the selected ideas (Ivo Fontana Mobili, Euroline Furniture, Live In and Torremato). It uses the digital environment to favor the sharing of resources and the cooperation between all the companies of the network..

All products realized, are marketed online through the platform. Formabilio business model is based on online sales. It grants to the winning designers a fee of 7% on all sold products and to the community a 10% discount on the products purchased if they have voted and chosen a winning project. The company's goal is to value the skills of all the players involved. The activity counter lists each actions carried out by the community members and grades their involvement in the project by building their reputation.

Four months from its launch, more than 40.000 people have registered and have joined the Formabilio's community. Among them, 700 designers submitted more than 1.100 projects for the first four contests. Up to now, 87.300 users joined the platform and 2050 young designers have been involved in 25 ideas contests by submitting a total of 4.500 proposals. The community has voted 22.500 times and commented 42.000 times. More than 80 ideas to produce have been selected and 44 have been realised by the Partners involved in the project and are now available in the online shop.

FINDINGS

In this section we report the results of the case study analysis we carried out according to the construct of research outlined above.

Actors and roles

The main actors involved within the community are designers and Partnes. Both of them act as primary resource

integrators, as they provide input for the design and the further realization of new products through new materials and new applications, as demonstrated by the following quotes.

"G: Very good! I like your idea. Probably you can use a part of it for the lamp backing. Anyway my vote is 5, the maximum. S: I think you're right. I can regain more space. Thank you so much for your suggestion".
Giancarlo e Silvia, Formabilio designers.

"The knowledge exchange within the community allows for the optimization of products and solutions. I remember a conversation of a designer who provided suggestions to better fit an idea. The proposal has been changed according to the suggestions and has been evaluated successfully in the following contest"
Denis, CEO Euroline –Partner.

As quotes reveal, Formabilio is the hub of the network. The company enhances the integration of resources among all players involved in the project. It plays as intermediary of the innovation process establishing connections and relationships among the actors of the community. Thanks to Formabilio actors are networked each other even on issues which are also beyond the specific context. Furthermore, it supports the learning process within the community by channeling and allowing the matching of the actors skills and knowledge to improve their effectiveness as resource integrators and to set up a new ways of creating value.

"Formabilio goes between us and designers to solve problems or to redefine some details of the product. …bridges the gap between the actors of the community as it interprets the need of both supplier and designers. Furthermore, it is possible interact personally with designers during the events organized by Formabilio"
Denis, CEO Euroline –Partner.

Potential customer or *made in Italy*-furnishing lovers are a typology of actors; who differently from the previous ones, don't have a decisive role in the creative process but their contribution is valuable as they provide comments , remarks and opinions on the product, materials, etc. Such community insights are taken in consideration to select the most interesting ideas and to test the product before its launch on the market.

"I like it, interesting project. I'll vote it".
Andrea, Formabilio community member.

"Good job! Your projects are always originals and interesting, but please, could you replace the green color with another one? It is too common and used".
Davide, Formabilio community member.

"Formabilio gives us the opportunity of direct feedback from customers about products. Traditionally, suppliers of components, like my company who has mainly B2B relationship, have not any direct relationship with customers…now, due to the engagement in the community of Formabilio, we are more awareness and interested in the customers' opinion. It marks our route and pushes us to interact more with designers and other suppliers - within the supply chain - to refine products according to the customers' preference".
Denis, CEO Euroline –Partner.

Resources

All actors are resources integrators. They integrate their own resources with ones made available from the community in different ways and intensity depending on the typology of role, skills, and of relationship they engaged. Specifically, they integrate human – knowledge, skills, time, effort – as well as non-human resources relating to the platform technical infrastructure to create new and sustainable solutions.

Data analysis and quotes highlighted that creativity, knowledge, technical and artistic competences, as well as, the culture of the made in Italy are the main resources that actors integrate within the community of Formabilio. May be such resources could be meant as a sort of shared values among them. Actors are continually encouraged to act upon, recombine and improve existing resources, as well as, to create new ones. This mechanism is well-recognised within the community as the suitable way to shift ideas into new and original products.

"Formabilio allow us to offer to the creativity of designers all our skills, competences and all our 60 years' experience and tradition, to further their opportunities and ours."
Katia, Manager Ivo Fontana Mobili – Partner.

"The traditional mistrust within the supply chain has been replaced by the culture of collaboration. I have the opportunity to improve my work by learning working techniques that belong to interrelated business (supplier company) and that till a year ago I perceived as very far from my work".

Denis, CEO Euroline –Partner.

Technology (especially referred to the technical infrastructure of the digital platform) is a core factor for the process of resources integration and for the development of the collaborative innovation practice. As showed in the figure 2, Formabilio.com is an user-friendly interface designed to ensure access, transparency (e.g. idea contest rules, project evaluation rules etc.), visibility of the community members (e.g. recognition by both peers and companies), sharing of information and opinion, and to provide the opportunities to collaborate. It is fundamental for stimulating and driving participants activities. Social software – Twitter, Facebook, Vimeo, YouTube, etc. – complement the technical infrastructure provided by Formabilio, but, differently from the blog and the space within Formabilio.com, they are used mainly by company to communicate the launch of new contests, events and news instead of to share and comment ideas. Social networks are just communication tools for Formabilio.

"Our records reveal that community members prefer interact and exchange opinions and ideas within the digital platform Formabilio.com instead of on the Facebook fan page. This trend is confirmed by the request of the community for a forum to freely interact".
Maria Grazia - Formabilio Co-founder.

Activities

Activities can be simple activities, such as, compliance with community (liking and voting), collating information (discussions observation), buying products, and/or complex activities, such as, suggesting new ideas, commenting ideas (provide suggestion to improve ideas), evaluating the technical feasibility of product solutions, producing wining products and co-learning. Members can be involved in one or more tasks according to their role within the community. Such activities foster and nourish the practice of innovation by enhancing the logic of collaboration and value co-creation for all actors involved in the project.

"Formabilio is a sharing community; it a creative lab that put ideas in the realm of practice."
Luca, Formabilio designer.

"Formabilio is a showcase for the GOOD DESIGN. It pays attention to the experimentation, encourages creativity and fosters the sharing and comparison among experts."
Chiara, Formabilio designer.

Value

The company's goal is to produce and share value with all player involved in the project. We identified different types of value: economical and financial, relational, reputational, cognitive and epistemic. For designers value relates first of all the opportunity to increase their professional competences as well as to obtain trust and reputation as a "professional designer" by peers, firms and potential customers (e.g. each Formabilio product is marked with the designer and manufacturer names). Moreover they extract also economic value from the collaboration as they gain monetary reward for each sold product they designed (a fee of 7% on all sold products) .

"I believe Formabilio is a good chance to keep in touch people wants share ideas and knowledge. It allows the stand out of young professional designer and their cooperation with potential customers and firms."
Maddalena, Formabilio designer.

"...my favorite Formabilio product is Nestore, when I saw it Formabilio, it made me smile. There is nothing more appropriate than a sofa to represent comfort, free time, a shelter against stress. Nestore combines together a relax area for humans and for pets. I find this idea really original. The petroleum green version is the one I like best, by the way."
Fabio Area Pavimenti – Partner.

The Partners are small-size, craftsmanship and high specialised Italian firms who are very sensitive to environmental, sustainability and made in Italy issues. For them the value depends firstly on business and network opportunities: Joining the Formabilio adventure allowed them to access wider network and to get in touch with other companies and partners. Such type of value leads to or is a precondition for economic and financial value. Moreover value is related to knowledge as it concerns with tackling new technological and market frontiers and coping with the challenge of competitiveness.

"Formabilio is the future. It gives us the opportunity to work with designer who have new ideas and, above all, the opportunity to enter in a global market."
Paolo, Live In – Partner.

"We have no doubt that the furniture industry is suffering the recession and that needs for change and revolution. A part of this change is shown in the very innovative development and sale system applied by Formabilio. We grew up in term of relationships with other suppliers and designers. We have information about materials and manpower costs that before were not easy accessible; furthermore, the reference system enacted by Formabilio allowed us to be engaged in other projects outside the community"
Denis, CEO Euroline –Partner.

Value for members of community is cognitive, relational and ludic too as all enthusiastic people who contribute by commenting and participating increase their own knowledge (about products, processes, designers, firms, materials, events….) and also find entertainment as they are design lovers and innovation sensitive. The first type of value for customers depends surely on the collaborative nature of the process: they are partners in the process of selection of the idea: the feel very deeply this participation and it is a great self-esteem benefit and gratification. The value for the customers is complex and relates the awareness of a solution which matches design, price, quality and sustainability (work processes, materials, employees respect, innovative culture). Of course customers can wish different types of value depending on their own engagement, system of values, role and expectations.

DISCUSSION

Companies are increasingly seeking to foster collaborative innovation as it is a key factor for the organisational success, performance improvement and survival in the competitive arena (Trott and Hartmann, 2009; Chesbrough, 2003; Chesbrough and Crowther, 2006). Recently, manufacturing companies operating in mature and traditional industry are trying to enrich the potentialities of traditional and strengthened methods through the use of interactive technologies to source new ideas (e.g. ideas contest). This type of open behavior combines the competitive feature of the challenge with the opportunity of interaction and collaboration enhanced by the virtual platform (Hutter et al., 2011).
Our study stressed both the role of interactive technologies and of network for boosting a revolutionary business model based on the practice of collaborative innovation. This practice effects on the working activities and process of all actors involved in the project. It extends their business boundaries and prioritize the interaction and the sharing of information, knowledge, competences, etc. with new actors in a changeable relationship system. Indeed, as quotes cited above highlighted, suppliers of component products – who traditionally focuses on a narrow business approach – cooperate with other actors (e.g. Formabilio, designers, other suppliers, furniture experts and customers) since the fuzzy front end phases and share passion and enthusiasm with them. The heterogeneity of the actors of Formabilio network contributes to make this community unique. Differently from previous cases (e.g. Nel Mulino che Vorrei, Nutella, Dell etc) that are based mainly on dyadic relationships (e.g. company and consumers, company and experts, company and fans), Formabilio community encompasses the point of view of different participants who are actively engaged in developing innovation through the mechanism of idea contest. Formabilio (the company) ensures fundamental preconditions for the triggering and the developing resource integration: the matching of the actors' skills and knowledge. Formabilio improves the members effectiveness as resource integrators and the members opportunity to extract value from the community itself.
Otherwise to previous studies (Sawney and Prandelli, 2000) that identify the community as one of the main actors in the practice of innovation we identify the community as the collaborative practice for the innovation development, as it is a new ways of creating value that results from the recombination of existing resources (Akaka and Vargo, 2013; Corradi, Gherardi and Verzelloni, 2010; Arthur 2009). Therefore, innovation and value emerge in and through the community and are enabled by web technologies, through the active doing and the resources integration. As stressed above, interactive technologies are operant resource (Caridà et al., 2014; Akaka and Vargo, 2013) which enable the development and the set-up of collaborative practice and ensure its recursiveness. This feature distinguishes the concept of practice from action (one of its element) and makes possible the development of innovation through the constant adaptation of the practice to the changing circumstances and context (Corradi, Gherardi and Verzelloni, 2010). Hence, the practice we identified and argued in the present study is not a static concept; it can may vary over time (McColl-Kennedy et al. 2012), depending mainly on the nature and on the architecture of its elements and on the networking system that frame it. In other words, the practice depends on the context that, according to an iterative view, creates and is created by the practice (e.g. community).

MAIN IMPLICATION

This study provides relevant implications for companies and managers who are challenged by the need to create the right context and condition to foster innovation. We framed collaborative innovation from the practice lens, by analyzing what people do, how people do and the consequences of their doing (Schultze and Boland, 2000). Drawing from previous practice research (Russo Spena and Mele, 2012; Korkman et al., 2010; Kjellberg and Helgesson, 2007) and from studies on collaborative innovation (Von Hippel, 2013, Trott and Hartmann, 2009; Døving and Gooderham 2008; Chesbrough, 2006), we identified key elements - actors, roles, activities and networking – and key process – the resource integration –to set collaborative innovation practice and to foster a shared understanding of what it is and to keep it doable and meaningful.

The analysis of Formabilio network reveals the importance to shift the concept of community from the implicit to the explicit dimension. It is codified and recognised as a part of the organization formal structure and hence as a modus operandi. It is more than an interactive tool or a collection of action or a community of people, it is the context where all these resources integrate themselves to foster innovation. It is a strategic practice that requires a formal organizational structures based on values, norms, and rules (Piller and Walcher, 2006; Prahalad and Ramaswamy, 2004).

Our study calls for a new, a more holistic and strategic role of the community and provides new insights to replace episodic and improvised activities for innovating with a structured, codified and recursive practice to enhance continuously the ideas co-generation process and to create value for all the actors engaged.

From the theoretical perspective, the study frames the concept of community under a new lens. As stressed above, community is not just the main actors in the practice of innovation, it synthesizes the practice elements by defining the locus where collaborative innovation occurs.

Finally, however the present paper involves both the concept of practice and community, the definition we proposed in the study is very far from the concept of community of practice. Indeed, while contributions on community of practice defined community as something that pre-exists to its activities (Corradi, Gherardi and Verzelloni; 2010; Gherardi, 2009), the structures and the elements that inform our idea of community and thus the collaborative practice are not fixed or given, but are constituted and reconstituted through the practice itself.

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Resource Integration in Innovation Processes: A Literature Review

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ABSTRACT

The aim of study is to provide a better understanding of the resource integration phenomenon through a bibliometric analysis conducted on 1072 ISI listed journal articles. The most important contribution of the study is the overview of what resource integration is, how it has been portrayed in marketing and management research and a deeper understanding of the six most important dimensions or topics and their theoretical basis. Furthermore, the analysis highlighted a clear division within the knowledge structure of RI, defining essentially two main research areas on the topic: the old school of goods-based logic and the recent school of service-based logic.

Keywords: Resource Integration, Bibliometric Method, Innovation

INTRODUCTION

In the last decade cooperation between different subjects, different companies and different stakeholders has become a core topic both in literature debate and in managerial practices. Specifically, in literature the sharing of resources has been emphasized, although using different terminologies and intensities, in different areas of management research. From the practitioners point of view the recent book "Co-business" of Turiera and Cross (2013) showed the positive effects of the resources matching and integration by providing 50 examples of business collaboration between diverse parties (competitors, company/customer, supplier/company, companies of different industries) who combine resources (technologies, applications, services) that result in improved solution's value.

In the field of strategic management studies, the term *co-opetition* coined by Brandenburger and Nalebuff (2011) encloses the essence of cooperation, even between competitors, as the authors stress that "in today's business environment, most companies can achieve more success in a dynamic industry than they ever could working alone […] … business, unlike war, is not a winner takes all proposition. The objective is to maximize your return on investment - regardless of how well or how poorly other people or other companies perform". However, studies on collaboration and sharing of resources in this area date back at the end of the 80s (Hamel, Doz and Prahalad, 1989)

In innovation studies, a shifting from a closed view toward an open view of innovation emerged both in the R&D based (Chesbrough, 2006) and in marketing based research stream (Edvardsson, 2012; Mele, Russo Spena and Colurcio, 2010). Specifically the main contributions on the technological side (Chesbrough, 2006, Trott and Hartmann, 2009) pointed out that the development of strong relationships among different parties is a precondition for successful innovation. Essentially in a marketing perspective, innovation is a value co-creation process of interaction and resource integration (Ngo and O'Cass, 2009) and network actors can mobilize resources and thus become co-innovators (Mele, Russo Spena and Colurcio, 2010).

In a Service Dominant Logic (SDL) perspective, the interaction among the parties is a significant enabler of organizational learning and knowledge transfer (Lusch, Vargo, and Wessels 2008) which foster the integration of resource from one partner with the processes of other parties (Vargo and Lusch, 2008). SD logic suggests that value is fundamentally derived and determinate in use through the integration and application of resources in a specific context (Vargo, 2008; Vargo and Lusch, 2008). Edvardsson and Tronvoll (2013), recalling the FP 9 of Vargo and Lusch (2008) "All social and economic actors are resource integrators" define resource integration as the involved actors' activities and interactions when resources are integrated and operated upon.

Actors are resource integrators and resource integration requires process(es) and forms of collaboration. Edvardsson, Tronvoll and Witell (2013) argue that institutions shape how resources are becoming and are used by regulating and shaping actors' resource integration and value co-creation efforts. Institutions enable and constrain resource integration and value co-creation in service systems (Edvardsson, Tronvoll, and Gruber, 2011).

Despite the prolific literature and the empirical evidence about RI, scholars are still far from a shared definition. Furthermore, despite the intuitive link between resource integration, value co-creation and innovation an integrated theoretical framework of these interdependent processes has been overlooked so far.
In a commentary published on Marketing Theory in 2012 Kleinaltenkamp and others tried to shed some light on the nebula that envelops terminology and concepts of RI in the marketing studies by defining some key research challenges.

The aim is to contribute to the theoretical debate in marketing and service research by providing a better understanding of the dimensions of the resource integration phenomenon and investigating through a bibliometric analysis the link between RI and value co-creation.

RESEARCH DESIGN

Methodology

The research goal is to contribute to the ongoing discussion on actors' resource integration by doing a systematic literature review. The focus is on describing different origins, topics and dimensions in research on RI as well as the enabling and inhibiting factors. , we deployed bibliometric methods to deepen and provide an overview of the knowledge structure of the RI research. We wanted to identify key elements and attributes that characterize the concept of RI throughout different contributions from both management and marketing studies.
A better understanding of the phenomenon and the codification of its specific domains will allow us to draw theoretical implications about the relationship between RI and value co-creation (innovation) processes.
In order to conduct the systematic literature review in the field of (RI), we deployed a bibliometric method. Specifically, to frame the state of the art of the (RI) issue, we employed different bibliometric measures: the publication activity and the co-word analysis (Benavides-Velasco et al., 2013). Indicators of the publication activity allow researchers to deepen the quantitative evolution of literature, by identifying the most representative journals, institutions and countries publishing in the discipline (Benavides-Velasco et al., 2013; Callon et al. 1983).

To perform the co-word analysis in the field of RI, we focused on the author-provided keywords. It allowed us to frame the conceptual structure of the topic and to obtain insight for future research that could contribute to the advancing, as well as, to the consolidation of this discipline (Benavides-Velasco et al., 2013).

Indeed, the co-word analysis technique (Benavides-Velasco et al., 2013; Muñoz-Leiva, et al., 2012; Callon et al., 1983) focuses on co-occurrence frequency of terms (e.g. keywords or subject headings). It allows researchers to identify and disclose the structural and dynamic aspects of scientific research area (Börner et al., 2003; Callon et al. 1991; Cooper, 1982), by discovering linkages among subjects in the field and tracing emerging research areas (Qin He 1999; Bhattacharya and Basu, 1998). As Qin He (1999) claimed, the co-word analysis is a powerful technique that offers a significant approach to knowledge discovery.

Data Collection

To carry out the study, data were collected from ISI Web of Science and specifically from the Science Citation Index Expanded (SCI-EXPANDED) and the Social Science Citation Index (SSCI) databases.

The choice of ISIWeb of Science as data source is consistent with its reputation of being one of the most important bibliographic databases (Sakata, et al. 2013; Cobo et al., 2011).

In order to set the research domain, we searched for scientific articles using the terms "Resource Integration" as the query, as this keyword better represents the research domain under investigation (Sakata et al., 2013).

To chart the actual development of our research domain we selected just papers within two ISI Web of Science categories, Management and Business for the entire period for which databases provide online coverage. The dataset used, covers a period of 28 years because the oldest paper embedded in our research domain was published in 1985. It consists of a corpus containing 1042 scientific articles that have been published from 1985 to 2013.

We selected only articles and no other types of documents (e.g., letters, editorials, reviews, etc.) since articles best reflect the production of the original research (Benavides-Velasco et al., 2013).

Co-Word Analysis

Keywords were extracted from the entire dataset and were selected on the basis of their frequency of occurrences to create co-word pairs. Because keywords were ranked on the basis of their maximum occurrence they are the most important concepts which informed research (Bhattacharya and Basu, 1998) on the investigated topics.

A total of 2649 unique keywords were collected from the selected articles (1072). Some keywords were revised and standardized, because they were expressed in different form but had the same meaning (Zhu and Guan, 2013). For example, (1) resource and resources were unified as resource; (2) innovation and innovations were unified as innovation; (3) value co-creation and value cocreation were unified as value cocreation etc. A total of 2554 keyword were included in the final dataset. The identification of the interrelationships among these terms has been carried out through the co-word analysis. To perform the co-word analysis the 41 most cited keywords with frequency >12 were chosen as the research sample. The selection of just 41 keywords satisfies two criteria: the selection of meaningful keywords on the base of their frequency distribution and the number of keywords suggested to get interesting results. On the point, Persson, Danell and Schneider (2009) claimed that around 40-50 keywords makes still quite nice maps, whereas a maximum is around 80-90 keywords.

In order to have a clearer picture of the scientific production of RI we adopted both the mapping and clustering techniques (Waltman, van Eck and & Noyons, 2010). Such techniques allow us to study the keyword co-occurrence network and to find which keyword was most useful in the course of knowledge exchange (Zue & Guan, 2013). Finally, we obtained a bibliometric map to show, in a visual way, strong associations and divisions between the several subfields of the RI stream of research (Muñoz-Leiva, et al., 2012).

Data Analysis

Although the science mapping analysis can be performed using generic software for social network analysis (Cobo et al., 2011; Börner et al., 2010) we used the free software Bibexcel (http://www8.umu.se/inforsk/Bibexcel/), as it has been specifically developed to manage data from different bibliographic sources, such as ISI Web of Science (WoS), Scopus etc., and to build maps that can be read by software such as Excel, SPSS, VOSviewer, etc. (Cobo et al., 2011). Specifically, we used VOSviewer (version 1.5.4) to create map based on network data. The map has been created using the VOS mapping technique and the VOS clustering technique (Van Eck and Waltman, 2010).

FINDINGS

The following tables and figures show some publication activity indicators (e.g. the publication trend, the most representative journals publishing in the discipline) and the research domains covered during the analyzed period. They offer some insights to frame the evolution of the literature on the topic of RI.

The figure 1 shows the annual distribution of articles on the issue from the 1985 to 2013.

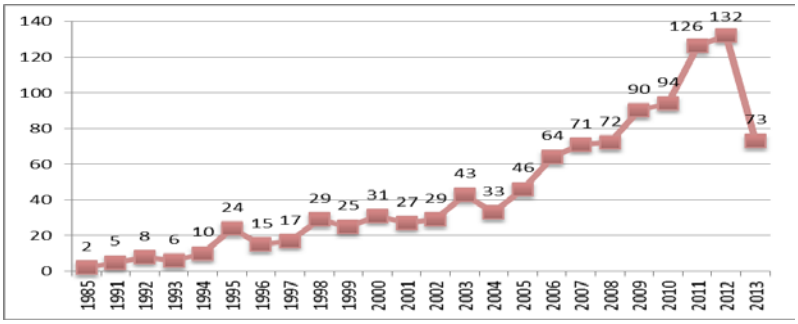

Figure 1: Annual totals of papers on RI distributed across Management and Business and SSCI's categories (1985-2013) (Our elaboration)

The scientific production on the topic shows an irregular trend. It has been characterized by a significant decrease in the 1996 (-38%), 2004 (-23%) and 2013 (-45%) and a significant growth rate during the 1995 (+140%), 1998 (+71%), 2003 (48%) and the 2011 (34%).

The increasing interest in the topic during the studied years ranges from many fields (e.g. marketing, management, operations, etc.), and many research interest (e.g. HRM, R&D, innovation, internet and the interactive communication technologies, the competitive advantage as strategic priority, the dynamic capability, etc.).

However, the first contributions on RI could be traced in 1985 (source ISI Web of Science), the increasing number of articles and the different domains emerging in the last years allow us to account for it as a new stream of research that is in an evolutionary stage.

These reflections are confirmed by the analysis of the journals publishing papers within the field of RI. The 1072 papers included in our sample have been published by 186 different journals with an average of 5.76 papers per journal. Data reveal two opposite trends: the polarization and the significant fragmentation on the scientific production per journal. Indeed, 32% of the journals published more than five papers by producing 76% of the contributions in the field. Among these, the first ten journals (the most productive journals) covered 36% of the scientific production. On the other hand, data reveal that 48% of the journals included in our sample published 1 or 2 articles on the topic. As stressed above, we relate this phenomenon to the recent cross fertilization of the topic and to the emerging of new research domains that draw the interest of journals that are traditionally far from the topic. The process of cross-fertilization could have a positively impact on the development of a more comprehensive and interdisciplinary body of knowledge (Benavides-Velasco et al., 2013).

Specialized journals in the area of management as International Journal of Human Resource Management, Strategic Management Journal and International Journal of Operations & Production Management have published the largest number of publications (figure 2). This area dominates, indeed, 43% of the journals included in the sample relates the topic of management with a productivity rate of 57%. Differently, journals in the area of marketing as Journal of the Academy of Marketing Science, Marketing Science, Marketing Theory, etc. are less common. They represent the 7,5% of the sample and have a productivity rate of 2,6%.

USA with 465 papers (43,3% of the scientific production in the field) stands out as the most productive country (figure 3). In the second place and at the top of the European ranking we find England, while the other EU countries are positioned behind China, Australia, Taiwan, etc.

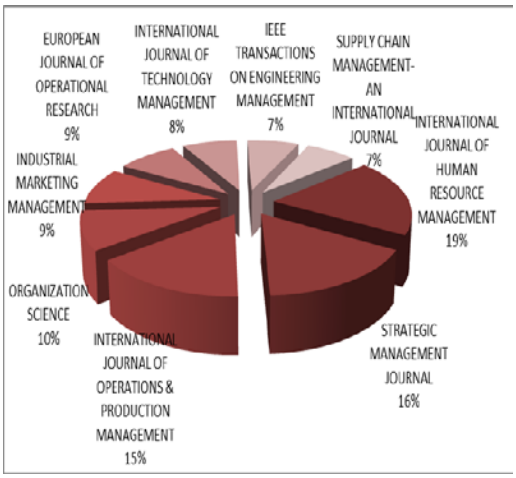

Figure 2: Most productive Journals on RI (Our elaboration)

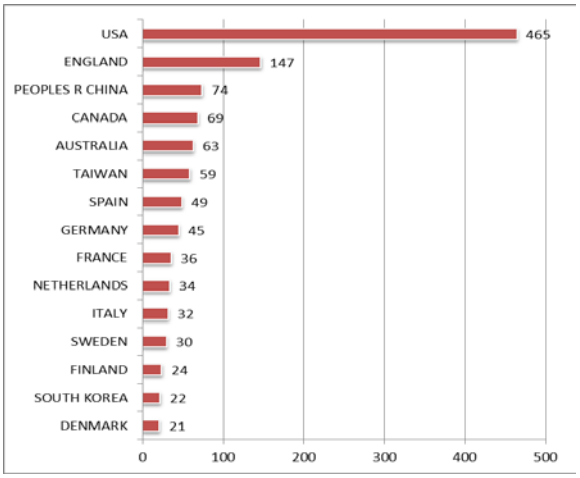

Figure 3: Most productive Countries on RI (Our elaboration)

Figure 4 shows some interesting results about the frequency of the author provided keywords. It confirms previous results emerging from the analysis of journals and shows how well-established themes linked to the topic strategic management dominate within the contributions on RI.

By extending the analysis beyond the fifteen most cited keywords new themes emerge, such as, value co-creation, SDL, internet, service industries, sustainable, etc. The analysis shows the high heterogeneity of research in this field of study, as the 47% of the keywords are cited just one time. The low level of frequencies confirms the wide variety of information characterize researches on RI.

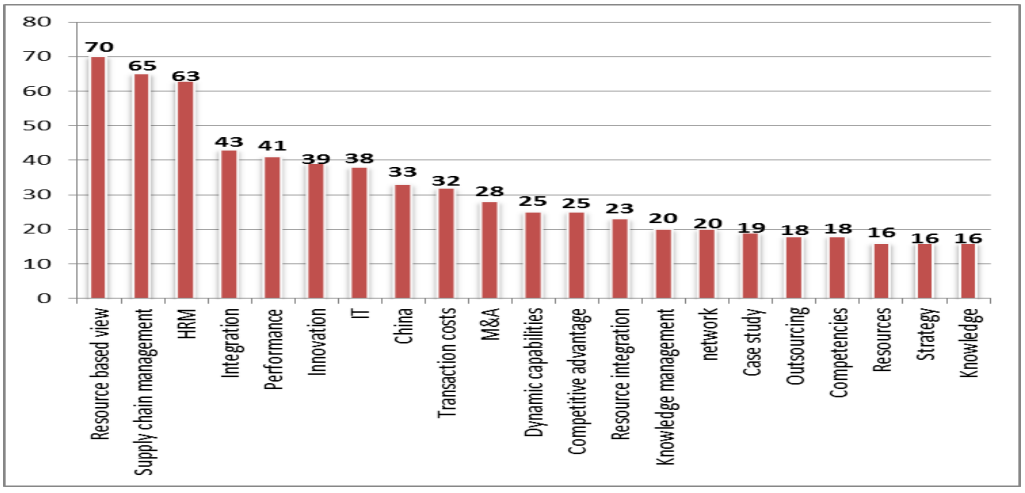

Figure 4: Most cited keywords (Our elaboration)

The Bibliometric Map

To frame the state of the art, and to trace some trends in the research on RI, we adopted both the mapping and the clustering techniques. They allow us to analyze the keyword co-occurrence network by means of a bibliometric map that shows the divisions and associations between the main concepts in the field of RI.

The following map (figure 5) identifies and discloses the structural and dynamic aspects of scientific research on RI. It shows descriptors (e.g. keywords) of the central concept (RI), and provides information on how they relate to each other (Pinto, Pulgarín and Escalona, 2014). The size of the colored bubble is straight linked to the number of descriptors occurrences. *"The more important an item, the larger its label and its circle"* (van Eck and Waltman, 2010, p. 256). Colors indicate the cluster to which a descriptor belongs to.

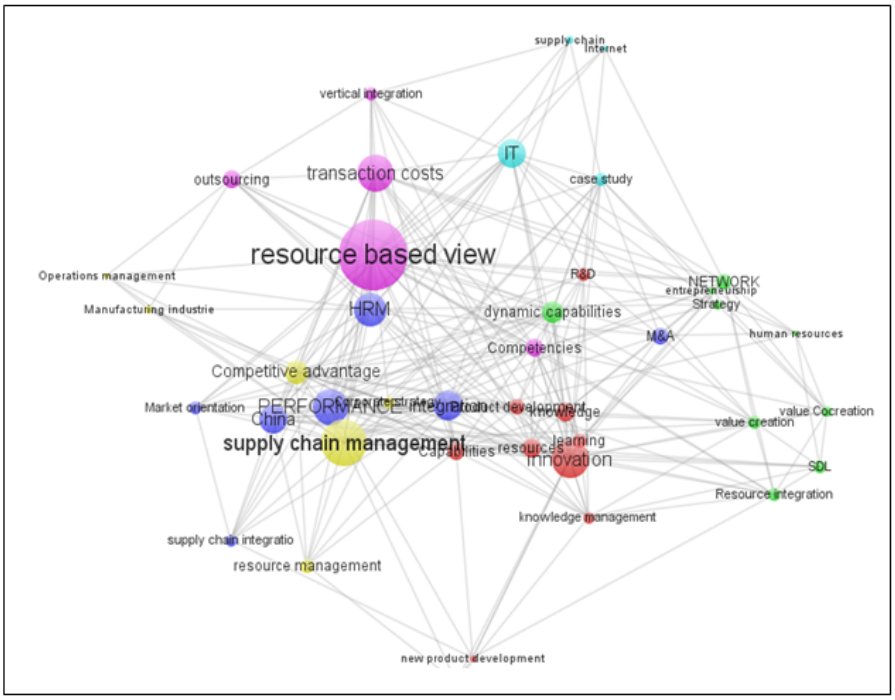

Figure 5: The concept map of Resource Integration (Our elaboration)

"Resource based view" is the central most important descriptor. It is characterized by the greatest number of links with other descriptors. It is followed by "supply chain management", "innovation", "performance", "HRM", "transaction costs" and "China". First three significant descriptors belong to different clusters.
Descriptors on the edge of the map, such as, "supply chain", "internet", "cross functional integration" etc. have little connection with other descriptors (this concept is more clearly displayed by the density map; figure 6). The map shows an ostensible nonsense. Indeed, "supply chain management" is a key descriptor of the research field, whereas "supply chain" has a scarce relevance, as it is on the edge of the map.

The map shows six clusters, distinguished by different colors, we labeled according the content after the analysis and the interpretation of data. The table below shows the main descriptors for each cluster. The proximity among clusters indicates a close relationship between their sub-fields, while clusters far from each other indicate only a weak relationship. The clusters distribution in the map is heterogeneous. The central area of the map is empty and all the descriptors are asymmetrically distributed around it.

RED	GREEN	BLUE	YELLOW	PURPLE	SKY BLUE
OPEN INNOVATION	SDL	GENERAL MANAGEMENT	SUPPLY CHAIN MANAGEMENT	RESOURCE BASED VIEW	SOCIAL MEDIA
Capabilities	Dynamic capabilities	China	Competitive advantage	Competencies	Case study
Cross-functional integr.	Entrepreneurship	HRM	Corporate strategy	Outsourcing	Internet
Innovation	Human resources	Integration	Manufacturing industries	RBV	IT
Knowledge	Network	R&A	operation manag.	Transaction cost	Supply chain
Knowledge manag.	Resources integration	Market orientation	resource manag.	Vertical integration	
Learning	SDL	Performance	Supply chain manag.		
NPD	Strategy	Supply chain integr.			
Product development	Value cocreation				
R&D	Value creation				
Resources					

Table 1: The clusters' descriptors (Our elaboration)

The analysis of the normalized link strength of the central descriptors revealed some interesting aspects about the association strength of key concepts. This measure allows us to compare in a fair way the co-occurrence frequencies of concepts occurring in many and few abstracts (van Eck and Waltman, 2007).

"Resource based view" has the strongest relationship with "transaction costs" (3.68), "supply chain" (3.01) and "resources management" (2.32). "Supply chain management" has the strongest relationship with "resource management" (5.20), "operation management" (4.70) and "cross functional integration" (4.11). "Innovation" has the strongest relationship with "R&D" (4.72), "new product development" (4.02), "knowledge management" (3.76) and "network" (2.87). On the contrary it has a weak linkage with "resource integration", "SDL" and "value creation" (1.18), as well as with "value co-creation" (1.43). Of course "resource integration" (green cluster) has the strongest relationship with "SDL" (17.36) and "value co-creation" (12.66), as it identifies a specific research domain. Furthermore, it is interesting to note the strong linkage with "new product development" (5.91) in contrast with the weak linkage with "innovation" (1.18).

Figure 6 shows the co-occurrence density map for the RI field. The color of each point in the map depends on the density of items at that point: "the larger the number of neighboring items and the smaller the distances between these items and the point of interest, the higher the item density. Similarly, the higher the weights of the neighboring items, the higher the item density" (van Eck and Waltman; 2010, p. 533). As stated by the authors, the density map allows us to get a quick overview of the important areas within the research field. Colors are assigned by default; red corresponds with the highest item density and blue corresponds with the lowest item density. "They indicate the amount of attention researchers pay to the research topics located in the various areas of a concept map" (van Eck and Waltman, 2007). The amount of researchers' attention is evaluated according to the number of scientific articles concerned with the specific keyword (van Eck and Waltman, 2007). Red color identifies more investigated and well-established research topics, whereas, green/yellow color identifies new and emerging research areas.

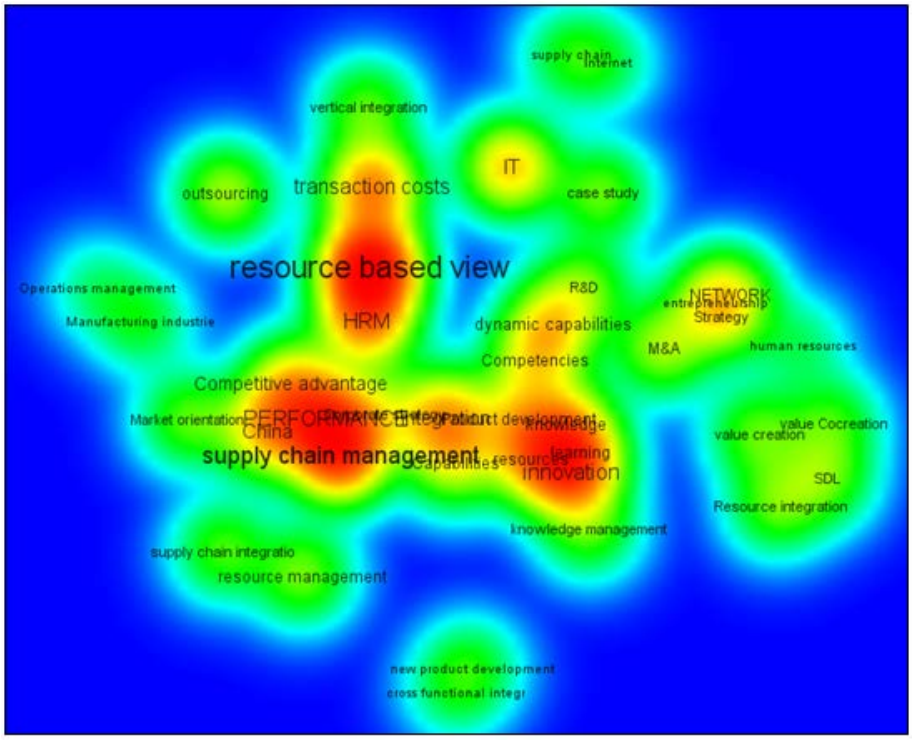

Figure 6: The density map of Resource Integration (Our elaboration)

The density map shows three more important areas. Each of them relates the first three central descriptors of the study: "resource based view", "supply chain management" and "innovation". They are the most consolidate domains within the research field we investigated. The boundaries of each domain mark exactly the studies within these fields. Specifically, the map shows two opposite trends; on one hand, the strong separation of the "resource based view" area from the other ones, and on the other hand, the weak separation between the "supply chain management" and "innovation" areas. In this latter case a smaller research domain including the descriptors "integration" and "capabilities" creates a continuum between the two areas.

Other important research areas relate domains including: i) “dynamic capabilities”, “competencies” and “R&D”, at the top of the innovation domain; ii) “IT”, that is located very far from other research domains; and iv) “network”, “entrepreneurship” and “strategy”, that identify specific and consolidated research areas within the SDL cluster (green). The research area marked out by “resource integration” and “SDL” shows a lightweight green/yellow color. It could be defined as a new emerging domain within the general field of studies on resource. It reveals that the label “resource integration” doesn’t identify the general field of study but identifies a process within the general paradigm of SDL.

DISCUSSION

We conducted a bibliometric study to review the literature on the issue of resource integration in management and business studies. The literature review highlighted that the earlier contributions on the topic of resource integration were produced in the beginning of the 90ies, while the peak of interest and production are registered between 2011 and 2012. These first findings are very important in order to understand and also to interpret the evolution of the concept through time, and to draft its different domain. The earliest contribution on resource integration can be framed in the research stream on Resource Based Theory and have been published mainly in Strategic Management Journal and Organization Science on the wake of Barney’s work (1991) and consistently both with the scholar interest for the new themes of resources, competencies (Hamel and Prahalad, 1990), knowledge (Nonaka, 1991) and with the changing business models in many competitive organizations. Through time and consistently with the topic on the top of the scholars’ agenda and area of interest, the concept of RI has been borrowed from other domains such as technology management, supply chain management, operational management. Up to 2010, contributions in marketing journals are scant but starting from this decade the domain of Resource Integration extends to marketing studies and has its production peaks. The interest of marketing scholars and the proliferation of contributions on the topic of RI in these years might be explained by the emerging value co-creation research stream and specifically on the formulation and on proposal of the Service Dominant Logic perspective which broaden the concept of RI and amplify its intensity in the marketing theory. Starting from the statement of FP9 of Vargo and Lusch (2008) and thus the role of RI for value co-creation processes becomes more and more important for value-in-context. Recent contributions emphasize that resource integration requires process(es) and forms of collaboration even underlining the role of institutions in enabling resource integration and value co-creation in service systems (Edvardsson, Tronvoll and Gruber, 2011).

Through the co-word analysis we framed the knowledge domain of RI by identifying six different research clusters which highlight the cross-field feature of the topic. The clusters concern different research stream and affects diverse fields of management (strategy, operation, technology, marketing, social media and digital marketing): Open Innovation, SDL, General topic, Strategic Management, RBV, Social Media/Digital Marketing. Each cluster identifies a well-defined research stream which put first one or another element’s respect to others according to the school of thought or the specific field.

The cluster we labeled *Open Innovation* (red) is focused on the sharing of knowledge as the main condition for the success of innovation, and emphasize the integration of resource as a mechanism to trigger and foster learning processes. It encloses mainly contributions from the research area of Knowledge Management. Contributions which just sketch RI with regard to surface aspects belong to this cluster; they focus mainly on the typology, nature and process of formation of resources, knowledge and capabilities.

The cluster *SDL* (green) finds network, resource integration and value co-creation as its main descriptors. It is intuitive that this group encloses recent contributions from marketing scholars who emphasize the role of actors and the dynamic of sharing in the whole resource integration process. The visual analysis of the map (Fig. 5 and 6) shows that in comparison to other clusters SDL holds an edge position isolated from all other interlinked and in some cases (blue and yellow) overlapped clusters: this evidence marks out differences in the content and in the approach to the topic of RI.

We had some difficulties in labeling the blue cluster as it groups diverse cross-field elements, and represents a sort of a miscellaneous box. We named it *General Management* as we believe that it encloses various contributions which treat the issue of RI according to a common and general meaning without referring to a specific theoretical perspective (such as Resource Based View or Knowledge Management). Particularly the descriptor China stands out, consistently with the distribution per countries (Fig. 3). It confirms that the use of terminology “resource

integration" in this cluster refers to a general topic of inter-firm cooperation and improvement of firm performance.

The cluster *Supply Chain Management* (yellow) encompasses contributions which emphasizes the role of relationship and of the integration according to a supply chain and an operation management approach. The focus is on the management of resources more than on its nature, dynamics and transformation processes and the context is surely the supply chain. The competitive advantage depends on the management of the process of resource integration between the actors of the supply chain; the potential of actors in transforming and integrating resources is still neglected.

The cluster *Resource Based View (or Strategic Management)* (yellow) gleans the label from its main descriptor. The emphasis is put on the type and on the quality of resources which determine the competitive advantage of firm. The process of resource integration is framed in a transaction cost perspective where it referred just to outsourcing processes rather than to real cooperation processes among actors.

Finally, the Social Media/Digital Marketing Cluster (blue sky) encloses studies and empirical research (as the descriptor case study points out) which identify the web tools and internet platforms as enablers for the cooperation and the integration of resources.

Furthermore the analysis highlighted a clear division within the knowledge structure of RI. The location of descriptors in the density map (figure 6) defines essentially two main blocks. Analyzing the content of the two areas defined by descriptors we identified the two blocks as the two main schools which produced contributions on the theme of RI: the old school of goods-based logic and the recent school of service-based logic.

Specifically, we believe that the descriptors located on the right identify depict a new course of knowledge in the studies on RI as this block encompasses the Open Innovation, the SDL and the Social Media/Digital Marketing clusters. On the other hand, the left side of the map embraces descriptors belonging to clusters such as Supply Chain Management, Resource Based View, General Management which depict the more traditional and consolidated goods logic.

CONTRIBUTION AND FUTURE RESEARCH

The aim of this study is to provide a better understanding of the resource integration phenomenon through a bibliometric analysis. The focus is on what RI is and the link between RI and value co-creation. The paper contributes with an overview of marketing and management research in the area of resource integration. Six different clusters have been identified and a number of dimensions of RI in each of the clusters have been put forward.

We also find that the most important topics such as resource based view and supply chain management, both belong to the old school of goods-based logic but at least to some extent focus on dynamic phenomena. We also find that innovation is pretty much a topic isolated from resource based view and supply chain management. Thus, there seems to be very little cross fertilization between different research fields and topics in the area of resource integration research. Furthermore, there seems to be a wide range of definitions and conceptualizations of what RI is, as is the case with the theoretical foundations. This can be seen as an opportunity but also as if the field is becoming more and more fragmented. We can also see that IT is important but may be not as important or dominating as one might expect. This might be explained by IT or ICT being embedded in many if not all the other topic areas, and is most often not treated as a separate area or topic.
Finally, Service-dominant logic (SDL) is developing and we show that resource integration is linked to dynamic capability and plays an important role and is dynamic in nature as well as linked to actors' knowledge, skills and motivation during value co-creation. In a SDL perspective the collaboration between the involved actors is an important enabler as well as inhibitor in resource integration. To sum up, the most important contribution is the overview of what resource integration is, how it has been portrayed in marketing and management research, and a deeper understanding of the six most important dimensions or topics and their theoretical basis.

Future research should focus on the theoretical basis for what a resource is and how resources are becoming (Zimmerman, 1951, Vargo and Lusch 2008). Tronvoll and Edvardsson (2013) define resource integration as the involved actors' activities and interactions when resources are integrated and operated upon. This should be focused on in different contexts such as healthcare, higher education, financial services and service infusion in

manufacturing. Since actors in SDL are viewed as resource integrators and resource integration requires process(es) and forms of collaboration, future research should empirically study how and why different forms are selected and how these forms are linked to more or less successful value co-creation processes. Another field for research is how actors' knowledge and skills shape resource integration in different service systems contexts. Finally we see a need to focus research on the role of resource integration in service innovation.

LIMITS

This paper adds value to the studies on marketing as by doing a systematic literature review of RI and by providing a clearer picture of it. However, some limitations, due to the bias that this analysis implies, affect the study. First, this study is based on the retrieved records from only ISIWeb of Science (ISIWoS) database. Although it is one of the most important bibliographic databases (Sakata, et al. 2013; Cobo et al., 2011), ISIWoS doesn't provide a complete view of the literature on RI. Accordingly, future researches should include other bibliographic databases, such as, SCOPUS, Google scholar, etc. Actually, this limitation partly depends on the lack of specific and standardized tools to collect data more accurately and quickly (i.e., Google Scholar) (Meho and Yang, 2007).
The second limitation of the study relates our preference for some specific bibliometric indicators and techniques: the publication trend, the most representative journals and countries publishing in the discipline, and the co-word analysis of highest frequency keywords. Future researches, should consider other bibliometric techniques (e.g., co-citation analysis), as well as, the comparison between different periods to complement this study.

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Collaborative Practices in Innovation Ecosystems

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ABSTRACT

In management literature "ecosystem" idea is becoming more and more relevant and it appears as a useful way to describe the set in which organizations operate. This is even more common when referring to innovation, in order to describe contributions arising outside from organization boundaries. Our research interests start from innovation ecosystem and are even framed in the domain of practice-based studies, leading to the overlapping of these two streams of research and to the chance to define the collaborative practices to convey innovation in ecosystems. We investigated this approach through a case study based on an innovation context composed by a high number of actors linked to cultural heritage issues, known as DATaBenC. The results of our analysis give us the chance to define this context as set by the proposers and tagged as an innovation ecosystem after defining its identity. Then each actor defines its own identities in the ecosystem and finally the actions are described as a way to *operationalize* the objectives. By summing up the three practices shed some more light on how innovation takes place, with a detailed description on how actors collaborate to reach common aims driven by innovation.

Keywords: Practice-based approach, innovation ecosystem, community of practice, collaboration

INTRODUCTION

This work addresses the recent idea of innovation ecosystem by taking a collaborative perspective to examine the mechanisms underlying a new way of doing innovation. Recent analyses on innovation processes pinpoint the need for collaboration and interaction (Nambisan and Sawhney, 2007). Innovation is mainly seen as a network issue raising by connections among a multiplicity of organizations that share common or complementary features (Nooteboom 2004, 2009; Chesbrough, 2011). The mechanisms or facilities to promote some forms of exchange of information and other resources have been recognized as critical for innovation (Lusch and Nambisan, 2012). Moore has proposed (1996) the concept of innovation ecosystem to refer to a loosely interconnected network of companies and other entities that co-evolves capabilities around a shared set of technologies, knowledge, or skills, and work cooperatively and competitively to develop new products and services. Other authors have defined innovation ecosystem as a network of relationships through which information and knowledge flow into systems of sustained value co-creation (Basole et al., 2008; Adner and Kapoor, 2010). A large number of different actors outside an organization boundaries are realized to be more and more needed (Bifulco, Russo-Spena, 2014), and they can be recognized as the main responsible for the processes of creating innovation and supporting its success (Michel et al., 2008; Chesbrough, 2011). Recently Lusch and Nambisan (2012) have used the ecosystem metaphor to describe the entangled system of actors, their interests and the activities surrounding an organization innovation context. The use of this metaphor is useful because it sheds some more light on how networked systems function and on how multiple actors interact to use and develop resources. These actors include not only organizations but also the institutional and cultural context within which different actors operate (Russell et al., 2011). The shared responsibility and contribution of different actors, both internally and externally to organizations, point out the increased level of complexity of innovation and posit new challenges to the management of innovation activity in networking context (Vargo and Lusch, 2008; Toivonen and Touminen, 2010). Collaborative and networking innovation has been differently approached in management literature. The "why" and the "how" of actors' collaboration have had a

primary focus of analysis in the literature debate. Well established is the discourse on the "why" as referred by Ketchen et al. (2007, p. 372) defining collaborative innovation as the "pursuit of innovations across organization boundaries" aiming to "close the gap between the level of innovation a organization is capable of creating and the level of innovation a organization needs to pursue strategic entrepreneurship". The "how", viz. the way, can be considered starting from Johnsen and Ford (2000) recognizing innovation as the result of combining different knowledge and expertise that exist within different organizations. The way this combination can happen is described by Miles et al. (2005) too as "the sharing of ideas, knowledge, expertise, and opportunities". When an organization interacts for collaborative innovation lots of partners can emerge as potential contributors to reach the aims and the analysis has to be "broad enough" (Bedwell et al., 2012) to include further ties enhancing the expected opportunities for all of them (Möller and Rajala 2007; Möller, 2010). In order to enable innovation, the operational mode in this type of a network cannot be understood only as an approach too structured or formalized by the perspective of focal or hub organization. Some researchers view networks as truly emergent, resulting from the open-ended interactions between actors getting benefits from these relationships (Möller and Rajala, 2007). The value creating activities oriented and mobilized by the interest of a single organization are assumed to be radically changed and a mutual value creation system is established to be sustained by value creation processes for all actors involved (Vargo and Lusch, 2008). The focus moves on social process and social structures in ecosystems that consist of loose and tight ties that enable or enhance the interactions among several organizations and actors (Edvardsson and Tronvoll, 2013). Innovation is stated to deal with a social process of construction by a group of actors whereas resources including not only knowledge but also value, schemas and practices have been aligned and integrated to create something of new and better for all the actors involved (Lusch and Nambisan, 2012; Edvardsson and Tronvoll, 2013). However the debate is still growing around some themes including 1) the nature and the role of multiple actors interactions (Chesbrough, 2011; Russell et al., 2011; Lusch and Nambisan, 2012) 2) the relevant competence and management mechanisms (Dhanaraj and Parkhe, 2006) and 3) the effects on collaboration on innovation performance (Nooteboom 2004; 2009). Instead the literature still lacks in understanding how actors collaborate in ecosystems by establishing and stabilizing relationships towards collective and mutual aims. More investigation is needed to unravel the mechanisms enabling the multiplicity of actors to converge towards common aims and stabilized relationships in an innovation ecosystem. In order to fill this gap, our work aims at investigate the emerging of coordinated and collective actions promoted by differentiated actors around a common issue. We analyzed the collaborative mechanisms at the basis of the settlement of an innovation ecosystem. More specifically the focus is on practices and their elements - activities, competences, goals, tools, and so on (Schatzki et al., 2001) - promoting the collaboration for innovation and the mechanisms of integration that they employ. To address this aim we look at the potentiality of contributions grounded within the strand of recent conceptualization of practice-based studies. Practice scholars see the practices - nor an individual or an organization - as unit of analysis of organizational and business phenomena (Gherardi 2000; 2001; 2008). The practices are stated to be 'a way of doing' embedded in a social cultural context where interlinked subjective (actors) and objective elements (resources, tools, meanings, language, and so on) are strictly intermeshed (Schatzki et al., 2001; Brown and Duguid, 2001; Gherardi, 2008). More in detail we explore the contribution of those scholars who use the practice lens to explain and understand the mechanisms of collaboration within and between groups, organizations and communities. Many of these studies address only marginally the innovation issues and the collaborative way to join and manage efforts in innovation activity. However by directing the focus on how actors collaboratively practice to address innovation in a networking context we aim to bridge the business and management literature on innovation with the practice studies and to illustrate more in-depth which mechanisms are at the basis of collaborative practices in a networking innovation. The paper is structured as follows. After addressing collaborative activities in innovation from the management and business perspectives the paper opens up at the contribution of practice-based theory to collaboration. The methodology section introduces our empirical setting and method. Then we illustrated the collaborative practices around the issue of establishing a new ecosystem for innovation in cultural heritage value system – the DATaBenC district. We identified the focus on emergent ecosystems as essential for understanding the process by which a multiplicity of actors collaborate on the basis of peer-to-peer relationships in order to establish and enact ecosystem activities and act collectively as a member of an ecosystem. By bringing the concepts and ideas from business management and practice theories and going through empirical results we contribute to identify a set of practices and actions as starting point of analysis to understand how collaboration allows the emerging of an innovation ecosystem. Finally, we articulate the implications on the need to combine managerial and social perspectives both theoretically and empirically.

THEORETICAL FRAMEWORK

Business and Network Perspective on Collaboration

The emergence of issues related to the fundamental questions of "why" and "how" networks origin has been earlier addressed in the context of business (Moore 1996; Iansiti and Levien, 2004) and network strategy fields (Blomqvist and Levy, 2006; Möller and Svahn, 2009). Network initiation and change are seen as created by mobilization of one or few main actors, which are more likely to occur in addressing new and uncertainty efforts (viz. innovation) when an opportunity is recognized by a large number of actors (Ritter et al., 2004; Möller, 2010). The focus is on dynamic processes of forming groups for the pursuit of an organization's main goals (Nooteboom 2004, 2009). The organization takes the lead of the network when it is more proficient in interactively shaping and developing the rules that constitute and govern its relationships with others (Möller and Svahn, 2009). According to the business ecosystem literature, the strategy of a keystone is at the core of construction of network (Moore 1993, 1996). This can be defined as a strategy that the main actor (keystone) proactively shapes an innovation network, controls its health and benefits the performance of the organization by investing in capabilities, programs, tools, platforms and technologies that tie the network together (Iansiti and Levien, 2004). The core components of an effective keystone strategy are to facilitate value creation and share most of the value with others in the ecosystem. The key points or activities of a keystone are summarized as follows (Iansiti and Levien, 2004): build and share high-value common assets; promote and improve the innovation capabilities of the ecosystem; share value and keep some of the value for itself; promote competition and selecting the most valuable partners. All these activities are expected to improve the efficiency of managing the ecosystem and promote the evolution of ecosystem in a way to support its sustainability. From a different point of view other scholars provide evidence of more interconnected and dynamic relationships the organization experiences by being embedded in a complex innovation network. In an innovation network the dynamic at the basis of the emerging relationships is assumed to be placed on the conscious and explicit creation of new knowledge and activity (Möller and Rajala, 2007) with all different forms of resources, competences and activities flowing through the threads and nodes of the network itself. The dynamic aspect emerges as a specific feature of network scholars (Ritter et al., 2004; Möller, 2010) and it is quite far from the business ecosystem concept of network more tightly aligned around a new product/service by a specific shared profit goal. Diverse collaborative mechanisms are linked to innovation and organization performance in networking contexts. One of these mechanisms is the activation of relevant capabilities to manage and coordinate network (Dhanaraj and Parkhe, 2006; Hallikas et al., 2009). Johanson and Ford (1999) empirical study of five organizations have provided a starting point that this coordination capability is particularly relevant over time. They have described collaboration emerging from a wider set of activities including: identifying/selecting partners, mobilizing, and timing, assigning (human resources), informing, synchronizing, and co-coordinating. The authors also have shed some more light about the nature of some of the activities - most notably informing, identifying/selecting and assigning - as largely one-directional, i.e. the perspective is too much on the actions of the focal organization rather than on the interactions. Others authors have furthered the role of coordination or orchestrator (Heikkinen and Tähtinen, 2006) and have discussed it in term of capacity to support absorptive competences among the network actors, fostering articulation and codification of tacit knowledge when it is reasonable and possible, and developing long-term inter-organization relationships and network vision and identities for all members (Hurmelinna-Laukkanen and Natti, 2008). Dhanaraj and Parkhe (2006) have also joined this debate by dealing with orchestration as the ability to mobilize and manage diverse participants over time. Three basic and interactive categories of activities have been identified at the basis of orchestration capability. They are: articulating, dealing with the vision development and the search of relative technology, knowledge and other resources needed; network composition, including the scanning, filtering and matchmaking of new partners to access to missing resources; management, as the widest category of activities covering the enhancing of transparency, fostering reciprocity, building trust, monitoring progress, identifying problems, promoting mutual learning, and conflicts resolution. The point is that the highest-performing innovation networks mobilized different partners over time to make ties to new types of partners as new strategic imperatives emerge (Möller and Rajala, 2007). Moreover according to Story et al. (2011) networking innovations also deal with the creation of different membership role for each organization involved in a network. The authors have identified three main network-oriented roles, tagged as connecting roles, integrating roles and endorsing roles as needed to support and promote the innovation competences and innovation development in a network setting. Also service logic of innovation (Michel et al., 2008; Ordanini and Parasuraman, 2011; Lusch and Nambisan, 2012) has addressed mobilization in Actors-to-Actors or ecosystem view. In these contributions the focus is on resources that could be combined by a more collective action. Inspired by Normann (2001), Lusch and Nambisan (2012) have stated that enhancing the maximum density, i.e. the best combination of resources mobilized for a particular situation – is in the goal of service platform for innovation. Drawing on the ideas of modular structure the service platform combines tangible and intangible resources created in order to cope with a collectively perceived and

shared issue. The ultimate goal of a service platform is to reinforce its members' abilities in resource integration and to produce collective benefit within the potentiality of combined resources to create something new and better overall the network.

Practice-Based Perspective and Collaboration

The theoretical background of practice-based studies is vast and has a long tradition in philosophy and in sociology tradition (Gherardi, 2000). Recently different and numerous research domains have joined the practice approach including organization and learning (Gherardi, 2000), strategy (Whittington, 2003), leadership (Carroll et al., 2008), design (Kimbell, 2009), marketing (Skålén and Hackley, 2011), and innovation (Dougherty, 2004). However the variety of streams is so wide that it is not possible to identify a unified concept and tradition in the practice-based approach (Gherardi, 2008). Notwithstanding, a common characteristic in practice-based studies can be found as they are multidisciplinary in their search for a non-rational-cognitive view of organization and business phenomena. According to Corradi et al. (2010) in determining a point of departure for the so-called practice turn (Schatzki et al., 2001) we can go behind to Lave's and Wenger's (1991) social learning perspective and their meaningful concept of community of practices (CoP). The notion of communities of practice is useful in breaking down from a cognitive and individual vision of organization and learning and to move towards a social and situated perspective of organization and organizational learning. Corradi et al. (2010) note:

> *The CoP can be conceived as a form of a self-organization which corresponds neither to organizational boundaries nor to a friendship groups. It is based on sociality among practitioners and on the sharing of practical activities. Sociality is the dimension within which interdependence arise among people engaged in the same practices (page 267).*

The CoP has been recognized to provide new meaningful insights as the plurality of news concepts they conveyed, viz. the *situatedness* and the sociality of knowledge process, the central importance of working activities as locus of the knowing process, the existence of collective identities and the assumption about doing as the only way to become a practitioner (Brown and Duguid, 2001). Knowledge is seen as integrated and distributed in the life of the community and doing is an act of learning and belonging as depending on a competent and recognized participation in a community. Wenger et al. (2002) stated the emergence of personal relationships and ways of interacting in a community of practice, together with a sense of identity. Moreover, Wenger (2000) has already provided a more complex definition of what belonging and participating mean in the strand of practice studies. The author has distinguished between three modes of being part of a social (learning) system, viz. "engagement" (doing things together, talking, producing artifact), "imagination" (constructing an image of ourselves, our communities and of the world in order to orient ourselves, reflect on situations and explore the possibility) and "alignment" (making sure that local activities are sufficiently aligned with other processes so that they can be effective beyond practitioner's own engagement). The concept of alignment is further explained by Wenger (2000) in detailing that it is *not as a one-way of submitting to external authority, but as a mutual process of coordinating perspectives, interpretations and actions to realize higher goals (page 228).* The identity issue has also contented by authors who claim for the reverse concepts of practices of communities (Brown and Duguid, 2001; Nicolini et al., 2003) and similar terms as the constellation of practices (Gherardi and Nicolini, 2002). It has been stated that individuals belong to more than one community with their own standards and modes of justification (Carlile, 2004) and that is not the community that pre-exist to its activities but the activities themselves generate a community when they are joined by different actors (Gherardi and Nicolini, 2002; Gherardi, 2009). In this sense the activities shape the glue which holds together a configuration of people in doing together and their social relations. Gherardi (2009) provides a more compelling definition of the practices to capture such complexity. She sees the practices as *the loci of learning, of the performance of a social knowing, of contingent rationality and as mechanism ordering resources for action* (Gherardi, 2009, page 356). Also Nicolini (2011) notes that the practice continuously changes, expands, and evolves. A dialectical mediated process of learning takes place as related not only to individuals in framing their understanding with practices, but also involving a dialectic process in a nexus of practices and a negotiation on established practices and knowledge, symbols, artifacts and mediated objects (Geiger and Kepler, 2009). The relevance of practices of communities' contributions depends on their role in trying to develop a notion of practices as they unfold and focus on how it is reaching novel practices that are not yet established. In this sense Bjørkeng et al. (2009) investigated an alliance program based on a public-private partnership and suggested three important mechanisms in the becoming of a practice. The first mechanism is the "authoring boundaries" that means the processes by which activities are constructed as legitimate part of practicing; the second one is the "negotiating competences processes" by which practicing and practitioners are constructed as competent; and the third "adapting materiality processes" by which material configurations are enacted and entangled in practicing and constructed as essential elements of a practice. In a different way Orlikowsky (2002, 2006) in highlighting the essential role of human action in the knowing in practice perspective has provided some preliminary results in understanding how to get things done in a complex organizational working context. She has interpreted the findings of an empirical study conducted in a geographically dispersed high-tech organization and has identified a complex repertoire of practices,

activities and knowing that generate and sustain a collective competence in distributed organizations. The categorization of practices includes: 1) sharing identity (maintaining coherence, commitment, and continuity across the multiple priorities and interests), 2) interacting face-to-face, 3) align efforts, 4) learning-by-doing, and 5) supporting participation. In debating these practices the author depicted them as overlapping and interacting at the same time and over the time in constituting practices through situated and shared actions.

AIM

We derived two important conclusions from the previous literature review. Firstly business and ecosystem researches have a preeminent focus on the manageability of ecosystem and on how to strategize for its sustainability (Moore, 1996; Iansiti and Levien, 2004). In these research approaches the collaboration taking place among a highly differentiate network of actors is addressed mainly by the perspective of hub or main focal actor. This actor strives for build on an environment conducive to value and opportunities for itself and other actors involved. Secondly the practice-based studies (Gherardi, 2000) take into account a more collective perspective. CoP and its reverse concept (practices of communities) represent an ideal type of how ties emerge collectively from a multiplicity of actors joining an organization on the basis of a mutual engagement and a shared repertoire of resources including languages, routines, artifacts, concepts, discourses, and stories (Wenger, 2000; Brown and Duguid, 2001). Often these collaborative efforts are seen as taken for granted action in bounded or purposeful groups of actors who produce and reproduce well established practices (Gherardi, 2008). When the emerging of novel practice is investigated it is often understood in a context of specific and often time-based purposeful project (Orlikowsky, 2002, Bjørkeng et al., 2009). How collaborative efforts emerge, and how they shape networks of intricate relationships overcoming the boundaries to create new communities is not in-depth investigated neither are the managerial implications of these efforts. By dealing with shortcomings of both business management and practice-based theories and striving in the efforts towards an integrated framework we next explore empirically the practices - or the way of doing - of actors who collaboratively contribute in shaping an innovation ecosystem. We aim to analyze how the innovation ecosystem emerges through the collaborative practices. More in detail we want to know how practices unfold the collaborative efforts of a multiplicity of actors in organizing and ordering collaboratively resources for actions in an emerging community.

RESEARCH STUDY

Method

Underpinning the findings presented in this paper is a qualitative and longitudinal action research study (Ramos, 2002) of an emerging innovation ecosystem. More in detail the case involves a multiplicity of active actors setting up the new technologic district in the cultural heritage scenario named DATaBenC (High Technology District for Cultural Heritage). As it regards the research method, our choice to follow an action research study depends on the features of the topic, as this methodology is useful to depict contexts in which relationships among different actors, the system they compose and their perspectives have to be highlighted (Burns, 2006). DATaBenC is a project launched at the end of the 2011 to provide a strategic support to cultural and environmental heritage of one of Southern Italy region, namely Campania. The linkages to territory are one more reason supporting our choice of the research context, as practice of communities has a positive effect on resources generation and cost-effectiveness in local contexts (Fiszbein, 1997; Lazzaretti, 2008; Lazzaretti et al., 2012). To follow action research method we chose to conduct a participatory action research study (Greenwood et al., 1993). This specific method has the predominant emphasis on genuinely involving and researching with the participants of a community (Hou and Pong, 2006) and presented a number of advantages for investigating phenomena in this case study context (Greenwood et al., 1993). From the researcher perspective this methodology fits with the needs and the importance of sense making, in particular when changes are happening during the observation period (Burns, 2006). This method is suitable for contexts in which professional social researchers operate as collaborators with members of organizations, groups or communities in studying and transforming those groups or to support them in “seeking to improve their situation” (Ramos, 2002, p. 1). This method also proves its usefulness in targeting both individual and group levels to prompt social changes and it has an expansive focus on collective participation and way of doing together (Ramos, 2002). Finally an action research methodology has a simultaneous focus on developing practical social changes and in developing and refining theory (Greenwood et al., 1993). Moreover the investigated context is strictly connected to

innovation and to collaborative innovation; our methodological choice can be confirmed as suitable by taking into account the research on innovation in networks carried on by Schwabe and Krcmar (2000) thanks to action research. Consequently, the participatory action research methodology provides a broader (as in number of participant investigators) and deeper (as in the cooperative opportunity to collect rich data) insights into the realm of practices in the investigated ecosystem. The steps of our research are aligned with methodological suggestions (Burns, 2006) and they contain both "building and evaluation" in the same process (Jarvinen, 2000). Empirical data was accumulated over 12 months (from July 2012 to July 2013 through undertaking multiple observations and through participation in plenary project meetings and brainstorming sessions related both to the whole set of partners and to teams resulting from the projects. We augmented data with information from serial semi-structured interviews and feedback sessions with the key actors; working sessions and workshop were organized in this sense too, with the researcher carrying on them; documentations reviews provided additional insights for our data analysis. It is useful to underline how these steps shape methods linkable both to qualitative research in its classical meaning, like participant observation and interviews, and to other methods more fitting with action research like inquiry groups (Burns, 2006). The transcripts of the interviews, working reports and all qualitative data collected were scrutinized for identifying patterns and recurring themes by all researchers involved in this paper. Then, the approach of Jarvensivu and Tornroos (2010) served to code data. The researchers identified the practices of collaboration as constructed by actors in setting up ecosystems, as well as, the elements related to the practices themselves. The identification of these elements took place thanks to a common analysis by all researchers of the empirical materials. We identified three practices and labeled them according to the common language emerging during the cooperative sourcing and analyzing of data research (Jarvensivu and Tornroos, 2010). These categories indicate a common way of doing, with shared language and similar set of actions and tools. The authors reviewed categories and discussed them in working session with participants to determine what further data collection was useful to provide a full description of the practices. The iterative process continued until the description of the practices was accurate.

Research context: The DATaBenC District

DATaBenC is a project launched at the end of the 2011 to provide a strategic support to cultural and environmental heritage of Campania Region. Public funding opportunity had been presented through a public call by Ministry of University and Research to support interventions about cultural heritage thanks to European Union plans. Two universities from Southern Italy made a proposal focused on a poorly protected, underestimated and almost badly-communicated heritage of Campania, by defining the necessity of an integrated system approach. The universities performed an analysis of the cultural heritage context, by underlining its features, the state of conservation, the gaps to be filled and the intervention to be performed to safeguard it. In the same time they focused on the resources available in the area and a gap in innovation capabilities emerged, but the area had a potential because of knowledge, capabilities, and education, especially in relation to the cultural heritage domain. The proposal to the Ministry is helpful to fill the gap about financial resources and to support the creation of new relationships, like partnerships and highly specialized districts.

The proposal submitted to the Ministry was shaped by four main objects:

1) strengthen the cultural identity and image of Campania Region;
2) define interventions to promote cultural heritage offering in an international context;
3) plan events based on service experience logic to increase users' inclusion;
4) increase the collaborations between the public sector and the business context.

DATaBenC wants to affirm that culture is able to generate creative and innovative processes for the development of local cultural and economic systems, in an integrated and sustainable way. The integrated approach is based on innovation as a network approach. This perspective depends on a multi-stakeholder vision of the innovating process, favored by the public-private partnership. Three research domains emerged from DATaBenC, and they are based on the features of the local context, leading to their testing in some projects to understand their suitability in supporting ideas on cultural heritage. Firstly integrated knowledge is a necessary and basic step as the actors have to know cultural heritage to be safeguarded before acting; the safeguard system has to be cognitive, thus it has to be based on mapping, risk assessment, education and divulgation itineraries. Secondly the diagnostic monitoring is needed to define a road towards a sustainable approach, by analyzing the present conditions of the cultural sites and by testing the effects of the pressures arising from different ways of usage on them; the finality of this research stream are defining analysis, testing and assessing the impacts of both touristic and other activities on cultural heritage. By summing up the conservation is based on data collection and elaboration and on human and environmental information. Finally the users' interventions have to be set in a sustainable way and the usage of technology is considered as a necessary support; ICT tools are defined as suitable ways supporting fruition and to improve the quality of services leading to higher levels of satisfaction. This third set of activities is expected to be performed through virtual platforms, apps, and other digital tools, as they favor an interactive approach to the interaction for the users, by combining physical features and virtual contents. The approach led through ICT is confirmed by the choice

of partners too; ICT instruments are considered as the pillar shaping an interactive context in cultural heritage services. Moreover DATaBenC aims to safeguard cultural heritage through them and thanks to the common interventions of all partners addressed and to a wide range of subjects directly and indirectly linked to the knowledge-based economy.

THE PRACTICES OF COLLABORATION

We depicted practices on the basis of the suggestions offered by our literature review and by defining them into the research context we chose, namely DATaBenC district. Three practices emerge from the above cited approach and for each of them we described the "what" (the path to be followed to achieve the aims connected to it), the "how" (the ways the aims can be achieved), the "who" (the actors involved in the practice, with particular reference to the role they have in it), the "why" (the consequences emerging from the emergence of the previous elements), and the "what for" (the outcome of each practice thanks to the integration of the previous elements).

Table 1: Summary of practices of collaboration and their elements (authors' elaboration)

Practice	What	How	Who	Why	What for
Setting the set	To connect, involve, and select partners	Call for contribution, plenary sessions, working group	Two proposers (2 universities) and the related networks to be involved	To define the general context as a set of relationship useful to achieve the aims	From actors involvement to actors really engaged
Setting the identity	To negotiate aims, define the ecosystem	Plenary sessions, focus groups, brainstorming	The proposers and the partners previously selected, as actors shaping the ecosystem	To share objectives, define the ecosystem identity and actors' identity in it	Creation of corporations Depiction of four projects
Setting the actions	To articulate objectives in specific actions and set the teams to achieve the aims	Restricted sessions, team meetings	Groups belonging to projects and teams belonging to groups, to work together in the actions shaping the objectives	To describe the workability of the ecosystem and the relationships among teams	Definition of roles, responsibilities, time, and costs of each actions to arrange deployment and monitoring

Setting the Set

When describing the "setting the set" practice we depict the elements necessary to describe the general context hosting a series of relationships aiming to the achievement of the predefined aims. This practice is led by the two proponents and is based on connecting partners, involving them and shaping ties towards common aims. The expected results are defined, leading to a self-selection of the partners. After the acceptance of the proposal the DATaBenC project officially started and a network was set up, aiming to focus its resources on a cognitive-relational high technology program, capable of generating a significant socio-economic value, locally, nationally and internationally, with the creation of new enterprises (spin-offs, start-ups), new professionals, advanced training, and the skilled use of knowledge (patents, know-how). The DATaBenC aims to integrate heterogeneous routes of research-education-innovation, to act as a sustainable growth engine, by creating a synergy between the various knowledge, skills and regional relations, and pursuing the common goal of conservation and enhancing of the regional cultural heritage: territories, sites, assets, and activities. The two universities involved in the proposal started connecting actors to operate on the basis of the general aims and in order to develop the necessary set of relationships in the area, especially to fill a gap in strategies about cultural heritage, environment, and tourism to safeguard the wide set of resources of the region in an integrated approach. The focus on territory is necessary as the funding procedure was just addressed to some areas of the Southern Italy. The two universities kicked off DATaBenC by connecting actors as potential partners of the project, in line with the aims highlighted in the proposal to the Ministry presented above. The way they chose to involve partner was a call addressed to their research and business networks, in order to create a set based on the contemporary availability of several kinds of resources. At the beginning more than 150 actors showed their interest in taking part to this context, but time by

time different selections took place, as we will underline in the following lines. DATaBenC was chosen as a suitable way to aggregate actors as it favors ties among several actors, like organizations, universities, research centers, laboratories, consortia, and users too. In this wide range of actors, even some other partners (e.g. Italian Employers' Confederation) had an important role, even if previous relationships acted as a filter in participating, because of different or unaligned interests and logics. Brainstorming and round tables were the most common ways of interaction in this part of the project, leading to a cooperative selection of the actors and to their engagement in the community. Apart from the actors leaving the project as soon as they crashed in competitors or in unwanted linkages, other ones decided to focus on the resources needed to decide if they can join the project and support its development and deployment. Hence the setting is composed by crossing different industries associated one another because of their ties to cultural heritage, both in an immaterial and in a material meaning, to favor the development of ideas to be performed together. The specialization of each industry is in focus anymore, but the combination of each specialization is crucial to draw the path towards the achievement of integrated knowledge, diagnostic monitoring and sustainable usage of the cultural heritage, namely the three research domains showed above. The network was being built through a competence-based approach, as the actors have to be aligned with the necessary competences. This leads to the involvement of a high number of subjects, namely about 70, showing two features: the availability of resources and the willingness to share them with other actors joining DATaBenC. The actors congruent with the two above cited characteristics are less than 50% of the whole number taking part to the in-progress context at the beginning.

Setting the Identity

This practice is useful to deepen the identity of the context shaped by actors, relationships, aims and overall interests shared by all kind of actors involved. Moreover each actor defines its own identity in the community, by shaping it in line with the conceived projects and the resulting ties. Projects are relevant as they represent the empirical context to test how the aims shaping the proposal can be achieved. Hence the three projects are connected to experimenting areas that respectively are museums, historical centers, and archaeological parks, whilst the fourth provides the ICT services to all of them and collect all data emerging from the projects to better understand the subjects depicting the context. Finally this practice led to the definition of a knowledge- and competence-based ecosystem, aiming to define a set of actors supporting innovation. DATaBenC is shaped thanks to a wide range of actors, both from different organizations and independent actors of the same business as it was described in the first practice, depicting a setting built around competences and knowledge requirements. Indeed this set can be referred to as an ecosystem because of the common interests and efforts in making all members aware of the potential contributions arising from their participation to support cultural heritage safeguard. This aim can be approached through the formulation and the development of "context-aware" services, viz. services oriented to the features of the surrounding context. Context-aware services can be conceived and provided through the most recent ICT, viz. cloud computing and participatory sensing, to make cultural heritage usable in a better way. The ecosystem aims to define standards aligned to the "future internet", to convey knowledge on the basis of each specific users, even by making cultural sites profitable in a full way, namely by taking into consideration the context. Moreover users' activities in relation to cultural sites can be tracked to improve services provided thanks to new sensorial approaches, leading to new information. The 69 actors taking part to DATaBenC increased the number of gatherings in this phase, by having plenary sessions, meetings focused on specific aims to going deeper in defining the interests of the district and in creating workgroups properly shaped towards the established aims. The relations inside the district have to be defined even in a legal framework, so a legal status had to be chosen. The meetings lead to the necessity of creating an association based on limited responsibility in a cooperating approach; this kind of legal status is known in Italy as Limited Liability Consortium. The competence-based approach led to the identification of three main areas of interest, viz. ICT, restoration, and cultural heritage use. So three Limited Liability Consortia were created and SMEs, research units, and consortia took part to them. By the way conflicts emerged as big organizations did not want to take part to these aggregations; in order to solve these problems a fourth Limited Liability Consortium was created, grouping the big organizations and the three Limited Liability Consortia. The public-private partnership approach shaped in the above described way played a crucial role in defining specialized teams and coordinating mechanisms to make provisions for a fully functional context. The key partners for these two tasks were the consortium of restoration organizations, the ICT providers, the technology transfer experts, the consortium of computer devices, and the departments of the research centers. It is interesting to underline how teams have been defined; during a series of focus groups involving all partners the projects were deeply analyzed to define how competences have to be mixed to accomplish the expected aims. This intersection between competences and projects led to the set up of different teams and moreover to arrange coordinating mechanisms, supporting the workability of the community. One more result of this focus on competences needed in projects is the emergence of some conflicts among organizations. They have decided to leave the community first of all as they compare the needed resources with the available ones and perceive a gap. Some other organizations decided to leave DATaBenC

due to how they perceived themselves in the frame shaped by the projects, viz. with a different vision from the expected one or because of difficulties occurred in their own business from a financial point of view. Thanks to the debate on projects and competences the aims were properly defined and they can be summarized with reference to knowledge-based services, monitoring and cultural heritage, viz. the three research streams of the proposal. These aims lead to the collective definition of four main projects to achieve the planned aims. When depicting projects the organizations defined their identity inside the resulting ecosystem, as they chose which of the projects can benefit by the resources they carry and this is the reason why one more selection took place. Projects play one more fundamental role, as they act as testing areas for the contracted aims. Finally the ecosystem concept is useful to focus both on actors shaping it as partner in the project and on actors perceiving benefits from it. The cultural heritage is totally taken into account in the ecosystem through a smart and digital approach to it.

Setting the Actions

In this third practice we portray how the aims are expected to take place through a detailed focus on the actions and on actors' contributions. We even describe how teams are built in a knowledge-based approach and how these teams work together apart from their belongingness to a specific project, as mixing and matching competences are continuously working mechanisms, managed by project leaders, acting as coordinators. The definition of the projects in the above depicted practice is not enough to lead to the workability of the community, first of all to understand how to achieve the common aims related to projects implementation, to define suitable knowledge management models, and to conceive and apply integrated knowledge platforms. In order to define the ways in which the district can operate by making leverage on the wide set of available resources, knowledge, and relationships created, actions have to be defined. This can be done by starting from the four projects; first of all they are all organized in the same way and on two levels as a result of negotiation among the partners in specific meetings involving each time a lower number of partners, due to the focus on specialization. When organizing the projects firstly the "Objectives" are described, and ten objectives are used to articulate each project. Secondly the objectives are structured in actions, linked one another. In this case the articulation can be different from an objective to another, due to the features of each action to be performed. The knowledge emerges once more in focus as the actions are described by considering knowledge and resources and by looking at the matching between what is needed and what is available for each partner. The process here described takes place thanks to a structured data sheet. It is built on the basis of the funding institutions suggestions for this kind of projects, but the ecosystem actors in a couple of meetings decided to modify it in order to better describe the contribution each actor can give to the objectives in relation to the actions to be accomplished. This document collects a series of information for each of the actions shaping an objective; first of all the actor in charge is defined, to coordinate the actions of the other subjects. This action is not performed by a big organization, but a specialization on a resource or on a research domain is the way to define this task. Secondly the supporting actors are focused, to create a team built in a properly way as it regards competences and resources favoring the achievement of the tasks of each activity. Thirdly the expected time and the costs are defined, to prearrange the monitoring activity to be made when the actions will be in progress. Finally the impact of the research activity is compared with the one of the industrial activity to be compliant with the kind of contribution required to each actor. This way of organizing the actions makes it necessary to build a specific team as many times as many detailed aims there are. Once again this approach shows a deep focus on knowledge. By the way teams are still interlinked one another, so the resulting ecosystem can be described as a series of groups, and groups are composed by teams. Organizations belong to teams, but they are linked both to organizations shaping close teams and to organizations taking part to other groups in the ecosystem.

CONCLUSIONS AND IMPLICATIONS

Our study opens up the business literature on networking innovation to the underexplored concept of practices and contributes to the emerging concept of ecosystem innovations in three main aspects. Firstly our study proves the usefulness in studying innovation ecosystem issues by looking at practice or better to a nexus of interconnected practices (Nicolini 2011), as unit of analysis instead of single organization or a network. Our research confirms that innovation is not created by governed and purposeful interactions among one main actor and its surrounding context. Instead it is a more emergent and negotiated process triggered by opportunities and uncertainties that a multiplicity of actors attempt to grasp by acting collaboratively. What becomes evident is that innovation is sustained and created in multiple interactions and social practices (Gherardi 2006, 2008). This contributes to shift the focus away from the consideration of the more static idea of structured networks of relationships within which actors have a unique and fixed role and positioning. The DATaBenC innovation community emerges as a form of orchestrating activities to which each actor contributes by providing opportunities and support for each other innovation goals (Orlikowski, 2006). The focus is shifted from strategy and competences of a single organization or a main actor to

the set of interrelated practices where the working and doing takes place in ongoing collaborative efforts to organize resources and actions to better meet the future needs. As second result a set of three collaborative practices is identified. These practices work as a sort of pick-lock to unravel mechanisms at the basis of constitution of new innovation ecosystem. The first practice we named "Setting the set" encapsulated the collaborative efforts to frame the set of actors setting up the DATaBenC innovation context. To build a sense of relatedness among all partners is the main content of this practice. The key question has been posed not by the business management perspective of the focal organization reasoning on who could be involved and mobilized for what, by what. And at the same time this practice includes not only issues of the engagement as stated by Wenger (2000). Instead it is more based on complex and negotiated sets of activities which hold together the configuration of actors, artifacts and social relations (Nicolini, 2011). Among these activities a great part of attempts concerns the knowledge flow and great efforts involve the partners into learning how to search for relevant members and each other knowledge bases. Collective mechanisms involve the process of eliciting competences with partners who evaluate each others as well as competences sharing processes become crucial to allow the setting up of the set (Wenger, 2000). Whether this process is perceived positively depends on a significant interaction and recognition between knowledge holders in their specific activities. Some actors such as university partners lay a sensitive role in the promotion of conscious interactions among actors, which draw partners into a deeper sense of their relatedness to each other (Nicolini, 2011). Relying on their knowledge of who knows who, the actors view each other as a partner to be engaged with in purposeful collaboration and to co-evolve together. Furthermore it has been argued that practices are in fact not only what the people do but are firstly the *loci* where entities come together and secondly the context in which meaning construction helps in recognizing one another that its practices are identity-forming and strategy setting activities (Wenger, 2000). In this sense we named "setting identity" the second practice; it addresses one of the main issues posited by scholars of practices. The key question as stated by Wenger (2000) is the need of practitioners to construct an image of ourselves, of the groups, and of the world in order to orient them, reflect on situation and explore the possibility. But it becomes evident as the identity building process emerges collectively as the attention of practitioners is directed at negotiated interests and aims. This process relies on the continuous evaluation and construction among the involved partners of what makes relevance in the context of practices and how to address these aims. Also the progress of knowledge integration at the boundaries of different projects is a specific result of this practice. In this case the attention is directed at the possibility to integrate competences, tools and meanings; parallel to this a wider knowledge basis is enacted in the collaborative context. The ecosystem identity comes from a continuous reasoning processes (Gherardi, 2008; Geiger and Kepler, 2009) involving actors in defining and negotiating aims, setting the projects and making explicit their contribution. This practice contributes to making a collective sense of the value and they foster a sense of ecosystem as partners recognize the need to be involved and dedicated to a new and wider project. It provides an accountable link, therefore, between the individual actors, members and the wider ecosystem context, and it provides a setting in which a collaborative practice emerges as a function of this link. The importance of depicting the identity of a community lies in the recognition that each actor's role is not fixed and pre-given, that knowledge does not pre-exist actions, and that innovation develops by contextually enact knowledge and competences in a collaborative organizing activities (Nicolini, 2011). Finally we defined the last practice as "setting the actions" as it enables actors in bringing together heterogeneous practices and resources in a multiple context of collaborative actions and it gives continuity to interactions and sensing about the set and the identity of the innovation community. Although this practice is framed within the more formal projects established by DATaBenC the "setting the action" arranges, matches and combines all resources in an affordable pattern. Rather than prescribing the tasks to perform according to a rigid structure that needs to be adhered to, this practice works as a call for collective actions to be developed. The actions of all partners are arranged on the well-connectedness of different resources bases, and collective knowledge emerges by the shared context of practical working interactions and collaboration. Toward this end, knowledge and artifacts are managed to be adapted to the partners' needs and constraints without ignoring the need to make them robust enough to establish a common point of reference among the partners. Finally concentrating on the idea of ecosystem innovation that emerges by the interplay of a nexus of three collaborative practices our work wants also to contribute to bridge the gap between management and practice-based literature. Our work provides insight on how an innovation ecosystem can capitalize and build its potentiality on its wide set of resources by collectively organizing resources to actions. The collaborative practices open up to the definition of the innovation ecosystem strategy as a complex and multiple process dealing simultaneously with the emergent establishment of actors' set, social recognition and legitimating of actor's contribution and negotiating activities. These processes may involve resistance and conflicts as well as call for both emergent and planned approaches to ecosystems strategy. The in-depth understanding of these different learning mechanisms creates the understanding about management and organizational efforts. However, further examination is still needed to specify the ecosystem innovation strategy and also to gather empirical evidence to develop it even further.

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Living Labs for Smart Innovation: a User-centric Approach

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ABSTRACT

The paper aims to describe the notion of Living Labs, then to frame it in a particular kind of innovation, namely smart cities. These metropolitan and urban contexts are redefined as it regards the way in which they have to be managed and due to the services provision. When stakeholders take part to this context, they carry different resources, favoring the emergence of innovation as a product of resource integration. Due to this, managers have to create the conditions to enable the mixing of resources towards smart projects. In line with this choice we depicted the city managers decisional process favoring user intervention through a two-step investigation: firstly we had an overall examination of Living Labs in Europe; secondly we analyzed two of the empirical evidences different one another because of the kind of area they are referred to through reports published by the actor acting as key player in the process towards smart city, and direct interviews performed with city managers to better investigate some issues. The investigation led us to the definition of a series of activities to leverage user's involvement achieving resource integration to support smart cities projects through an innovation process mainly based on users contributions.

Keywords: Living Lab, User-centered Innovation, Smart City, Resource Integration

INTRODUCTION

Our research is addressed to investigate the usefulness of Living Labs in urban contexts and, more in detail, in cities approaching to *smartization*. These labs represent a particular inclusive methodology in defining innovative initiatives and particularly social innovation (UE-URBACT, 2011). Following the definition of the congruity of this perspective with smart cities finalities we want to depict the effects on innovation to be pursued by city managers through Living Labs. In the innovating process, Living Labs (LLs) are one of the paths to involve people, and in particular users (Almirall and Wareham, 2008); all actors are considered in the same way as contributors of this process, as they carry their experience, the resources they own and their personal beliefs in a set built to share towards a common aim. This kind of approach recalls the notion of resource integration, as a process designed and planned by managers (Badinelli, 2012) to achieve a goal. In this way a wider set of resources can be built, reaching the *density* as suggested by Normann and Ramirez (1993), viz. the best combination achievable thanks to the resources mobilized. The two authors highlighted the relevance of integration as a challenge for the new economy and to enlarge the knowledge base with continuity. A wider knowledge foundation can be embedded into an organization's offerings to improve them. The mix of resources deriving from several sources is tied to the idea of uniqueness too; this thought is taken into account as the knowledge arising from resource integration can be totally new (Hoyer et al., 2010) and useful in creating innovative goods or services. The results emerging from resource integration are relevant for organizations (Dholakia et al., 2009), no matter if they produce something already existing or they aim to get innovative outcomes. The usefulness of this mix of resources emerging is even linked to common benefits deriving for all actors involved, as they can use resources they can access to, instead of using resources they own (Badinelli, 2012). An organization's capability to become a collector of resources is itself a critical resource, especially

when it is referred to already existing sets of relationships (Möller, 2007). The resource collection is just the starting point towards the achievement of some results, as the resources put together need to be integrated towards the established and the emerging goals. Managing a resource integration process is a complex issue due to the difficulties in setting a context composed by dispersed actors (Möller, 2007). In managerial literature there are several – and even different one another – attempts to classify resources (Normann and Ramirez, 1993; Day, 1994; McColl-Kennedy et al., 2009) to be integrated and then used, but the links among resources, tools, and contextual conditions is what emerges. The usefulness of these linkages is expressed when taking into account the success attained by an actor, as it depends on quantity and quality of resources controlled (Anand and Khanna, 2000). In this domain the role of knowledge resources is highlighted as relevant, because learning aims are achieved thanks to the mixing of knowledge arising from joint ventures and alliances (Kogut, 2000). Such a combination can hardly be achieved in different ways, due to the mutual usefulness of different contributions. Hence the coordinating activity is pivotal and it can be performed by a single organization or by a set of organizations, acting as integrating actors; by the way the approach has to be *open* to avoid a strong centralization, as it usually leads to a great reduction in generating learning (March, 1991).

LITERATURE REVIEW ON LIVING LABS

Living Labs as contexts of innovation through integration

After summing up the characteristics of resource integration it is necessary to highlight some differences with LLs; in this latter, the context to collect resources is specifically defined and the procedures to combine are the basis to sustain actors' involvement (Muñiz and Schau, 2011) and to keep their engagement alive during the time, thanks to the "enthusiastic assistance" in helping other actors besides themselves (Dholakia et al., 2009). In a more general way the users' participation is enabled thanks to a kind of governance and a well defined structure (Almirall and Wareham, 2008). The linkages to the notions of governance and structure do not have to be considered as a limiting factor in the implementation of LLs in different contexts; the *open* approach and the enabling of interactions towards innovation are applicable in different fields. The support provided by ICT is crucial in enhancing the potential results achievable through LLs. More in detail the new technologies can prop up the collection of data (Cosgrave et al., 2013) and ideas, improve their mixing and optimize the results (Niitamo et al., 2006). The relevance of a LL emerges when considering its outcomes as a long-term resource for a set of actors, instead of just taking into account the results for a specific project. It has to become a way of thinking when approaching innovation, especially if contexts require the involvement of different actors. This logic is not enough spread in complex systems, as the coordinating actors usually define boundaries, aimed outcomes, and actors (Cosgrave et al., 2013). In this way the *openness* of the emerging system is not exploited since they do not use all the potential contributions emerging from unexpected actors or resources and from the resulting combinations. The role of coordinators is usually performed by an organization, a research centre, an institutional actor like a government body, or one or more organizations, but it is important to begin by combining the right resources to establish the lab and carry it on. As it regards this issue, central institutions like European Union often offer grants to favor the arrangement of this kind of milieu aiming to innovation. When the issues regarding funding are solved it is necessary to focus on the necessity to enhance the *openness* of the context, especially by applying the notion of cross-border innovation (Schaffers and Turkama, 2012). This typology of innovation set usually takes place when small actors perceive business opportunities from wide or international context they cannot reach as a stand-alone. The difficulties emerging from these contexts have been analyzed by Schaffers and Turkama (2012); these barriers are connected to market settings, language, culture, regulatory settings or other features calling for a support emerging from collaborations. These connections can emerge from the closer networks, leading to the definition of cross-border networks. This approach leads to collaboration among different LLs too, enabling the creation of innovation and new markets. The two literati above cited attained the definition of four major phases to establish relationships overcoming the existing borders; namely they are three: connecting, planning, and supporting, followed by the closing one linked to the outcomes. The first phase is necessary to identify the opportunities emerging from the business context, leading to the definition of the opportunities for innovation and to the subsequent identification of partners to collaborate with. The second part of the process goes deeper into relationships as roles and responsibilities are defined; in the same time the contracts about activities to be performed are signed to allow the beginning of activities. The third phase of this process is named *support* as the activities are performed to sustain the innovating process towards the aims. Finally the process is completed with the assessment of the achieved benefits and the emerging impacts from the activities performed in the network.

The settlement of the network is a relevant prerequisite to allow partners acting together towards common aims. The interaction environment can be shaped thanks to some elements linked to the actors and to their participation, as de-

fined by Bergvall-Kareborn and Stahlbröst (2009), as they underlined the role played by *openness*, *realism*, and *empowerment*; the *openness* is connected to the opportunity of including new users, and this is strictly linked to von Hippel thought (2005) on interdependent innovation development, as it depends on the contributions arising from several users. The *realism* means a focus on reality, both when considering users and when paying attention to life situations. Finally the *empowerment* is relevant as a way to get people motivated and so to lead to their engagement. This latter is usually a hard job to be performed (Ramaswamy and Gouillart, 2010) as organizations have to manage an intricate web of interactions linked one another towards the same aim and this often leads to generate conflicts. The cooperation performed by several actors in contributing to resources collection and combination can be better analyzed with reference to open innovation. More in detail the common actions to interact in combining resources lead to innovation communities (von Hippel, 2005), as these are contexts enabling a faster sharing process with a higher effectiveness. LLs are totally aligned with the described logic as they involve users in the innovation processes in a context shaped by different actors (Almirall and Wareham, 2008). These actors can be companies, research centers, public entities, and so on, and they all aim to create a platform allowing actors' involvement in an innovation process. Almirall and Wareham described these labs as the better place for open innovation, because the mutual agreement among actors lets all of them moving towards a common aim thanks to transversal activities. The carrying out of these activities is relevant to describe governance as the main difference between LLs and other open innovation arenas; this key feature appears as differently set in LLs as they depends on public private partnerships. When acting in this way, the potential actors from both private and public domains (Rothaermal and Thursby, 2005) can all be involved together with users (Almirall and Wareham, 2008).

Living Labs and smart cities

The description introduced above and built on some literati contributions shows the chance to create LLs to favor interventions in metropolitan areas and urban contexts, as the actors shaping these two kinds of contexts are so similar to the ones taking part to innovation. Private actors, public entities, and individuals are all influencing and influenced by this typology of cooperation. This consideration emerges as stakeholders participate with a relevant role in urban contexts, no matter of the characteristics of the space to be analysed, as urban areas are defined as "system of systems, (...) system of stakeholders" (Bélissent, 2010, p. 16). The reciprocal overlapping between innovation process and cities led to the definition of a LL as an "open research and innovation ecosystem" (FIREBALL, 2012) involving different actors, viz. stakeholders, to define ideas and scenarios, to assist a deeper analysis of local areas needs and to support policy makers. The so-called socio-emotional intelligence (Goleman, 2006) can be activated through this way of collaboration, leading to the chance of driving innovations (Cosgrave et al., 2013). As it regards LLs in urban areas we observed lots of literati contributions framing innovation in smart cities. The smart cities' notion emerged in about a decade by evolving from some previous and partial perspectives; thus in 2000 Hall focused on the digital city, as a context monitoring and integrating conditions of all of its critical infrastructures. A similar approach by Ishida (2002) added a specific reference to hardware components, and the evolution towards the notion of smart city went on by supplementing the software features to attain "social and human development (...) in a participative governance model" (Caragliu et al., 2009, p. 50). Thus hardware and software elements have been combined in a definition linked to the quality of life and the sustainability (Caragliu et al., 2009) by integrating three fundamental dimensions (technology, people, institutions) (Nam and Pardo, 2011).

One more focus on smart cities can be useful to underline how it is linked in literature to innovation, as Schaffers et al. (2011) underlined how the open innovation can support the provision of internet-enabled services to test interventions and to validate activities. Internet acts as the way to make involvement easier (Roy, 2005) and to activate interactions among all stakeholders. This way of thinking has been carried on even by literati working on the so-called helix models. Etzkowitz (2008) began this modelling about interactions when proposing the Triple helix describing the contemporary contributions by university, industry and government to favor innovation. Some years later the model was analyzed again in the revised triple-helix (Lombardi et al., 2011), with a deeper focus on innovation, defining the path towards the Quintuple helix (Carayannis et al., 2012) shaped by 5 systems named as: education system, economic system, natural system, media-based and culture-based public, political system. In line with previous considerations on resources collection and combination, the main advantage of an innovation approach in smart cities can be described as the mixing of digital skills, creativity and innovative models to facilitate the creation of linkages between technologies and the related applications (FIREBALL, 2012). Moreover this solution is helpful to support local administrators in relation to the shortage of public finances. As the implementation of the LLs was becoming relevant, some literati (Concilio et al., 2011) asked for a specific observatory, by underlining their importance in smart cities contexts. The approach proposed through these collaborative ecosystems is defined as a "user-centric approach" (Copenhagen Cleantech Cluster, 2012) as citizens are considered as the most relevant actors.

LLs have been implemented in different ways in smart cities, leading to some slightly different approaches, defined by European Union in its reports as *Citylabs* (Enemark and Kneeshaw, 2013) or *Social Living Labs* (UE-URBACT, 2011). The two definitions are useful to stress the contexts in which the innovation can perform effects and to underline the high relevance of social contributions and the results achievable for the social stakeholders. *Citylabs* are LLs contextualized in cities to support some kinds of investment, to enable local actors' participation and to favor the implementation of best practices arising from previous interventions in comparable areas. More in detail these labs emerge when interventions on mobility have to be performed, with particular reference to two concurrent aims. Firstly the necessity to support the development of smart logics connected to infrastructure building or their refurbishment, transport services, integration tolls, and multimodal transport. Stakeholders' contributions are connected to local plans to be defined, especially as it concerns the screening of mobility needs, the design of sustainable urban mobility plans, their subsequent implementation and the evaluation of process to feed the future improvement of plans. Secondly mobility acts like a set of interventions leading to improvement in other services and in other aspects in a city context, like energy consumption, environmental conditions, safety, and support to local businesses. *Social Living Labs* are different from the *Citylabs* because of their wider and more general approach to cities improvement. The idea of a *Social Living Lab* comes out from several needs, like the decrease of public finances, the demographic shrinking, and so on; due to these issues it would be hard to choose one of them to be challenged and forget about the other ones, thus a democratic and participative approach to them can be useful to integrate the problems and solve them with a more integrated approach. Public interests are first of all defined thanks to the intervention of citizens and stakeholders, then the features of the lab emerge: first of all a co-creation approach is required to build interactions addressed towards a mutual and contemporary involvement of citizens, local institutions and organizations. These interactions have to mobilize resources to be levered on for solutions; the proposals have to be framed into the existing vision of smart interventions and then implemented with a contemporary monitoring activity. The participation of a wide range of actors is needed to explore the context, as the knowledge hold by each subject has to be merged with other available data to map the areas asking for interventions. The solutions emerging thanks to a co-creation mindset and defined in the contexts highlighted through the exploration have to be tested before being launched; thus the experimentation is necessary to have a basic evaluation of the effects. This activity is a "trapdoor" for useless or low-effective projects or it acts like a "starting flag" for hopeful programs. Finally the evaluation of the interventions is done thanks to stakeholders' satisfaction and it allows higher level of attention on unsolved issues, even suggesting the areas asking for a new activation of the lab activities.

Living Labs towards a wider perspective

One wider perspective on LLs can be observed in connection to the concept of ecosystem, a notion widespread in various fields of study but recently it became more and more interesting even in management literature, with particular reference to innovation. Moore in the 90s coupled the issues of innovation and ecosystem to describe the set of actors, technologies, knowledge, skills, and context in which the cooperation aimed to innovation took place. Time by time more literati deepened this topic to depict innovation contexts in which the set of relationships is fruitful to innovate outside an organization's boundaries (Ketchen et al., 2007). More recently even in smart cities' research the idea of innovation ecosystem was applied, as the whole range of subjects involved in smart cities management shape an ecosystem, considered as an urban laboratory, and in a more detailed way an urban innovation ecosystem (FIREBALL, 2012). The idea of ecosystem connected to cities was already in some researches a few years ago thanks to Komninos (2002), but only after smart city notion had appeared the two topics were merged. Nowadays the same author (Komninos, 2011) defined a series of chances for smart city innovations to be achieved thanks to an ecosystem-based collaboration, in order to take into account all actors shaping the network of relationships in urban and metropolitan areas. In this way internet keeps its central role, but it becomes an instrument instead of being the main source of innovation; this role is now acquired by subjects of the open innovation context.

When considering such a wide range of stakeholders (Bifulco et al., 2014), it is necessary to understand which are the mechanism sustaining their willingness to participate or favoring their participation; the improvements aimed in smart city projects act as enablers of the engagement for citizens (Lee et al., 2013). The authors make even a connection between *openness* and engagement, by defining actions useful to assess services designed thanks to open platforms; in this approach citizens and communities act together with mutual influence in cooperating. A similar point of view is presented by Anttiroiko et al. (2013) as they confirmed the opportunities offered by cooperation to design smart city initiatives, but they even highlighted the existence of some activities to be performed by central actors of the ecosystem, due to the impact of some activities on local agencies costs. The ecosystem approach is sometimes linked to bigger territories too, as it happens when talking about regional interventions (Levén and Holmström, 2012) through technologies. Stakeholders in this larger perspective are interested in taking part to this context as they become part of an innovation ecosystem and they can acquire different resources. When considering organizations, the two authors stated knowledge is what they expect the most from this kind of context, so they offer

services to get a position in the ecosystem and the subsequent benefits in terms of knowledge. Finally there is one more version of LLs, known as *Territorial Living Labs*, aiming to get innovations in territories in a social perspective (Concilio et al., 2011). Territories acquired a new role, as they are considered as collector of social relationships and interactions. The key concept to describe *Territorial Living Labs* is the "strategic piloting", as a process to drive the whole setting towards innovation and on a larger area, in a system acting as a loop, because the activities can support the improvement of a territory, but it can increase social cohesion towards common aims related to innovation.

The emerging gap

As our literature review showed, the LLs approach is quite spread in innovation paths, and particularly in cities management, especially when referring to smart cities. All stakeholders play a fundamental role as they are carriers of different kind of resources, knowledge and experience, useful to fill the complex set of resources needed to move towards a smart innovation in cities and in their management. Hence, stakeholders have to be managed in a suitable way in order to favor their contribution to the so-called *smartization* process. The literati contributions we took into account in our review deeply described the contributions emerging from LLs and from the wide range of stakeholders shaping it, but research on the way to manage actors' involvement in LLs is far from being in-depth investigated. The necessity to make people involved in contexts like LLs is underlined in some contributions (West and Gallagher, 2006; Almirall and Wareham, 2008; Levén and Holmström, 2012) stating how an actor can decide to take part to these set of relationships when perceiving value from it. We aim to move from this gap to propose guidelines to deal with stakeholders taking part to LLs driving them towards a relevant and useful support. This intervention is helpful to provide an innovative way in managing cities during their approach to smart logic. Some similar approach took place just with reference to some specific field, like smart health services (Almirall and Wareham, 2009), ICT tools (Levén and Holmström, 2012) or in a more general way when describing the process to set up a LL (Levén and Holmström, 2012). A specific call for research on how to involve people in all potential usages of a LLs is presented in literature (Almirall and Wareham, 2008).

SMART INNOVATION IN CITIES MANAGEMENT

Research proposal

Starting from the above cited gap emerging from the literature review we want to depict in detail how actors' are involved in LLs aimed to support smart cities. In order to define this issue we firstly describe the innovation ecosystem shaped around LLs and the mechanisms shaping their workability. These characteristics will lead us towards a proposition of guidelines for city managers to involve people in smart cities' projects to make their participation fruitful due to uniqueness (Prahalad and Ramaswamy, 2004) of the resources they own and to the set of resources resulting from all actors sharing resources. In order to make our proposal we deeply analyzed the empirical evidences related to LLs all around Europe, to focus on the most important elements to get people engaged in the innovation contexts and to understand how the activities are performed when such a wide range of actors are combined in LLs. Moreover we investigated which the outcomes are emerging from each LLs, to facilitate the identification of the usefulness of this approach. After this first overview on empirical evidences from Europe to screen the phenomenon in a general way, we in-depth investigated two areas moving towards *smartization* through LLs, to understand the definition of cities to be involved and the deployment of this activity with the resulting achievable aims. The choice of the empirical contexts to perform our investigation is illustrated through the methodology approach we are about to describe in the next lines.

Methodology

We selected smart cities in which this way of creating an innovation ecosystem had been implemented in order to investigate and define the usefulness of this intervention and the way in which it performed its effects. The sources we used to make this selection were different and can be connected either to reports from European central institutions (Enemark and Kneeshaw, 2013), local agencies (ANCI, 2013), and to literati researches (Komninos, 2011, Schaffers and Turkama, 2012). First of all we depicted a list and a short description of LLs in Europe, and then we selected cities to be analyzed in depth on the basis of their territorial dimension and on their geographical position, in order to achieve a wider perspective from different evidences.

After listing the cases we developed an approach based on excellence (Yin, 2003) and we chose the LLs achieving the best results and the ones more enforced in the time. We based our research both on reports and on interviews

with actors directly involved in the implementation of LLs, in line with Denzin suggestions (1978) on triangulation.

Living Labs empirical evidences: a general overview in Europe

Many European cities have been involved in smart cities projects (European Parliament, 2014) and we have selected those one involved in LLs initiatives for the creation of an urban open innovation environment. In detail we have focused our attention on cities or territories in the EU member states that are broadly accepted as being the most committed in innovation policies and we have chosen 11 examples spread across Europe, from the North Sea to the Mediterranean Sea, each one as a member of the European Network of Living Labs (ENoLL): Amsterdam, Apulia, Barcelona, Copenhagen, Ghent, Helsinki, Lisbon, Manchester, Oulu, Santander and Thessaloniki.

Amsterdam. Before the official launch of the Amsterdam Smart City (ASC) project in 2009, the capital of the Netherlands had already presented the Amsterdam Living Lab (ALL) in 2008 with the goal to help companies to test new products in a real user environment. This initiative is supported by the City of Amsterdam, the Province of Noord-Holland, Stadsregio Amsterdam and the Ministry of Economic Affairs and it works in close cooperation with the Amsterdam Economic Board (AEM), University of Amsterdam, citizens, knowledge institutes and companies. The ALL has developed the following main initiatives (AEM, 2009): Amsterdam Smart City, a unique collaboration between inhabitants, businesses, research institutions and government authorities with the ultimate goal to reduce CO_2 emissions; APOLLON, a European LLs network to reinforce partnerships; FabLab, a workspace with modern proto-typing machines that has developed into a global network of standardized open hardware setups; Mocatour (Mobile Cultural Access for Tourists) an app to enable tourists to submit and share personal views.

Apulia. Since 2012 in Italy was created the Apulian ICT Living Lab, an initiative promoted by Apulia Region to test new approaches to innovation activities, with the European funds. The project's aim is to create an "open ecosystem" in which different actors such as researchers, companies and groups of citizens can design new products and services through the use of ICTs (Agrimi et al., 2013). It has been implemented by InnovaPuglia, a company hold by the main local agency, and it has been started with an online procedures to manage regional calls for proposals on innovation in order to realize the creation of a "Requirement Catalogue" with themes, problems and challenges related to the eight domains, and the "Living Labs Partnership Catalogue" with the participation of local associations, public bodies, research laboratories as proposers of user-led needs and at the same time, potential partners of funded projects aiming to provide solutions to the challenges (Di Ciano, 2013). A second phase has concerned the design of appropriate solutions through different calls for proposals in order to select and provide grants to competitive projects: in November 2013 the third call has been closed and the submitted projects are still under evaluation.

Barcelona. In 2008 within 22@Barcelona district started the 22@Urban Lab, a project created by the City Council in order to encourage business innovation and facilitate the use of public space as an urban laboratory to test new products and services in a real environment (http://www.22barcelona.com/). A pilot proposal is presented to the Urban Lab Board which has to confirm the project linkages to an unmet municipal need and people's quality of life. From the start, more than 12 companies participated in testing innovative services in different spheres as urban development, mobility, ecology, ICTs (Ajuntament de Barcelona, 2013). In 2012 another LL in Barcelona was born, the Barcelona Laboratori (BcnLab), a community to make the City of Barcelona as an open laboratory in culture, knowledge, creativity and innovation (http://barcelonalab.cat/ca/). The project was developed by the Directorate of Creativity and Innovation of the City of Barcelona with i2cat Foundation, University of Barcelona, University Pompeu Fabra, between others institutions, together with academia, business associations and to promote a cultural innovation focused on citizens.

Copenhagen. Since 2007 the City of Copenhagen has implemented new and innovative solutions within transport and mobility, waste and water management, green energies and smart grids in order to realize the ambitious vision of becoming the world's first carbon-neutral capital by 2025 (City of Copenhagen, 2012). The strong relationship between the Danish capital and the environmental sustainability (energy, mobility, air) has conducted to a transformation of the city in a LL for new green solutions with the aim of the creation of a greener, more sustainable and liveable city. Copenhagen has recognised the important roles of the different stakeholders in order to reach the sustainability goals and it has identified the following central partners: citizens, business community, investors, knowledge institutions, companies owned by the city and government. People's engagement in the urban life is relevant especially concerning the mobility domain: Copenhagen aims to be the most bicycle-friendly city in the world (City of Copenhagen, 2014) and users are actively involved in the identification of the improving areas, so that all

the investments in the cycling infrastructures are based on the needs of citizens and the sense of ownership is enhanced.

Ghent. The City of Ghent has created the Ghent Living Lab (http://www.ghentlivinglab.be/nl) since 2006, linking the ambition of the Local Digital Agenda with citizens' potential and with the aim of connection among SMEs, activists, researchers, students, citizens, and government. The fundamental process at the basis of Ghent LL is the creation of new products and services and it consists of different and subsequent actions such as observe, ideate, co-create, try and launch (Rosseau, 2012). In 2012 the portal data.gent.be was created to assure the availability of open data and this website was presented within a training course for citizens, called Ghent DataTalk. Ghent LL has used the open data as a pillar to develop most of the projects realized, especially the ones related to the creation of apps, such as "Citadel...on the Move", a wide competition for the creation of an app that works across Europe, and "AppsforGhent" that has reached the fourth edition in 2014 (http://appsforghent.be/).

Helsinki. The capital of Finland is the home of the Forum Virium Helsinki, the private limited company owned by the city of Helsinki, which develops new digital services and urban innovations in cooperation with companies, the city, other public sector organizations and residents (https://www.forumvirium.fi/en). Since early 2006 one of its innovation projects focus has been the development of user-driven innovation process, methods and tools within the Helsinki Living Lab network (http://www.helsinkilivinglab.fi/): an ecosystem of the LLs and their partners in the Helsinki Metropolitan Area. Helsinki Living Lab (HLL) is both a communication hub and an open umbrella brand for enabling companies and the public sector to get in touch and co-operate (HLL, 2013). Furthermore it helps these actors in designing new services and products, and reinventing and improving existing ones by using the feedback from authentic user experiences in real urban environments.

Lisbon. Since 2008 the City of Lisbon has been committed to become a smart city in order to improve its citizens' quality of life. Thus, it has been implementing measures to achieve that goal, including the promotion of programs to enable citizens' participation aiming at a sustainable development of an economic, social and scientific environment (FIREBALL; 2012). It is in this context that the Municipality decided to create the Lisboa Urban Living Lab (LxULL), an environment that nurtures co-creation processes focused on four key areas: smart cities development, e-government and e-participation, digital innovation and Future Internet, entrepreneurship. The different projects realized have been focused on users' involvement that is guaranteed by different methods and tools such as the test of new applications and services using fibre and wireless, the setting up of focus groups, action learning sets, study circles and user-developer interfaces, the use of social networking through online co-creation networks generating and analysing crowdsourced open data, the planning of support and mentoring activities by connecting users with skills and experience to new users.

Manchester. Founded in 2003, the Manchester Digital Development Agency (MDDA) is responsible of the city digital strategy related to the digital inclusion, industries and innovation. The main issue is the generation of investment for innovation and new infrastructures and the development of Manchester smart city in areas such as energy, fibre and wireless networks and services. One of the latest initiatives is the Manchester Living Lab which aims to allow the easily connection and collaboration between people and businesses, supported through a range of European Union programmes (http://www.manchesterdda.com/livinglab/). The projects (Viitanen et al., 2013) include involving citizens in testing energy management systems through smart meters, working with government agencies to open up data, developing a next-generation access fibre based digital infrastructure and working with local residents to equip them with the skills to support the co-production of new community services.

Oulu. The city of Oulu in Finland supported development programmes, especially in the field of innovation and ICTs, from early 90's in order to achieve good living conditions for residents and a stimulating environment for companies, so that it has become a leading wireless R&D hub within the global innovation ecosystem and they have formed an excellent urban LL, with a focus on the real-life user centric innovations. The city's LL approach has been reinforced with the development of OULLabs (Oulu Urban Living Labs - http://www.oullabs.fi/), a network built to bring together LLs, companies, public sector, social user groups and individual users for co-creation of user-centric appliances and services and to expedite growth of businesses, focusing on ICTs, e-health, education and smart cities (Väinämo, 2013). The key resource of OULLabs is the test users' community and discussion forum called PATIO, which connects developers and the active community of more than 600 end-users.

Santander. The city of Santander since 2010 has been involved in the development of an Internet of Things (IoT) platform full of data received from 12.000 sensors (http://www.smartsantander.eu/) and the involvement of developers, citizens, researchers, organizations, and the business sector in the creation of new Apps. This linkage with the participation domain has conducted to the growth of the IoT Santander Living Lab, fully committed to the open data approach (Sanchez, 2012). Some of the most relevant projects within the LL have been: SmartSantanderRA, a free

App based on augmented reality technology and real-time information; SEN2SOC, a mobile and web app which bridges SENsor measurements and SOCial networks interactions; a service called participatory sensing through the app El Pulso de la Ciudad (The Pulse of the City); Santander City Brain (http://santandercitybrain.com/), an open ideas platform to share ideas and projects, comment and vote on suggestions and upcoming initiatives.

Thessaloniki. The City of Thessaloniki is trying to become a smart city via two parallel processes: the first is linked to the development of innovation clusters and technology districts while the other is related to the deployment of broadband networks and web-based services for business, government and citizens (Zaharis, 2009). The bottom-up initiatives created in this city context are related to the web applications and e-services which provide real-time information, especially concerning mobility, and an easier relationship among different actors. The higher results of this stimulating environment has been the setting up of Thessaloniki Living Lab, created in order to develop innovative ICT products and services by providing a testbed for fermentation and cross-fertilisation of ideas, concepts and prototypes (FIREBALL, 2012). At first stage, Thessaloniki LL has been focused on the engagement of a pool of individuals and end-users in a small town within the Metropolitan area of Thessaloniki.

LIVING LABS TO ACHIEVE SMART CITIES

The overview of different experiences in developing LL initiatives has allowed us to underline the common features among them, such as the linkages with the various UE financing instruments, especially those related to the just ended Programme of Competitiveness and Innovation (CIP) and European Regional Development Fund (ERDF) 2007-2013, the importance of a public institution's pivotal role in the earlier phases and the relevance of coordination tools, both technological ones as platform, forum and blog, and face-to-face ones as workshop, round table and laboratory. As our overview implies, we have conducted our study on some examples of LLs characterised by a focus on the development of innovation relevant for citizens, in which the role of organizations, public authorities and universities is, above all, to support citizens in their innovation activities with the provision of tools, information, development forums and skills. Starting from these citizen-centred quadruple helix cases (Arnkil et al., 2010) we have narrowed the field of our investigation on the Apulian and Barcelona LLs as relevant examples of user-driven innovation environments which are different from each other because of their territorial dimensions: the first is related to a wider territory corresponding to the Italian region, while the other pertaining to a metropolitan area.

Actors' involvement

The Apulian ICT Living Lab can be considered an example of *Territorial Living Lab* (Concilio et al., 2011) because it is not referred to a smart city context but it is linked to a wider perspective that include five cities corresponding to the Italian provinces of the Apulian Region. The Apulian LL represents a hopeful initiative thanks to its main characteristics, in particular referring to the mapping of end-users' needs set up as the starting point of the innovation processes and the creation of a web portal as a sharing instrument for the community (http://livinglabs.regione.puglia.it/). The above mentioned eight domains (environment, safety and social protection; cultural heritage and tourism; e-government; social inclusion and active and healthy ageing; energy; education; transport and mobility; creative industry) have been filled with a list of 473 needs and the information about the related 34 projects can be visualized on the official website. People can participate thanks to the online community which allows three main activities: the selection of a topic with the corresponding list of needs submitted to the platform, the players included in the catalogue, ICT research and innovation projects already financed, the active LLs; the opportunity to take part in the blog, the so-called "Living Labs Cafè", activated only in Italian, a virtual place for free discussion, ideas exchange, suggestions and contributions; the chance of using a wide range of social media (Facebook, Twitter, Google plus, Flickr, Youtube, Slideshare) to enhance the interactions. Among the ongoing LLs we have noticed a predominance of projects based on open source platforms, integration instruments, mobile applications and creative tools: these evidences let us underline the fundamental role of end-users as co-creators in the innovation process.

The other example that we have selected differs for its territorial dimension, in fact we focused our analysis on the LLs experiences developed in Barcelona metropolitan area. The 22@Urban Lab is strictly related to the involvement of organizations in innovation processes and it aims to solve two different needs: the one from companies on how to better fit their offerings by engaging users in early experimentation and real-life environments, and the one coming from city halls addressing the need for fostering innovation and creating innovative spaces. This focus on the economic growth and business investments is balanced by a deeper attention to people's involvement in the other LL in Barcelona, the BcnLab. This initiative was born as an ecosystem that encourages civic innovation in arts, science and technology, and it has been developed as a laboratory-city based on the quadruple helix model (Lombardi et al.,

2011) which includes citizens, public administrations, research institutions and Universities, and companies (micro, SME and big companies). The primary activities of BcnLab are related to creative industries, science and research communities, and arts in order to create a stimulating field for development of new concepts, ideas and projects. The most relevant characteristic is the focus on communities among different stakeholders from civil organizations, companies, research centres and public administrations, so that it has been possible to create a so called "Community of Communities" with 150 communities which are subdivided in 6 interest groups: citizens sciences, creativity, digital cultures, entrepreneurship, open infrastructures and social innovation (Serra, 2014). One of these groups has an important role in facilitating the processes of technological, social and cultural innovation, and it acts as a bridge between the social sciences and the world of engineering. It uses qualitative and ethnographic methods to explore the social uses of technology and the interpretation that users make of their experiences with technology in order to collect information on user s' requirements and develop new methods of co-design. BcnLab has adopted an innovative approach changing the perspective from the "community of practice" to the "community of project" and it has ensured citizens' involvement through in-depth interviews and groups' dynamics of Kurt Lewin (1953) up to reach more than 150 users as participants in innovation projects. This engagement has been reached also thanks to the online open platform that allows citizens to create and submit their projects.

Deploying and monitoring activities

Our analysis about Apulia went on thanks to the interview performed with one of the person in charge of InnovaPuglia (this name is a syneresis between Innovation and Apulia), an organization hold by the main local agency to develop solutions addressed to city enhancement. This organization operates thanks to a portal embedding the data emerging from three websites related to travelling and events in Apulia and to a social network for tourists visiting this area. An information system connects data and processes of these online spaces to generate a set of information useful to provide better services to organizations, citizens, and tourists. The portal created by InnovaPuglia can be seen as the platform to develop the services, but the contents are necessary if a city enhancement is the most relevant aim; thus, the managers decided to launch some calls during years to get people involved and to obtain their contributions. The first one was such a big success, in spite of the expectations and more than 400 proposals were sent by several kinds of stakeholders linked to the territory of Apulia. The big quantity of results was under examination by the organization's managers and they synthesized them in three main streams of intervention, namely: creating a territorial information system, favor the creation of smart communities, supporting services like health services, energy provision, and justice thanks to digital systems. The person we interviewed stated the first aim was reached with a wide digitalization process, achieving the expected results in more than 95% of the local area. As it regards the second stream of intervention, the smart communities have been created and they are sustaining the new calls promoted by the company, with both totally new proposals and ideas to improve the existing ones. When describing the creation of the LLs inside the community, the helix-based models (Etzkowitz, 2008; Lombardi et al., 2011; Carayannis et al., 2012) have been taken into account and referred to as relevant by the interviewee, with citizens and organizations acting as co-proposers of initiatives, research centers performing their supporting role in interacting with the other actors, and local agencies coordinating the whole process. The third kind of intervention is related to public services improvement and during the interview the results were considered quite positive, as the cost-efficiency processes achieved a 50% reduction in some cases. Most of the activities usually performed by local agencies through its operators widespread on the territory are managed through the territorial information system. Citizens' engagement in this range of activities is pivotal, as stated by the person in charge we interviewed, because organizations were forced to participate and at the beginning their contribution was not so useful, while citizens represented a relevant source of ideas, needs, and data to allow the development of the platform and its usage in connections with the new way of public services provision.

In order to deepen Barcelona logics to promote a *smartization* process we had a face-to-face interview with Vicente Guillart, the Chief Architect of the City. He presented the initiatives in his city to describe the road towards a smart context. He argued the real challenge is doing something new in an already existing city and in a wide and overfull area; because of this, one of the first issues to be taken into account is the mobility, as the bigger and more crowded the city is the bigger congestion problems are, with direct consequences on the quality of life. The quality of life can be improved thanks to the promotion of citizens and city identity and by avoiding the emergence of significant differences in social classes. In order to reach these aims the city management decided to launch a project known as "United States of Barcelona", leading to the creation of city zones with their own identity, just as it happens in the states shaping the USA. Hence, markets are needed to give autonomy to each areas of Barcelona, to satisfy identity and daily needs. Two contests were launched and addressed to citizens, organizations, and all actors related to the city, confirming what we had found in the analysis of the report presented above. This idea arose because in previous years the local university supported the City Council in creating a LL and the high quality of the results they achieved led to the stabilization of this approach when facing challenges related to the urban context. It is interesting

to underline one of Guillart statement about LLs, as he affirmed city management certainty and competences in creating these labs on their own, viz. without the support of the university that had acted just as an initiator of this approach, as it gave the know-how to create labs as model to co-generate solutions. The University still takes part to some LLs (as we described when analyzing the report), but the leading role is kept by city management. The involvement of citizens and their resulting participation allowed the definition of a priorities list to focus on the intervention to be done in the upcoming years. Namely these priorities are: greening the city, decentralizing energy production from the central areas, supporting a new industrial revolution through a specific lab, promoting the sharing logic, investing in a more performing information system, decreasing the number of cars from the city centre, and launching an international contest to re-build transport infrastructures in the heart of the city favoring the increase of the space to be part of the greening actions. As identity was so pivotal in supporting these projects, Guillart stated the relevance of citizens' involvement in a participatory process to define the interventions to be done. The role played by citizens involved in the previous LLs is crucial and the results achieved in this way influence the way in which new aims are set. Indeed the domains already conveying positive results are less focused than in the past, whilst upcoming needs are at the top of the list. The ideas about interventions to be fulfilled need cooperation between governance bodies and organizations with both citizens and citizens' associations to identify together how to solve critical issues, instead of just listening to complaints and acting with no consultation.

A framework LLs-based

The analysis of the reports published to describe what happened in Apulia and Barcelona LLs led us to the depiction of a best practice to achieve users' involvement in the proposal of ideas supporting the innovation process related to smart cities management. First of all needs have to be mapped in order to have an overall perception of the interventions to be performed in a city. In this phase citizens' role is fundamental and because of this the reports show two necessary decisions: where participation has to take place and how. When referring to where, city managers have to define which are the physical or virtual space to favor interaction; when considering the how, suitable tools have to be settled to allow citizens participation. After these choices the two cases shows both a difference and a similarity: the different choice depends on the subjects to be classified as sources of information on needs, because in Apulia the proposals arrive just from citizens, while in Barcelona the suggestions emerge from potential users and city halls; the similarity depends on the criteria to select the proposal as both citizens' needs and local agencies perspective are taken into account. After needs are listed the city managers perform a categorization on them, to define which are the domains to be considered for interventions, in order to be efficient when focusing on the investments to be done, looking for scope economy, especially when referring to instruments, like ICT.

The second step of our investigation gave us some more insights as from direct interviews we had an in-depth focus on the most significant features. In detail we noted the relevance of the platform where citizen's interventions are expected to be addressed. It depends on the choice done in the first stages of this process, namely when the city management has to decide "where" the interactions can take place, namely in a physical or in a virtual context. The interactive platform is useful in two ways: firstly to collect proposals and to favor a debate between citizens and city managers; secondly as it represents the starting point to define the strategies to deploy the interventions in the different domains, in a digitalization perspective. The deployment of the actions leads towards the necessity of monitoring, as city managers have to define a set of indicators to understand the efficiency of this process and to periodically check if the expected results are achieved or the strategies have to be redefined. In this case the definition can take place through citizens' involvement in the interactive platform itself.

CONCLUSIONS

LLs emerged as a useful context to innovate and *smartization* processes benefit from them as it came out from reports. One more demonstration about their usefulness depends on the continuous usage of this approach in several cities among the ones considered. The interviews we performed face-to-face were helpful to confirm the potential contribution to innovation emerging from LLs. The respondents underlined some aspects we had found in our literature review and we had used to depict the effects. In the final part of our research we tried to define the way in which different features of the smart development of cities can be supported through LLs.

Limitations and further research

This research has been performed with a focus on Europe and we can state the focus is complete as the reports have been useful to depict all LLs in this continent. All this evidences are influenced by EU support in setting the LLs, so the research can be improved in the future by taking into account empirical contexts outside Europe, with the aim of

making comparisons as it concerns the different approaches resulting. We took into account two LLs to perform an in-depth investigation, hence with a similar perspective showed above a more detailed focus on the other LLs can be performed by interviewing a higher number of city members. Finally it would be interesting to perform a similar analysis in an ongoing project and in order to do this we have already pinpointed a location. Indeed this city is involved in a smart city project in these months and we are directly involved in the definition of the interventions to be done, so we will investigate on it in-depth.

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Knowledge and Learning in Practice-Based Studies: An Integrated Perspective to Understand Innovation

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ABSTRACT

This article goes in-depth in the conceptual analysis of knowledge and learning as social cultural phenomena. We focus on studying three practice-based learning approaches we named - "knowing-in practice", "knowing-in-between practices" and "cultural-historical activity theory"- through their key concepts. More specifically we are interested in how these approaches interpret the creation of new social structures, learning processes, and practices in cultural-historic contexts for the creation of new knowledge, practice and activity. The study brings new conceptual insight to the topical phenomena about learning mechanisms and provides evidence on how these mechanisms have the potential to contribute to innovation. Thus, as our conclusion we state that we benefit on in-depth understanding about different elements of learning in and between actors in order to create better conditions for collaborative development, renewals and innovations to take place.

Keywords: practice, practice-based theory, activity theory, knowing, learning, innovation

INTRODUCTION

The contribution of knowledge and learning to innovation has been widely investigated in literature. It is generally agreed that innovation is a process of generating, combining and transforming knowledge (Nonaka and Takeuchi 1995) and innovation and learning have been addressed as most important drivers of business success (Lundvall and Johnson, 1994). However during the last decade innovation and knowledge theories have been transformed by a fervent debate and have moved significantly towards a new conceptualization of these phenomena. In some cases the evolutions are being led by authors who question the epistemological and ontological foundations on which innovation and learning have been grounded in the traditional studies.

On the innovation side, the main insights address to a broader conceptualization of innovation that overcomes the traditional discipline boundaries, as outlined by different authors (Carlborg et al., 2013; Edvardsson and Tronvoll,

2013; Rubalcaba et al., 2012,). They search for the development of new ideas and frameworks that more deeply explain the complex and multifaceted nature, structure and processes of innovation in a new service mindset (Vargo and Lusch, 2008). Innovation is said to nest both service and tangible goods into an integrated overarching service concept (Lusch and Nambisan, 2012; Ordanini and Parasuraman, 2011). It depends on open processes and it is conducted out in networks with external actors, including customers, and involves various employees and managers (Chesbrough, 2011; Rubalcaba et al., 2012,) through both bottom-up and top-down processes (Rubalcaba et al., 2012, Toivonen and Tuominen, 2009). In addition, innovation exists in a process in which the service provider and service beneficiary (e.g., a customer), together with other social and economic actors re-bundle and integrate resources, values and schema (Edvardsson and Tronvoll, 2013) in a social system to create value for themselves and others, in new and better ways (Lusch and Namisan 2012). Consequently, some authors point out a shifting from positivism and linear innovation models towards socio-constructivism and complex social processes of interacting among multiple actors (Edvardsson et al., 2013). More attention is also being paid to social and work activities as venues for innovation (Toivonen and Tuominen, 2009), while innovation as a blurry, emergent and uncertain process takes center stage as more actors, both outside and inside of organizations, participate in the process (Chesbrough, 2011, Lusch and Nambisan, 2012, Rubalcaba et al., 2012).

On the knowledge and learning side, the main contradictions to the established knowledge theory within management and organization studies (Nonaka and Takeuchi, 1995) stem from practice- based learning studies. During the last decades, this research stream has started to affirm (Gherardi 2008) through a hard critique of knowledge understood according to the logic of possession (Cook and Brown 1999; Gheradi 2000). Practice based authors use the foundations of Lave and Wenger's (1991) community of practice learning theory to suggest that practices or actions should be the critical point of analysis and that understanding knowledge requires examining the context in which it is used and developed (Brown and Duguid, 2001). Scholars within the service innovation research stream and practice-based learning theories posit many challenges to the theoretical debate. In some cases the new issues have decreased the uncertainty and the opacity of the topical concept they address. The debate within both research streams is still in progress and lacks a clear, well- established definition of what innovation means or what practice-based learning approaches entail.

Although generalization is difficulty, it is possible to trace some links across the literature on the evolution of both research streams. We see that both knowledge and innovation are no longer seen solely as things that can be created or possessed (e.g. scientific facts, physical output). Knowledge and innovation are co-constructed in social interaction by utilizing and integrating resources, schemas, artifacts and tools within and between individuals, groups and organizations in action and in practices (Engeström, 2004; 2007; Gherardi, 2000; 2009a; Svabo, 2009). However, although innovation and practice-based learning studies are potentially relevant to one another, we see that they have evolved independently with little theoretical integration.

The contribution of learning to new innovation traditions has remained somewhat ignored and therefore not problematized. According to Ellstrom (2010) the innovation research has focused too much on the idea of knowledge as a commodity acquired and transferred through formal learning processes (such as education and training programs). The informal or implicit social processes of leaning in everyday work are not taken in to account, as the knowledge and competences are not only used, but also created in the collaborative effort. In addition among practice-based learning theorists the debate is more focused on what the important characteristics of knowledge are and how knowledge is acquired in a social-cultural context. The result is the rise of multiplicity of studies (Gherardi 2009b) without unified perspective on knowledge and learning processes. In addition the debate lacks an understanding of which elements of knowledge and learning as social-cultural processes have critical implication in organizations and their innovation efforts. Moreover, some management researchers complain that too often, learning in organizations is seen as subjective and vague whereas new conceptual models might be needed (Zollo and Winter, 2002). .

The purpose of this paper is to go in-depth in the conceptual analysis of knowledge and learning as social cultural phenomena to understand how the mechanisms underlying learning processes have important implication in organizations and their innovation activities. This work is part of a wider research project on practice-based learning approaches to innovation aimed at investigating the benefit of a deeper discussion about the mechanisms and interfaces of innovation and learning. The project is still in progress. In the present work we address the first stage of the research project. Here the focus is on clarify the learning conceptual constructs that have been defined in numerous ways across the wide array of practice-based studies (Gherardi, 2000). First we present an overview of the practice-based theory by introducing the epistemological foundation of practice and the different research

streams it creates. Then, we build on the contribution of Nicolini et al. (2003) and Corradi et al. (2010) in distinguishing among the different perspectives on learning processes within the practice-based theories. The literature review proves useful by adding articles and other sources to our literature base. By deeply analyzing and integrating authors' positions, we focus the study on three main approaches: "knowing-in-practice," "knowing-in-between-practices" and "cultural-historical activity theory". These approaches are aligned with Gherardi (2000), Ellström (2010) and other practice scholars (Brown and Duguid, 1999) who see the learning process as capable of enabling changes in practices that result in innovations. We then examine the approaches for their analyses of elements at the basis of learning and explore how the theories could converge to support a more robust learning framework for innovation. Finally we compare the approaches and explain the need for a more integrated perspective in which the theories complement each other and could contribute to the expansion of the domain of practice-based learning in innovation.

PRACTICE-BASED STUDIES

An overview

Recent studies introduces to the practice-based lens as an epistemological choice to understand phenomena in organizations and society (Corradi et al., 2010; Gherard,i 2009a). Theory of practice is wide and fragmented (Gherardi, 2000). The practice-based approach engages researchers from organization and knowledge studies (Gherardi, 2000), strategy (Jarzabkowski 2003;Wittington 2003) and leadership (Carroll et al., 2008), markets (Hackley et al. 2009; Kjelleberg and Helgesson, 2007), marketing (Storbacka and Nenonen, 2011) and consumer research (Schau et al 2009; Tronvoll et al., 2011; Warde, 2005). Also, Korkman et al. (2010) draw from practice theory and Service-Dominant logic (Vargo and Lusch, 2008) to outline practices as resource integrators and thus as fundamental units of value creation.

Innovation studies have addressed the practice-based approach only marginally. Preliminary insights come from studies of Orlikowski (2002) and Dougherty (2004) which focus on practice-based knowledge and its link with innovation. Swan et al. 2007 also deal with practice based innovation stressing the relationships between objects, knowledge, work practices, social groups, and social contexts. Recently, Russo-Spena and Mele (2012) by using practice lens define innovating as a co-creation process that involves an array of factors, including actors, actions and resources, in addition to the mere innovation output itself.

A commonality in practice-based studies (PBS) is the discourse that the unit of analysis is a practice or a set of practices rather than an individual or organization. A practice has been defined as a way of doing that is embedded in inwardly and outwardly linked elements (Korkman et al., 2010). The practice lens joins the individual and collective dimensions and the human and technological elements, emphasizing doing and knowing.

Knowledge and learning insights

The practice based learning approaches have become influential among researchers studying organization and organizational knowledge management. Characteristic to practice-based learning studies is that they are multidisciplinary in their search for non-rational-cognitive view of knowledge. According to Gherardi (2008) the practice turn is accomplished in the shift from knowledge (object) to knowing (activity) where the latter is something that peoples do together collectively and socially. Knowledge does not reside in people's minds nor it's a commodity that could be simply transferred from one context to another; rather it is an activity situated in social, working and organizational practice (Nicolini et al., 2003).

The practice scholars mainly follow Lave and Wenger's community of practice learning theory (1991) that first questioned the difference between knowledge, which can be objectified and is independent and knowing which implies a process or action whereby object, subject context and knowledge are indistinguishable. The concept of situatedness and the sociality of knowledge are encapsulated in the idea of community where practitioners are connected by joint enterprise, mutual engagement, and a shared repertoire of resources, experiences, stories, tools, and ways of addressing recurring problems (Wenger, 1998). Practitioners in a community have a shared

understanding of what the community does, of how to do it, and of how it relates to other communities and their practices. It is only through the practice that the value of knowledge becomes apparent and knowledge is conceived necessarily as product of the activity, context, and culture in which it is used. Legitimate peripheral participation is a term Lave and Wenger (1991) have coined to refer to the progressive involvement of newcomers in a practice as they acquire competence (Nicolini et al., 2003) by practicing in a community and building a way of being a practitioner in the world. Competence and identity are intertwined and depend on recognized participation in a community of practice that is inseparable from doing.

The key insight, thinking of learning through participation in practice enables authors not only to shift focus to the spatiality of practices as situated in specific context (Cook and Yanow, 1983) but also to convey the aspect of fabrication and facticity of knowledge (Gheradi 2008). Gherardi (2008) remarks that knowledge is fabricated by the situated practice of knowledge production and reproduction and that participating in practice is consequently a way to acquire knowledge in action and to change and perpetuate such knowledge. This view reinforces the concept of practice as a working activity that transforms knowledge, activity and social relation (Brown and Duguid, 2001). In this sense the reverse concept of practices of communities (PoC) is used by Brown and Duguid (1991; 2001) to counteract the idea of practice as canonical way of work that converges towards the conventional tasks and jobs. The purpose is to show how informal groups form work around practices to improvise solutions to problems, when canonical accounts of work break down (Brown and Duguid, 1991). The practices of communities cut horizontally across vertically integrated organizations and emerge as a network of practices through collective learning activities. These are based on situated and improvisational work and on the simultaneous and interdependent construction of identity and community.

Similarly Østerlund and Carlile (2005) point out as community of practice is essentially a picture of how knowledge is socialized into a rather static practice community, while it does not consider the relationship between communities as a potential driver for change. Amin and Robert (2008) argue for the importance of differentiating among varieties of communities and refer to the epistemic community (Haas, 1992) to identify communities that create new knowledge never existing before and based on the mobilization of ambiguity, uncertainty, and changes. However, it is the activity theories perspective (Engeström 1987; 2004; Blacker et al., 2000) and the efforts of sociology of translation scholars (Gherardi and Nicolini, 2002) that has most thoroughly introduced the changing dimension needed to understand the dynamics of learning and practices. These orientations took place in the 2000s as a "counter trend" that entirely dissolves the idea of practice as routinized activities although they retain the idea of knowledge and learning always rooted in a context of action and interaction.

As the discourse on practice and learning has expanded, many learning scholars have taken a renewed interest in practice-based studies (Corradi et al., 2010). To illustrate how this discourse emerges and includes different perspectives and approaches, the next sections will compare and contrast the theories. The cross-comparison offers a basis for a framework that traces the progress in the disciplines and provides a guide for the development of practice-based debate on learning and innovation.

PRACTICE BASED LEARNING APPROACHES: A CATEGORIZATION

Finding a framework to treat practice-based learning approaches as a homogenous strand of thought is really difficult, given that the approaches comprise many sometimes conflicting discourses (Corradi et al., 2010). Nicolini et al. (2003) in their attempt to provide a classification clustered practice-based learning approaches into four distinct traditions. These are the cultural interpretive tradition presented by Yanow (2000), social learning described by Wenger (2000), cultural and historical activity theory presented by Blacker et al. (2000) and Engeström 2004), and the sociology of translation presented by Gherardi and Nicolini (2002) and Shuman (2003).

Recently, Corradi et al. (2010) have also introduced a different way to categorize practice approaches by using different labels. More precisely they introduce three labels for sharing a common discourse on knowledge and learning as concepts to define practice. These are the practice-based standpoint represented by Brown and Duguid (1991), the practice-based learning represented by organizational learning scholars (Carlile, 2004; Nicolini, 2007; Strati, 2007), and knowing-in-practice studies including Gherardi's (2000) and Orlikowski's (2002) studies.

The spread of the practice concept has led to a wide variety of definition and authors claim a more integrated perspective (Gherardi, 2009; Gherardi and Strati, 2012; Nicolini, 2011) to create a more accurate and complete depiction of the role of knowledge and learning in organization phenomena. Distinguishing between knowing in the practice and knowing the practice Gherardi (2003) provides an initial step forward in the understating of the knowledge as an institutionalized outcome and practicing as an institutionalizing process that changes the practices. However more still remains unknown about how the dynamic of practices has been addressed in the literature and on how practices and learning change either incrementally or radically through the application of situated knowledge in the social context. From a dynamic perspective of change in practice and learning three main approaches seem to emerge in the literature. We named these perspectives knowing-in-practice, knowing-in-between-practices and cultural-historical activity theory. Each of these approaches is composed of a number of characteristics that indicate what learning are and which are elements through which they unfold. We discuss these approaches and their elements in the next sections.

Knowing-in-practice approach

In the literature on practice many authors differentiated by the use of the expression knowing instead of knowledge. Inspired by Lave and Wenger's (1991) learning theory, knowing-in scholars have attempted to explore the link between knowledge and the practices of organizational members that is to examine what is termed a process of knowing in practice (McIver et al., 2012). Insights from ethnomethodology studies (Garfinkerl and Giddens, 1984) guide the research of knowing in-practice scholars (Brown and Duguid, 1991; 2001; Cook and Brown, 1999; Orlikowski, 2002; Tsoukas, 2005; Wenger, 2000) who see knowledge as applied and dynamically produced when actors regularly engage the world in practice.

Cook and Brown (1999) in distinguishing between epistemology of possession and epistemology of practice have placed knowledge in the former case and seen it as a tool in service of knowing, which is about activity and relationship as opposed to a substance, commodity or piece of information (Svabo, 2009). Knowing is seen as situated in the system of ongoing practices of action and it is different in the sense that is relational, mediated by artifacts, and always rooted in a context of action and interaction (Cook and Brown 1999, Brown and Duguid 1991, 2001). The relational nature of knowing is seen not only in the sense of Lave and Wenger's (1991) and other social learning scholars (Wenger 2000) discussion about participation as identity building process. Knowing is also an aspect of individuals doing work in interaction with things and the activity of the social and physical world (Brown and Duguid, 1991; 2001). This means that to be acquired knowing requires some form of interaction in a situated socio-cultural and material context and these aspects also differentiate it from tacit knowledge and know how. This marks the difference from Lave and Wenger's (1991) idea of knowledge as pre-existing to activities of practitioners and contained in a community of practice; knowing implies the idea of knowledge as continually produced by the ongoing activity of practitioners within practices through practicing (Brown and Duguid 1991; Cook and Brown, 1999). Knowing- in-practice scholars embrace a view of knowing that has to do not only with re-productive work of knowledge done by practice but mainly with an epistemic work inherent in action (Brown and Duguid 2001).

The distinction between practices as canonical (or espoused) and non canonical (divergent from conventions) task runs throughout Brown and Duguid's (1991) arguments to clarify the distinction between working and learning. Meanwhile work practices often follow the prescribed lines of canonical communities, learning is more likely to emerge across the fault lines of communities. Learning becomes a sort of bridge between working and innovating, i.e., learning emerges in practice and is deeply implicated in the series of canonical and non-canonical practices that take place in the different communities of practices that compose the organization.

However knowledge is not omitted from the discourse on knowing as it is the interplay between knowledge and knowing that can generate new knowledge and new way of using knowledge (knowing) (Cook and Brown, 1999). Participation in practice is a way to acquire knowledge-in action but it also could be seen a way to change such knowledge and to produce and reproduce reality (emergent reality; knowledge as material activity). Practices are not simply routinized actions because their execution involve a learning process that occur both through know how and know what in actions and as a result of the reflective activity of human actors. Stressing the social nature of knowing and learning does not mean dissolving the role of the agent in the practice. Common to the knowing-in practice scholars is the view that learning involves mainly understanding a dynamic interaction between the agent,

knowledge and practice and this is only feasible by providing evidence of how knowledge and knowing mutually interact.

Orlikowski (2002) has encapsulated this concept in her knowing-in-practice perspective. Eschewing a distinction between knowledge that exists "out there", encoded in external objects, routines, or systems and knowledge that exists "in here", embedded in human brains, bodies, or communities (Orlikowski, 2006) she has emphasized the knowledgeability and reflexiveness of human actors. The knowing and learning happen as individual go about their tasks, monitor the subsequent flow of action and obtain new knowledge or adjust and update their existing knowledge according to these new experiences. Aligning with the social learning approach (Wenger, 2000) the cultural interpretive tradition developed especially by Yanow (2003) have focused on those practice mechanisms that sees individual acquiring knowledge in action in the form of participation in context. Contextual elements including language and objects are seen to shape how individuals learn and how they acquire knowledge and competence.

In summing up the knowing-in-practice perspective examines the specific activities that people engage in while solving problems during their daily interactions. Knowing-in-the practice and knowing the practice are seen as two side of the same coin. Knowledge and learning develop from and are manifested in practice, expertise and skills at work and are iteratively sustained by a mechanism of social interactions with the social and material world (Brown and Duguid, 2001)

Knowing–in-between practices approach

Many practice based authors describe practices as a negotiated activity of ordering and resolving differences that depend on a range of spatially and distributed knowledge within knowledge communities (Lindkvist, 2005) or communities of practices (Gherardi, 2009b; Nicolini et al. 2003).

This perspective embraces the view of authors who look at the range of mechanisms through which local practices are constituted and connected within and across organizations embedded in their socio economic and institutional context, rather than considering practices as a purely organization accomplishment. The discussion of Gherardi (2008) about practices as a between in concept is of particular interest in this sense. The author argues that the concept of practices constitutes a bridge between antithetical concept because "practices lies in the habitual features but has also the characters of purposeful action" …and…" they are nor habit nor action" (Gherardi, 2008 page 523). Gherardi (2001; 2008) also highlights that this dynamic occurs on one hand as practices are internally changed. On the other hand the social dynamic is described as stemming from the ongoing conversation among practitioners on normative standards, that is, what makes a practice good or how it needs to be changed. The collective dimension of learning and practicing is emphasized, and it is conceived as the result of reflective activities emerging from a dialogue and questioning between and among practitioners (Gherardi, 2000; 2008; 2009a; Nicolini et al., 2003).

Practices signifying the set of recurrent activities governed by prescription norm and values in a prefixed and special social domain are in part overcome by the idea of practices that are capable of bridging the heterogeneity of skilful social undertakings and that allow for a certain degree of variance and changes in the interactive works (Bruni et al., 2007; Nicolini et al., 2003; Nicolini et al., 2012). The interest moves towards the analysis of social and collective learning that take place at the boundaries among different communities (Nicolini, 2011; Nicolini et al., 2012) as not a single, local practice but rather as a shift in the overall nexus of interconnected practices (Gherardi and Nicolini, 2002) . The attention is thus diverted from the practice itself to what Nicolini et al. (2003) call the texture of connection of practices in which it is immersed.

As Nicolini (2011) notes a dialectical mediated processes of learning take place not only in relation to individuals framing their understanding with practices, but also in relation to a dialectic process and a negotiation of established practice and knowledge, symbols and artifacts and mediated objects (Gherardi and Nicolini 2000; Nicolini, 2011; Nicolini et al., 2012) Organizational knowledge is seen as a the product and the process of a translation made by an action network comprising individuals and communities, organizations and institution and their intermediaries. These intermediaries include human and non-human actors such as technologies and discourse carrying situated knowledge (Gherardi and Nicolini, 2002; Nicolini et al., 2003; Nicolini et al. 2012; Orlikowski, 2002). Insights from the Actor network theory (Latour 1987) inspire the works of social translation authors

(Gherardi, 2008; Nicolini et al., 2012) in emphasizing the constitutive power of associations in the nexus-shaped context of practices. Any form of social order is stated to be an outcome of observable instances of ordering, and learning is also understood as mediated by comparison among the perspectives of all the co-participants in practices but does not necessarily involve merging and synthesis as a result. Carlile (2002; 2004) stresses the importance of observing discussing and acting in relationships with other actors and in connection among practices. In her approach the role of the boundary object emerges. Their bridging activity provides the communities of practitioners with a venue to communicate coordinate and collaborate. Boundaries objects are both means and products of interaction and of learning in and between communities (Carlile 2004). They are critical because they allow the emerging local knowledge of particular groups to be accessible to others within the broader epistemic communities (Gherardi, 2008; Nicolini, 2011).

What becomes apparent is that learning is sustained and created in multiple interactions and social practices. Cunlifee (2008) note that learning is *intersubjectively and ongoingly created shared senses which participants see at the moment as providing acceptable orientations and way of moving on* (page 133). Learning as dialogical process explores the different way of seeing and interpreting issues and in searching for a bridging and sharing, the possibilities for changes are created (Geiger and Kepler 2009; Geiger and Schreyögg, 2009). The discourse on practices and among practitioners or communities becomes a specific practice itself whose aim is not only to reach understanding or produce a collective action but also to foster learning by incorporating everyone's perspective.

In summary, Gheradi's knowing-in-between (2008) concept provides a useful category to develop the idea of practices as a mode that is relatively stable in time and as socially recognized way of ordering heterogeneous items into a coherent set (Gherardi 2006 page 34) that remains attentive to emerging events. Learning and knowledge follow the same argument. They are not only situated in enclosed groups, but they are also distributed in and between groups and involve human and non-human actors (Gherardi, 2008). They develop through an in-between process of production and reproduction between stabilization and innovation (Gherardi, 2009a; 2009b)

Cultural-Historical Activity Theory

Cultural-historical activity theory has much in common with contemporary anthropological, ethnometodological and actor network approaches (Blackler et al., 2000). However, its roots lie in Russian psychology. Engeström, the main developer of cultural-historical activity theory, built its conceptual framework on Vygotsky's (1978) cultural-historical psychology and Leontjev's (1978) activity theory, combining them with ideas from pragmatism and constructivism. Engeström introduced the theory to organization studies in the late 1980's (Engeström, 1987). Its main starting point is that human capacities develop and abilities emerge in action with the historical and cultural setting in collaboration with others in the co-construct of social reality. The theory doesn't follow only the actors, but takes into account the structures and systems dynamics, and focuses on the emancipation of thought and the creation of new skills, activity and practices. In this way it interprets practice as an activity and explores the links between events and context.

The most important key concepts of cultural-historical activity theory (Engeström 1987; 2004; 2007) relate to the view that human action is object-oriented and those actions take place in a socio-technical activity system as communities with certain tools, rules and division on labor. The object of activity is seen to differ from goals in that a "goal is conscious, short-lived finite aim of individual actions" whereas an "object is heterogeneous and internally contradictory, yet enduring, constantly reproduced purpose of a collective activity systems that motivates and defines the horizon of possible goals and actions" (Leontjev, 1978). For example, the object of activity for a doctor can be the treatment outcomes instead of just diagnosing symptoms. Moreover, a change in the activity, or the expansion in the object, means a tension and a change needs in some or all of the elements in the activity system. Typically, these tensions and conflicts trigger the need to change in the first place (Engeström, 1987).

Cultural-historical activity theory provides the ability to examine the daily life, development and learning practices from constructive and process-oriented perspectives for the creation of profound changes in the activity (Engeström, 1987; 2004). It approaches the process of learning as collective development, and is interested on the 'expansion of the object' (Engeström, 1987). Expansion of the object refers to the process in which the learner(s) focuses on not just the problem at hand but also on the wider context that generates those problems, and consequently, creates a broader horizon of possibilities (Engeström, 2001).

The expansive learning process (or learning by expanding) can be characterized as a conscious, step wise process for the expansion of the object that typically benefits different types of interventions with reflective material (Engeström, 2004). More precisely, the idea (Engeström, 2007) refers to a process in which an activity system, for example a work organization, resolves its internal and external contradictions by constructing and implementing a qualitatively new way of functioning for itself. This new way refers to a complex and time consuming learning process in which people come to recognize tensions within their activity systems, reflect on their origins, discuss alternatives, and collectively refashion an activity system around the reconceived object of activity (Blackler et al., 2000; Blackler and Regan, 2009). Typically the process includes five phases: 1) perceiving the contradictions in the current way of acting (need for change); 2) constructing new object and motive; 3) forming a work hypothesis or concept; 4) implementing (experiencing / experimenting) the new concept and 5) generalizing the qualitatively new way of functioning.

In his 2007 article Engeström emphasizes that expansive learning requires a strong personal involvement by the participants. It is possible that in certain "potential episodes" learners unite with specific situational solutions and ideas of general systemic change. The personal and the collective, as well as the immediate and the future oriented can merge in these phases, and the actors move (in their cognition) between actions and activity, and among past, present, and envisioned future. The pursuit of newness is central to the cultural-historical activity theory and is interested in the type of learning that requires radical exploration for the generation and reconceptualization of the type of activity that does not yet exist, and thus, may serve as a seed for innovations (Lounsbury et al., 2007).

Moreover, today learning among different activity systems is needed. Engeström (2004; 2007) calls this co-configuration (see also Victor and Boynton 1998) which requires continuous collaborative learning and creation of solutions according to customers' and users' needs. This requires flexible "knotworking" (viz. distributed collaborative expertise in pursuit of a task- Engeström et al. 1999) and takes place in heterogeneous patchworks of small and large, unnoticed and noticeable actions, in which no single actor has the sole, fixed authority or ready-made rules. Rather, real-time interpretation and the synthesizing of information between the parties require new dialogical and reflective knowledge tools, collaboratively constructed rules, and infrastructures (Engeström, 2004; 2007).

In his (2004) article Engeström writes that it is not so well understood how such forward-oriented expansive learning is intertwined with movement across activity systems. Concepts such as boundary crossing, multi-voiced dialogue, negotiated knotworking, and cognitive trail-blazing have been advanced. These concepts create good starting points for putting the idea of horizontal and inter-organizational dimension of learning in the center as seeds for collective innovations, but more research is needed to create the next generation of expansive learning theory for the inter-organizational and horizontal perspectives.

A COMPARISON AMONG PRACTICE-BASED LEARNING APPROACHES

The literature analysis allows us to trace the content of the contributions of the three approaches to the development of practice-based theories on knowledge and learning. We want to move beyond the analysis within approaches and offer a comparison among the three approaches of knowing- in-practice, knowing-in-between practices and cultural-historical activity theory. A cross-comparison highlights similarities and differences and offers a basis to frame an integrated approach to practice-based learning.

We started from Lundvall and Johnson (1994) who distinguished among four different forms of producing knowledge – know what, know how, know why and know who. Moreover by examining arguments of the different approaches we identified an additional element- the "where". This latter category shapes all the other forms of knowledge and learning and as in practice-based studies (PBS), the unit of analysis becomes the practice itself which is the locus of working and doing. The following table articulates the results of our analysis based on the set of elements we identified to address our comparison.

The first category concerns the dimension of where that is the locus where the knowing and learning are undertaken. In the knowing-in-practice approach the practice is the locus of learning that takes places in social relationships that

normally occur in the workplace. Learning focuses on the way individuals interpret or make sense of their knowledge and experience at the work (Brown and Duguid, 1991).

Table 1.A comparison of the approaches

	Knowing in	Knowing in between	Cultural-Historical Activity
Where learning occurs:	Practice	Nexus of practices	Activity systems
How learning unfolds	It is emergent	It is emergent, provisional and unstable	It is dynamic, systemic, profound and conscious
Why learning emerges	Unconscious and conscious attempt to acquire and produce knowledge	Unconscious and conscious attempt in organizing resources in a nexus of practices	Triggered by conflicts and uncertainties in the current activity, conscious attempt to expand the object of activity to better meet the needs for the future
Who learns	Individual in communities or among them	Communities of communities Individual/collectivity subjectivity	Individuals and activity systems in or between them
What learning produces	Production and reproduction of practice	New practices	Reconceived object of activity, novel meaning schemas, tools, activity and practices, as well as activity systems

The knowing-in-between practices approach looks at nexus of practices as loci where individuals together construct an understating of what they have around them and learn from the social practice of collectively organizing and ordering resources for action (Gherardi and Nicolini, 2002). Practicing is not merely a process of recurrent events, it is a movement that develops and unfolds through the intensity of connections that drive the process of changing and learning. The cultural-historical activity theory (Engeström, 1987; 2004; 2007) sees learning taking place in collective interaction, in or between activity systems of certain cultural-historical context. Referring to the second category, the "how", specific differences can be seen in the way that knowing and learning unfold. For the knowing-in-practice approach the source of knowledge and the learning process lies in the use of knowledge as a tool of knowing within situated interactions with both the social and physical worlds. Knowing and learning refers to the epistemic work that is conducted as part of action or practice; it is dynamic, concrete and relational. These ideas become enriched by knowing- in- between practices approach. This approach proposes the idea that knowledge and learning are not only based on social interactions but also on discursive behavior, which give rise to social order. This social order involves plurality and diversity, human and non human actants and comes about through discourse and negotiation. Knowing-in-practice and knowing-in between practices stressed the idea of learning happens in social interactions between people, alongside work-activity, in the flow of experience with or without awareness of it (Gherardi, 2000). The cultural-historical activity theory sees that the expansive learning is a profound and dynamic process. It refers to transformative learning that radically broadens the shared object by the means of novel tools, models, and concepts that are multilevel and integrated constellations (Engeström, 2004).

By looking at the "why" the learning process emerges, and we address significant differences between the both approaches on knowing on one hand, and the cultural-historical activity theory on the other hand. For example, the knowing-in-practice, and the knowing-in-between practices approaches provide a basis for understanding learning as something that is led by unconscious and conscious attempts. In the first case the attempts are aimed to acquire and produce knowledge in the latter to organize the wider set of resources within a nexus of practices. As already mentioned, the knowledge and learning are viewed necessarily as emergent and dynamic, provisional and unstable (Nicolini et al,. 2003; Nicolini, 2011). The motivation behind learning in the cultural-historical learning theory is the conscious attempt to expand the object of activity to better meet the future needs f that is triggered by conflicts and uncertainties (Engeström 1987; 2004; 2007). This way, the learning mechanisms behind cultural-historical activity theory appear more normative. It shows that conscious aim and motive for learning as a change in the

activity is needed in a more step-wise process. It refers to a rather radical exploration process of learning something that does not yet exist and thus it creates new knowledge and new practices for a qualitative transformation of the object and entire activity system. .

Referring to the "who" issue raises the question of the subject of the knowing and learning. The knowing-in-practice is understood as situated knowing formed by actors who act in a particular shared setting and engaging in an aspect of the social and physical worlds. Individual cognition is the basic learning unit and the context in which learning happens is somewhat predetermined (Gherardi, 2009b). The knowing-in-between practices approach takes a more intertwined view. Both the individual and collective dimension form a nexus of interdependence in knowing and learning and each dimension influences and is influenced by the other (Gherardi, 2006). The attention is devoted more at collective dimension of creation of situated discursive practices. In contrast to the knowing- in-practice that focused more on the individual who learns in a community or among communities; in the knowing in between practices, the communities or the collectives can be seen as central to how participants learn. The cultural-historical activity theory focuses on how an entire activity system and its actors transform and sees learning mostly as a collective phenomenon. Learning is described as occurring between different activity systems (Engeström, 2001; 2004; 2007).

Finally we address at the "What" people produce in their situated knowing and learning process. In the knowing-in practice studying the focus is on how practice are socially sustained through situated way of learning and on the criteria for appraising and situating the way of transmitting the practices. This means to look more at how practice is produced and reproduced within the community of its practitioners and it is internally changed (Gherardi, 2008). Knowing- in-between practices illuminates on the collective achievement that allows practitioners to evaluate the various performance of their working practice and in doing so to contest or negotiate a new order of actions i.e. new practices. The cultural- historical activity theory places its focus on the reconceived object of activity, novel meaning schemas, activity and practices, as well as activity systems. In other words, the creation of explicit concepts, models, and tools should lead to the implementation of those concepts and tools in horizontal boundary-crossing encounters. Learning can be understood as changes and emancipation both in cognition and in activity in practical and conceptual level in the activity systems (Engeström, 2004; 2007).

5. OPEN UP THEORIES TOWARDS AN INTEGRATED APPROACH

In this paper we examine how different streams of practice-based learning theories as 1) the "knowing-in-practice" approach (Cook and Brown 1999; Brown and Duguid, 1991; 2001) 2) the "knowing-in-between practices" approach (Gherardi and Nicolini 2002; Nicolini et al.,, 2003 Nicolini 2011) and 3) the "cultural-historical activity theory" (Blacker et al., 2000; Blackler and Regan, 2009; Engeström, 1987; 2004), address theoretically the processes on learning at workplaces, within and between different communities.

By exploring and comparing conceptually the key concepts of these theories our work offers three contributions to the practice-based theories discipline. First we conducted a literature review of most of the studies of each approach, synthesizing the main assumptions. Although we are already able to find some studies comparing practice-based learning theories, the theoretical contribution to an integrated approach on learning is still rather poorly explicated. As Corradi's et al. (2010) highlighted, the perspectives taking the practice as a conceptual starting point for knowledge and learning has a wide and fragmented theoretical background. In any case, the multiplicity of labels proposed by authors grew mainly from the need to draw a path in the chronology of practice-based studies and the emphasis is more on different definitions under which practice has been discussed. By conceptualizing the intrinsic dynamic of practice the approaches we study, prove helpful in breaking down the aspects of practices - sometimes used to describe repetitive routine activities- and shed light on the inherent reproductive and creative features of practicing. In doing so they offer a useful contribution by considering the critical processes of development and creation of changes and innovation strictly tied to discourse on practice.

Second, our study allows comparison among the different elements at the basis of learning within the three approaches. As a theoretical framework for comparison we utilized the four common forms of knowledge of Lundvall and Johnson (1994) and added the "where" dimension as it is proved to be central in the practice-based discourse (Gherardi, 2008).The framework provides simplified valuable guidance for addressing the different approaches to knowledge and learning. This framework compares the different loci where knowledge and learning

unfold and provides evidence on how knowing- in- between practices approach assumes a complex and intertwined idea of context of practicing. In addition the framework allows us to highlights "how" learning takes place differently in the work-activity, and the "why" of learning process. The emergent and unconscious idea of learning in "the knowing-in-practice, and the "knowing-in-between practices approaches counteract an object-oriented view of the learning mechanisms behind cultural-historical activity theory. Furthermore, the framework addresses the different perspectives of "what"— production and reproduction, the creation of new and changes — and "who" — individual in communities or individual/collective subjectivity.

Also by comparing approaches we emphasize the importance of integrating the emergent and normative view of learning for a better understanding of how changes and innovation are produced in practice. From addressing the shortcoming of the knowing-in-practice and knowing-in-between practices approaches emerges the idea of practice in which actors engage in predominantly adaptive learning; in contrast the cultural-historical activity theory opens up to a creative process of learning. By concentrating on the idea of interplay in a nexus of practices our work want also to affirm the need for an integrated practice based learning approach enabling to better address the complex and multifaceted dimension of practices. Learning in a practice-based approach has to address the emerging and the purposeful attempts to acquire and produce knowledge and order as well as the attempts to expand and promote creative learning. In an integrated practice based learning view, learning can be described as a process that has multiple phases dealing simultaneously with the emergence of anomalous activity, the problematization of extant knowledge and practices, the social recognition of novel knowledge and the negotiation of processes that may involve resistance from incumbents as well as calls to legitimize the new knowledge and practices. However, further examination is still needed to specify tentative integrated theoretical framework and also gather empirical evidence to develop it even further.

As the final concluding remarks we state that the practice-based learning theories we compared provide answers to different ways of learning (more emergent/unconscious and more normative, planned and profound). Then an in-depth understanding of these different learning mechanisms creates the understanding that they are not exclusive, rather, they provide better understanding on how learning and innovation can take place differently from socio-cultural and practice-based viewpoints. In this way as theoretical and managerial implications we can see practice-based learning approaches having the potential to contribute to different kinds of innovations (Ellström 2010). Furthermore, from managerial perspective, it is important to be aware of different learning mechanisms in practice-based studies in order to create conditions to enhance innovations in different socio-cultural contexts.

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Learning Driven Collaboration Management for Unstructured Service Processes

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ABSTRACT

We conducted ethnographic studies of several service works, such as social welfare case work in a city and, customer support desk work for a computer maintenance company, etc. We found the unstructured nature of service to be one of the major problems in improving service performance and quality. We propose a collaboration management model for structuring and improving unstructured service processes. We conducted an experiment in social welfare work in a city. An expert and two teams of case workers participated. The case workers successfully elaborated the initial work template created by the expert by two learning cycles of the proposed collaboration management model.

Keywords: Unstructured Service Processes, Organizational Learning, Knowledge Management

INTRODUCTION

The development of scientific management methods for improving the performance and quality of service has been expected. We conducted ethnographic studies of several service works and found the unstructured nature of service processes is one of the major problems in improving service performance and quality. In this paper, we discuss the issue of service processes obtained from our field work, and propose a collaboration management model for structuring and improving unstructured service processes. We will also demonstrate the results of our experiment conducted in social welfare case work in a city.

UNSTUCTURED SERVICE PROCESSES

Ethnographic studies were conducted for several service works, such as social welfare case work of a city [Obata et al. 2012], as well as, customer support desk work for a computer maintenance company [Ohori et al. 2012], etc. We found common problematic situations [Obata et al. 2013]. Workers had to handle irregular requests despite the fact that processes for handling irregular requests had not been predetermined. Thus, workers had to address irregular requests through collaboration with experts in multiple departments in an ad hoc manner. Due to this cycle of ad hoc work being repeated, business processes were complicated and tacit. As a result, only a few experienced workers accumulated sufficient knowledge of business activities, creating a heavy burden on a few experts. Those few experts could be a bottle neck for improving performance. Moreover, in order to complete irregular requests, many implicit decisions were made that were not always perfect nor consistent. Making implicit decisions explicit is also an important factor for improving the quality of services. Continuous improvement of processes and decisions are needed to improve the quality of services, however, intensive task analysis is needed to clarify such unstructured work processes.

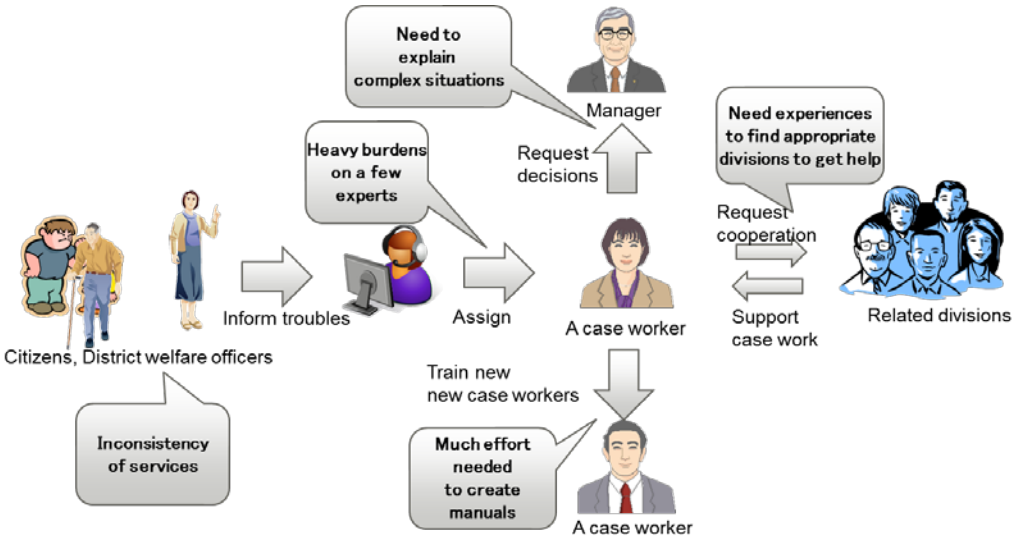

Figure 1. Problem situation of social welfare work in a city

LEARNING DRIVEN COLLABORATION MANAGEMENT

We propose a management model called LdCM (Learning driven Collaboration Management). It allows for each worker and manager to collaborate in forming work templates from unstructured service processes without the heavy burden of task analysis. The collaboration process consists of two types of learning cycles: individual learning cycles, and organizational learning cycles. In the individual learning cycles, workers complete their work guided by recommended actions and decision points with specific conditions described in templates. The templates consist of conditions and recommended actions and decision points in a tree structure. Workers conduct their actions based on a template, and record their activities and decisions through linkage with a template. After they complete their task, they compare the actions they took with the recommended actions in the template, and record the lessons they learned. On the other hand, templates are elaborated and improved in organizational learning cycles. When managers refer to the lessons learned in difference cases, they can easily find what actions should be added, or modified under specific conditions, by comparing templates with the actions they took.

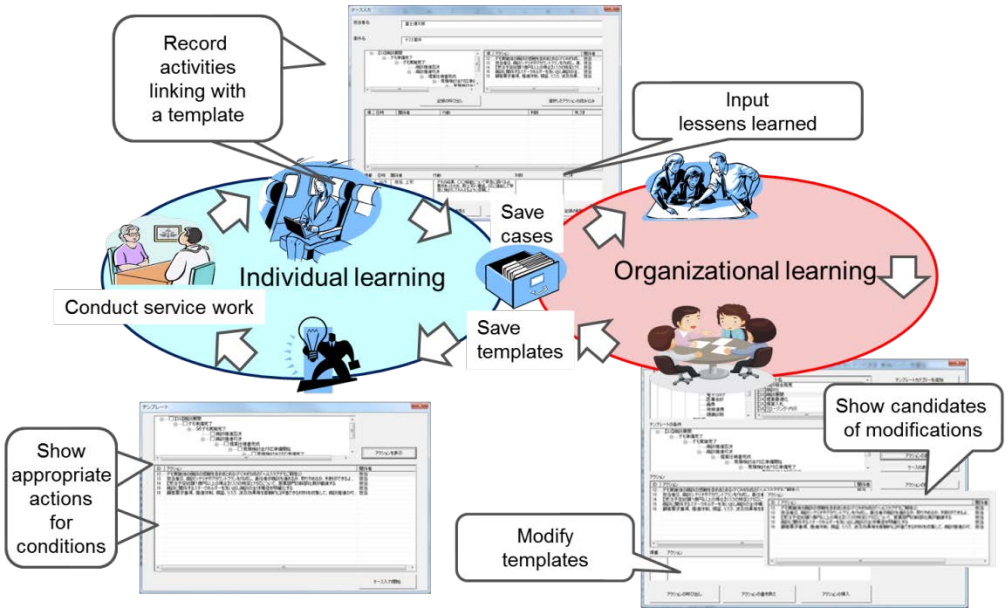

Figure 2. Learning driven Collaboration Management

EXPERIMENT

We conducted an experiment in social welfare works in a city. An expert and two teams of case workers (a mix of experts and novices with five, and six members) participated. The expert created the first version of the template for mistreatment cases that consisted of 10 conditions and 37 actions. From there, two learning cycles were conducted using the template. After the two learning cycles, the initial templates were elaborated into 14 conditions and 56 actions. Participants in the experiment commented that the template and the management model were very helpful in clarifying and improving their unstructured work processes efficiently. Expert case workers commented that they could express their tacit knowledge efficiently using the template. On the other hand, novice case workers commented they could learn implicit decisions and the know-how of experts.

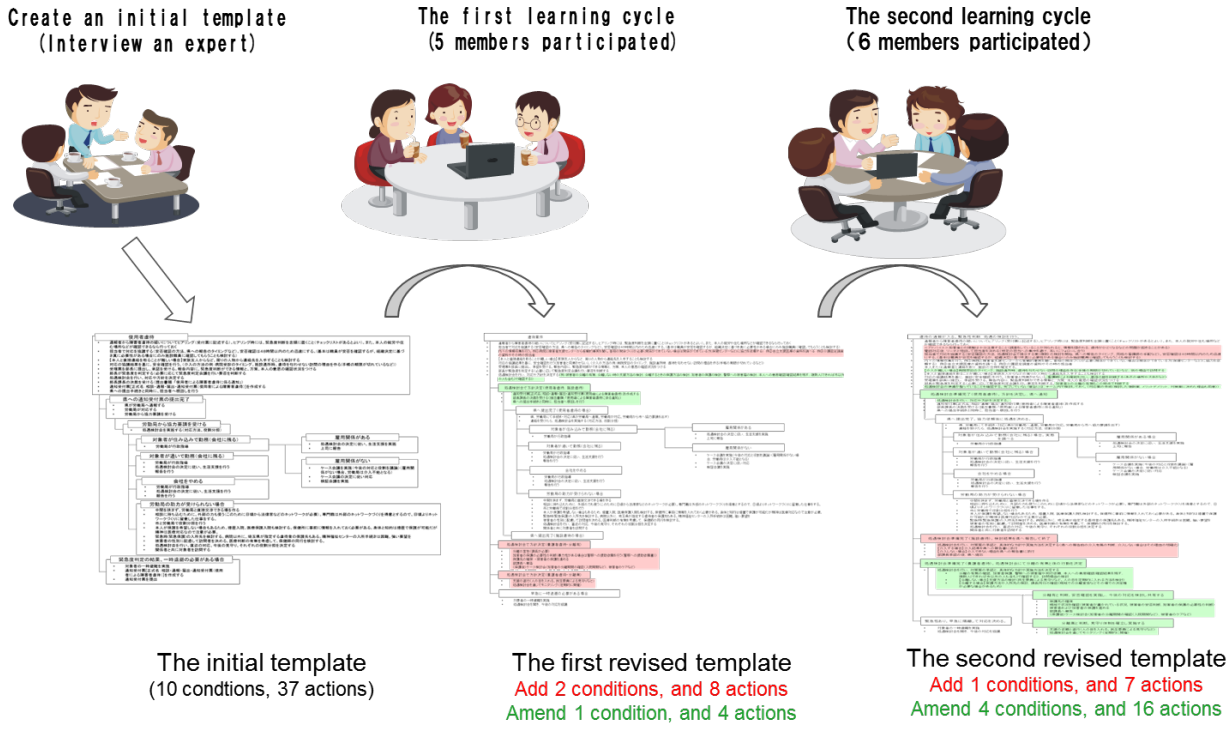

Figure 3: Elaboration of the template for mistreatment cases

CONCLUSIONS

We found the unstructured nature of processes to be one of the major problems in improving service performance and quality. Our proposed work model functioned well in a small scale experiment concerning social welfare case work. Further research will be needed regarding large scale and longitudinal experiments in different types of service works.

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Section 7

Quality Management in Service Engineering

Applying the House of Quality to the New-Building Construction Commissioning Process

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ABSTRACT

Commissioning (Cx) is a quality process for building construction used to verify that the Owner's Project Requirements (OPR) are being met by the final design and construction (D&C). The goal is to confirm that each phase of the project is linked back to the OPR through quality assurance methods. Leadership in Energy and Environmental Design (LEED) certification is an OPR and can contribute to difficulties within the D&C process. The LEED rating system offers numerous point opportunities that span the full range of design disciplines. It is difficult to quickly understand how a design decision made by one discipline impacts another discipline's goal(s) for maximizing LEED points in their respective areas. The House of Quality (HOQ) tool of the Quality Function Deployment (QFD) methodology can provide a means of comparison among the OPR, the proposed design, and the design impacts among the LEED credits. This paper will introduce a proposed four-phase QFD model that has been specifically modified and tailored for use by the Commissioning Authority through all phases of D&C process. It will then focus on the methodology for developing the first phase of the model, which is expanded for projects seeking LEED certification. The remaining three phases of the Commissioning QFD are discussed elsewhere. The first phase or pre-design phase will consist of two HOQ matrices for LEED projects. The first HOQ will be used to assist in identifying the LEED credits to be included in the OPR and to understand the design impacts among the LEED credits selected. The second HOQ will evaluate the alignment of the architect/engineer team's Basis of Design (BoD) with the OPR, as well as identify the impacts among the OPR and the impacts among the BoD.

Keywords: House of Quality, HOQ, Quality Function Deployment, QFD, Leadership in Energy and Environmental Design, LEED, Commissioning, Construction

INTRODUCTION

The construction of a new non-residential building can represent one of the largest investments any business will face. With most investments, it is desired to maximize value and minimize cost and this of course holds for most new building construction. Trends are driving building designs and construction methods that are considered "sustainable" and/or "green," however the benefits of going sustainable/green vary greatly depending on the needs of each potential building owner.

In the case of a traditional design/bid/build construction process there are distinct phases in the building lifecycle. During each phase certain groups have responsibility for deliverables and those are generally structured as follows: Pre-design phase – owner and architect (and often the engineers); Design phase – architect and engineers with owner feedback at design reviews; Construction phase – general and sub-contractors with oversight by the owner's construction manager (CM); and Operations & Maintenance (O&M) phase – the maintenance team assigned to the building. Typically the owner's project manager (PM) will be involved from pre-design through occupancy; however, the PM may have minimal involvement other than schedule and budget concerns once construction begins and the CM is involved. It is unlikely the PM will be involved with the project after occupancy, which leaves sole responsibility of the O&M phase to the O&M staff. If a building is to be sustainable, project emphasis must continue beyond construction into the O&M phase of the building's lifecycle. This becomes difficult when project oversight is relinquished at turnover. The commissioning authority (CxA) is likely the only player with project responsibilities beginning at conception and continuing through the warranty period.

Cx is an owner initiated process that is expected to bridge all phases of a D&C project, including O&M, by verifying that D&C processes meet the OPR. As each team hands off to the next, the commissioning authority (CxA) will confirm that the preceding team is providing the following team with the necessary information to complete their responsibilities in a manner that meets the OPR. This begins with the owner, meaning the OPR needs to be as detailed and complete as possible so the designers understand what they are to provide.

Next, the designers must produce construction documents that are adequate for the contractor to build what is designed. The contractor must provide submittals for the materials and equipment which confirm the selections meet the drawings and specifications. Then the construction must be completed as specified in the construction documents.

Finally, the training and documentation provided to the O&M staff must provide a clear picture of what they will be operating, how it was designed to operate, why it was designed that way, and how it should be operated and maintained. Without the O&M staff having this knowledge it is unlikely the building will be sustainable. The O&M staff is basically stuck with what is turned over to them when construction is complete. If the process of linking all activities back to the OPR fails in any previous phase it is unlikely they will be able to operate the building as expected. Figure 1 presents the major Cx activities in a typical new-building construction project as proposed by ASHRAE Guideline 0-2005. The CxA will have the responsibility of ensuring these activities are realized and that each meets the expectations of the OPR. As there is a handoff of responsibilities at each phase, the CxA ensures and verify that each handoff is sufficient to meet the OPR. Though building commissioning is not a new concept and is the focus of much work by Cx organizations and practitioners, there are still weaknesses in the process that can be addressed.

As part of an effort to prequalify firms for future project needs, a formal request for quote (RFQ) for Cx services was sent to numerous Cx consulting firms. Thirteen formal responses were received. One key question asked within the RFQ was: "How will the basis of design be verified with regard to the owner's project requirements?" None responded with any type of process for how they would accomplish this, simply that it would be done. An assumption made was that they either did not have a formal method or they did not wish to disclose. Regardless, there is no published methodology for this process and firms or persons entering the field are left to figure it out as they go.

This is seen as a weakness in the process and serves as partial motivation for this research. The reason for contracting a third-party representative, the CxA, is for the owner to get some hard documentation that all of the verification is being accomplished and is sufficient. Without some type of method used by the CxA, the owner is left with the same uncertainty as would be if they simply took the word of the architect/engineer (A/E) team and contractors. And the question remains – "when this project is complete, will I get all that I asked for and am expecting?"

A deviation this proposed methodology takes from ASHRAE Guideline 0 is moving "verify the BoD meets the OPR" from the Design Phase to the Pre-Design Phase - this a critical step and design should not begin until the owner and A/E team are confident the BoD and OPR are in alignment.

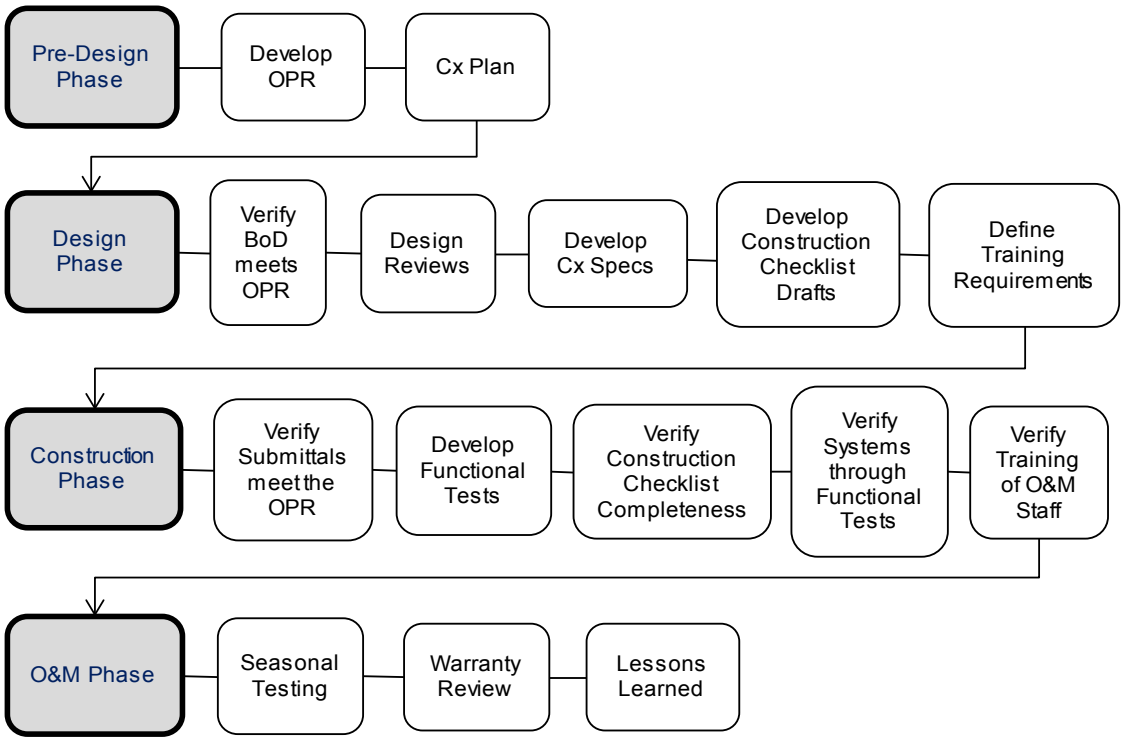


Figure 1. Commissioning activities

QUALITY FUNCTION DEPLOYMENT

Quality function deployment (QFD) has traditionally been used by companies for product development and manufacturing to determine the best design options, manufacturing processes, costs, and level of quality among others. The matrices of the four-phase QFD model are designed to bridge the major phases of product development and manufacturing. Phases proposed by Clausing (1994) are House of Quality, Part Deployment, Process Planning, and Operations Planning. The goal is to ensure that the needs of the customer are translated through to the final product.

Hauser and Clausing (1988) asked, "Design is a team effort, but how do marketing and engineering talk to each other?" This is a question that many in the manufacturing industry might answer, "not well." A similar question could be asked within the construction industry, "Design is a team effort, but how does the owner and A/E team talk to each other?" Many in the construction industry might answer same way, "not well." This is no fault of either party as they typically do not speak the same language. Many owners do not understand the technical jargon of architects and engineers. With product development, marketing is typically adept at determining what the customer might want in a product. With building design, the architect typically has the first contact with the owner and most architects are proficient with the programming effort required to determine what the building should be, however much can be missed when it comes to the building systems. Hauser and Clausing (1988) illustrate how quality function deployment and the house of quality (HOQ) can provide a solid method of communication between marketing and engineering, which then continues downstream to the manufacturing and quality assurance activities. A similar method using the HOQ and QFD can be adapted to the D&C Cx process.

The HOQ is a tool within the QFD process which provides a means of matching the product's design with the voice of the costumer or customer requirements. Figure 2 illustrates the basic HOQ. Customer requirements are ***what*** the customer desires of a particular product based on marketing studies. The design response is ***how*** the designers will meet the needs of the customer. Design correlations are used as a means of understanding if one design response has an impact on another design response. The body of the matrix holds the relationships, or how well each design

response addresses the customer requirements. The marketing matrix and design data matrix are used by the marketing and design teams for developing and prioritizing the whats and hows. In short, QFD is designed to gather the customer's needs and desires of a product, weigh those needs and desires against the needs and desires of the company, verify that engineering designs the product to those requirements, and verify that manufacturing can produce the product as designed. The goal is a product that will appeal to as many customers as possible.

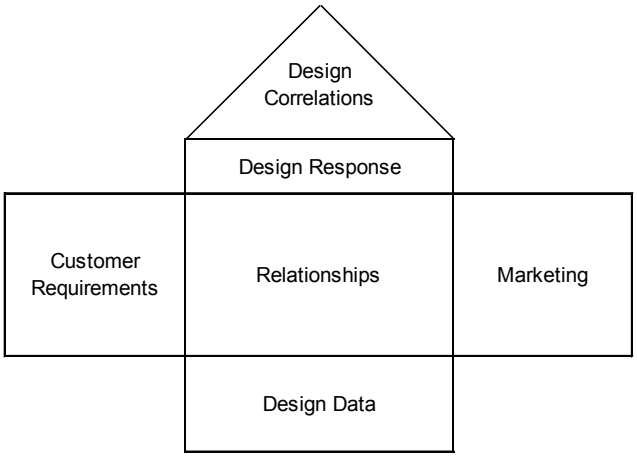


Figure 2. Basic HOQ

Quality Function Deployment in the Construction Industry

Researchers over the past several years have demonstrated ways QFD can also be a beneficial tool for the construction industry. Mallon and Mulligan (1993) present QFD as a means for meeting the customers' requirements in construction projects, providing an example of such for a computer workroom. Eldin and Hikle (2003) conducted a pilot study, using the design of a classroom as a case, to determine the effectiveness of using QFD as a means of developing conceptual designs in the preliminary phase of construction projects. Ahmed et al. (2003) utilized QFD for a civil engineering capital project. Yang et al. (2003) integrate fuzzy set theory into the QFD process for use as a decision making aide in construction design. Alarcon and Mardones (1998), Gargione (1999) and Abdul-Rahman et al. (1999) used it in the design phase to capture the customer needs. Dikmen et al. (2005) examined a completed building to capture customer needs for marketing purposes. Delgado-Hernandez et al. (2007) considered nursery development/design. Each of these are primarily looking at the design and capturing the needs of the customer. These processes appear to be structured for use by the design team or could be used by the owner where the owner would then specify the design criteria. This may have a tendency to constrain the design creativity. Kamara et al. (2000), Pheng and Yeap (2001), Lee and Arditi (2006), and Lee et al. (2009) used QFD as a tool for concurrent engineering and design/build applications.

The objective of this paper is not to regenerate how QFD could be used by a design team within the construction industry as a means to improve their final product (design only), rather to introduce a QFD model that has been specifically tailored for use by the CxA during the entire D&C process and to focus on the development of the first phase of the model. This will consist of two HOQ matrices, one specifically for LEED projects and one serving as the Pre-Design HOQ.

The OPR is considered a living document and is subject to change throughout design and construction. Changes may occur at any time during the project and any changes must be approved by the owner and be updated by the CxA. The BoD is also a living document and will very likely change as the design progresses and should also be updated as needed. The Pre-Design HOQ has been adapted and modified to provide a method to analyze any proposed changes to the OPR or the BoD and to quickly determine how the change will affect the other OPR and BoD criteria.

The proposed commissioning QFD model is presented in Figure 3. This model was developed to integrate with the Cx process recommended in ASHRAE Guideline 0. The four phases of the model link the major design, construction, operations and maintenance, and Cx activities back to the OPR. For these activities to be linked between phases the information in the hows area of the previous matrix will transfer to the whats area of the

following matrix. The whats and hows for each matrix are as follows:

Pre-Design Phase: OPR (what), BoD (how); Design Phase: BoD (what), Design [broken down by division, system, sub-system, and components] (how); Construction Phase: Design [broken down by division, system, sub-system, and components] (what), Construction [broken down by sub-contractor and components installed] (how); and finally, O&M Phase: Construction [broken down by sub-contractor and components installed] (what), Documentation [construction checklists, functional performance tests, training, O&M manual, systems manual] (how). These will effectively tie all activities back to the OPR and provide a solid foundation for the O&M staff at occupancy.

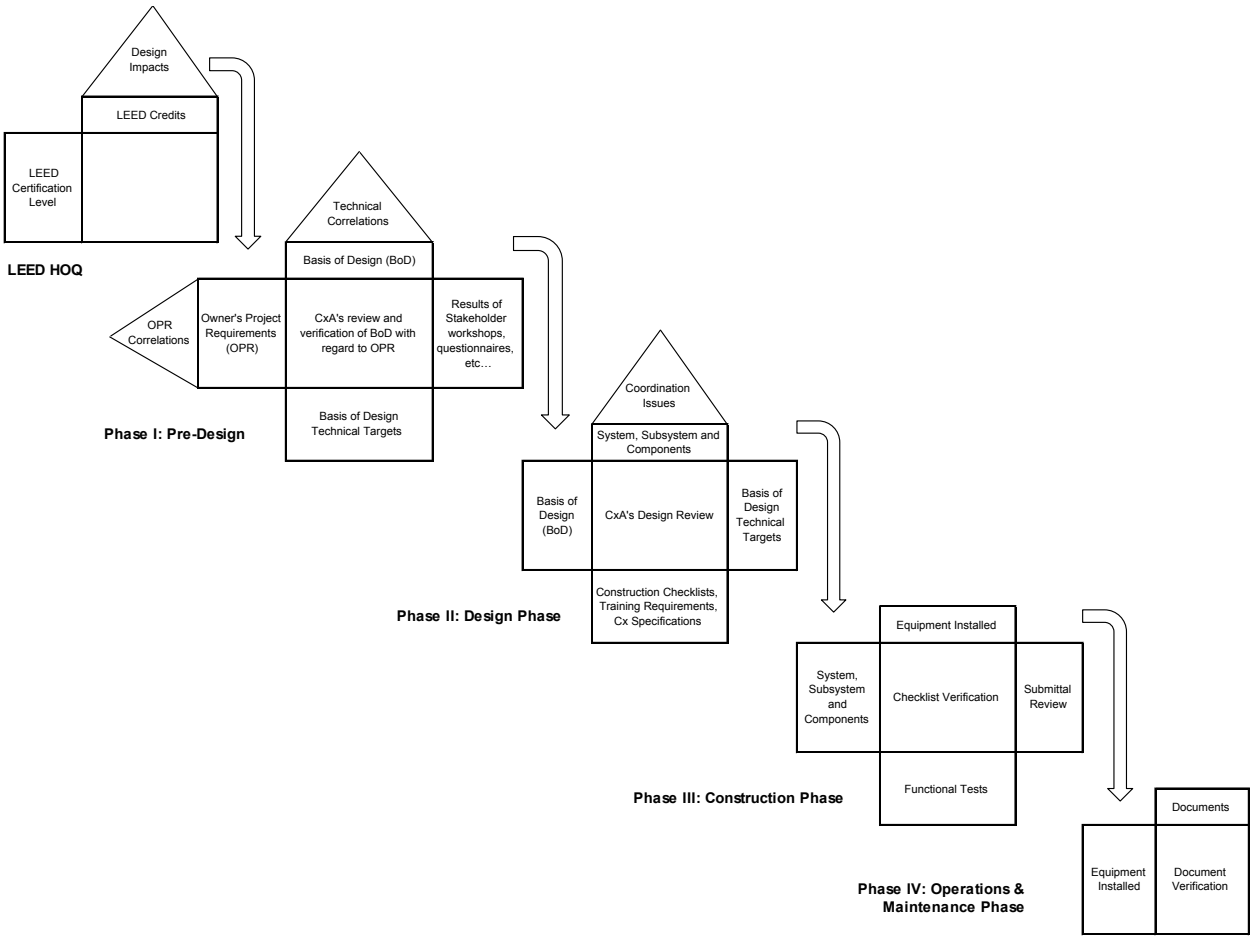


Figure 3. Commissioning QFD model

METHODOLOGY FOR THE PRE-DESIGN PHASE

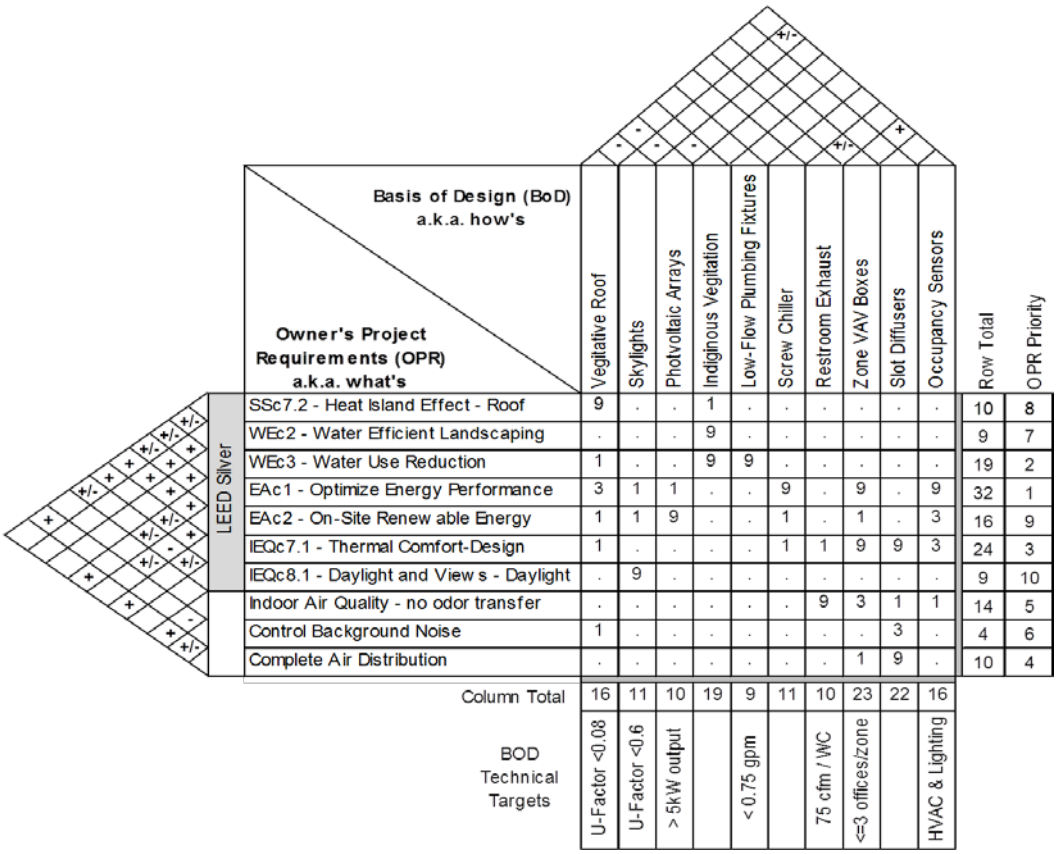
Building the Pre-Design HOQ

The first step in the Cx process is assisting the owner with developing the OPR. There are many methods for assisting the owner in developing the OPR, some of which might include workshops with key stakeholders, questionnaires, group meetings, or nominal group technique. Based on the focus of this research, these methods will not be discussed here with the exception of those OPR that include LEED certification.

Information gathered from the OPR development workshops will be entered into the marketing matrix and whats sections simultaneously. This will provide an opportunity to prioritize the OPR based on importance to the owner.

Once the OPR has been established, prioritized, and approved by the owner the information is finalized in the whats area of the house. The approved OPR along with the priorities should also be provided to the A/E team to use as a reference and compliment their programming and design effort.

The BoD, based on the approved OPR, will be generated by the A/E typically during their schematic design phase and will be provided to the owner and CxA. The BoD is entered into the hows area of the house. Each project will have a different OPR and BoD; therefore, Figure 4 presents the Pre-Design HOQ in a much abbreviated state. Hypothetical OPR and BoD have been added for illustration purposes. One specific addition here is the LEED requirement. In this example, 'LEED-Silver' has been added as an OPR along with some possible credits. The LEED requirements and how to deal with them will be discussed later.



Owner's Project Requirements (OPR) a.k.a. what's \ Basis of Design (BoD) a.k.a. how's	Vegitative Roof	Skylights	Photvoltaic Arrays	Indiginous Vegitation	Low-Flow Plumbing Fixtures	Screw Chiller	Restroom Exhaust	Zone VAV Boxes	Slot Diffusers	Occupancy Sensors	Row Total	OPR Priority
LEED Silver												
SSc7.2 - Heat Island Effect - Roof	9	.	.	1	.	.	.	.	.	.	10	8
WEc2 - Water Efficient Landscaping	.	.	.	9	.	.	.	.	.	.	9	7
WEc3 - Water Use Reduction	1	.	.	9	9	.	.	.	.	.	19	2
EAc1 - Optimize Energy Performance	3	1	1	.	.	9	.	9	.	9	32	1
EAc2 - On-Site Renew able Energy	1	1	9	.	.	1	.	1	.	3	16	9
IEQc7.1 - Thermal Comfort-Design	1	.	.	.	.	1	1	9	9	3	24	3
IEQc8.1 - Daylight and View s - Daylight	.	9	.	.	.	.	.	.	.	.	9	10
Indoor Air Quality - no odor transfer	.	.	.	.	.	.	9	3	1	1	14	5
Control Background Noise	1	.	.	.	.	.	.	.	3	.	4	6
Complete Air Distribution	.	.	.	.	.	.	.	1	9	.	10	4
Column Total	16	11	10	19	9	11	10	23	22	16		
BOD Technical Targets	U-Factor <0.08	U-Factor <0.6	> 5kW output		< 0.75 gpm		75 cfm / WC	<=3 offices/zone		HVAC & Lighting		

Figure 4. Pre-Design HOQ

The body of the matrix will be used by the CxA during the review of the BoD to verify it meets or addresses each of the OPR. Using a numbering scheme of 9 (strong relationship), 3 (medium), and 1 (weak) in each cell to specify how well each BoD meets a particular OPR will be used. This numbering convention has been utilized by many researchers and is recommended by Cohen (1995). A "." is used to populate a cell in which the combination has been reviewed and found to have no relationship. This is meant to reduce the duplication of work which may occur if the cell is left blank and multiple people are conducting the review.

It is important to understand that these entries are the professional opinion of the CxA and are not intended to be a critique of the design per se, rather to identify points of discussion between the owner and design team if it appears some OPR are not well represented in the design. The values in each row and column will be summed to identify which OPR are well addressed by the BoD and how well each BoD is addressing the OPR as a whole.

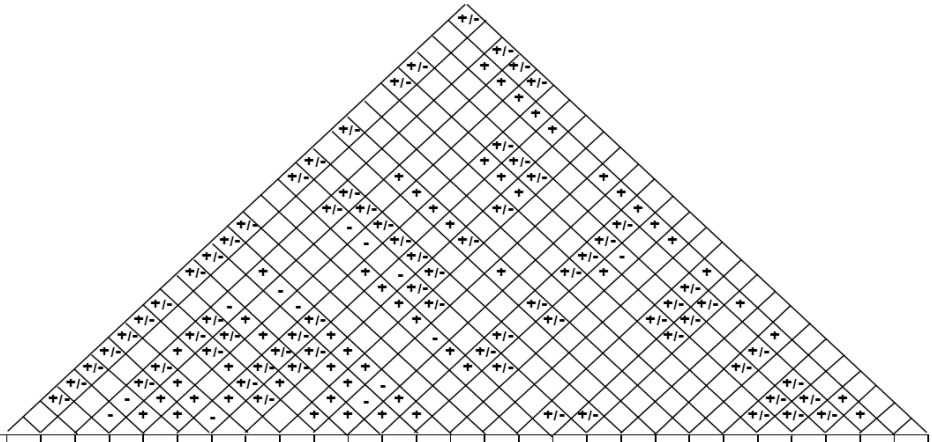
The design correlations area (roof) of the HOQ is used to understand the impact, negative or positive, one design criteria has on another. The methodology for the roof will be explained with the development of the LEED HOQ.

The addition of a correlation matrix to the OPR is specifically for the CxA to use while assisting the owner and A/E team align the OPR and BoD. This correlation matrix identifies the impact(s) a change in one OPR will have on another OPR. The CxA may identify OPR that have not been well addressed by the BoD. During discussions between the owner and A/E the owner may be asked to change the OPR. Using the correlation matrix the owner can now quickly understand how that change might affect other OPR. This is particularly useful for LEED projects.

Building the LEED HOQ

There are many combinations of credits that can be utilized to accomplish an owner's LEED certification goal, but the combination that best fits the OPR and the owner's definition of value is a question that must be answered early in the process. This is complicated and requires much coordination, cooperation, and communication.

At this point all of the certification levels and the required points are added as OPR, as the final level that will be achieved is not known this early in the process. The LEED credits will now be added as BoD responses. Figure 5 represents an abbreviated LEED HOQ. The remaining credits would be entered in the same manner, but are not able to be displayed in the format of this document. Therefore, an abbreviated version is provided. The associated points for each credit are added to the target value (LEED Points) row above the credits categories. LEED categories and credits along with the associated points can now be quickly referenced.



Difficulty of Accomplishment (0 = Easy , 10 = Hard)	10		7	7	5	6	3	3	4	6	3	10	8	5		4	8	2		4		2	6	4	5	9	7
Maximize (▲) or Target (×)	×		×	×	×	×	×	×	▲	×	▲	▲	▲	×		×	▲	▲		×		×	×	×	×	▲	▲
Target Value (LEED Points)	1		1	1	1	1	1	1	4	2	4	19	7	2		2	3	2		1		1	1	1	1	5	4
LEED Catergory	SUSTAINABLE SITES								WATER EFFICIENCY			ENERGY AND ATMOSPHERE					MATERIALS AND RESOURCES					INDOOR ENVIRONMENTAL QUALITY				ID	RP
LEED Credits / LEED Certification Level / (Point Requirement)	SSc1 - Site Selection		SSc5.2 - Maximize Open Space	SSc6.1 - Stormwater Quantity Control	SSc6.2 - Stormwater Quality Control	SSc7.1 - Heat Island Effect - Non-Roof	SSc7.2 - Heat Island Effect - Roof	SSc8 - Light Pollution Reduction	WEc1 - Water Efficient Landscaping	WEc2 - Innovative Wastewater Techniques	WEc3 - Water Use Reduction	EAc1 - Optimize Energy Performance	EAc2 - On-Site Renewable Energy	EAc3 - Enhanced Commissioning		EAc6 - Green Power	MRc1.1 - Building Reuse	MRc2 - Construction Waste Management		MRc7 - Certified Wood		IEQc6.1 - Controllability of Systems - Lighting	IEQc7.1 - Thermal Comfort - Design	IEQc8.1 - Daylight & Views - Daylight	IEQc8.2 - Daylight & Views - Views	IDc1 - Innovation in Design	RPc1 - Regional Priority
Certified (40-49)	9		1	1	1	1	3	1	1	1	3	9	3	9		3	3	1		1		1	3	1	1	3	1
Silver (50-59)	9		3	3	3	3	3	1	3	3	3	9	3	9		3	3	3		1		1	3	3	3	3	3
Gold (60-79)	9		3	3	3	3	3	3	9	3	9	9	9	9		9	9	9		3		3	9	3	3	9	9
Platinum (80-110)	9		9	9	9	9	9	3	9	9	9	9	9	9		9	9	9		3		9	9	9	9	9	9

Figure 5. LEED HOQ

The row above the target value is used to symbolically represent whether the target value should be maximized or is the target. Many credits only offer one point level (all or nothing) while others offer a range of points. If the points are "all or nothing" an "✕" is used to indicate this is the target. If the points are a range a "▲" is used to identify that the goal is to maximize points. The next row above is used to represent the difficulty of achieving the target or goal. In this case the CxA's experience in the D&C fields would be used to rank the difficulty of each credit from 0 – 10, with 10 representing "extremely difficult." Primarily the difficulty represents the level of cost, time, and resources required to accomplish the associated LEED points. Each project will have its own level of difficulty for achieving certain credits so this section will vary from project to project. The values are not critical to achieving a particular level of LEED certification, but are useful in engaging the owner in the process of determining which credits are truly important to them and ultimately which should be included in the OPR.

The matrix between the certification level and credits is now populated. This can only be completed with some understanding of the LEED process and the requirements for achieving the LEED credit points. Generally though, without that knowledge, it can easily be seen that in order to achieve LEED Platinum, which requires a minimum of 80 points from the available 110, attempting most of the credits will be necessary. Achieving 80 points is not an easy accomplishment.

The same numbering scheme of 9 (high), 3 (medium), and 1 (low) will be used to populate the relationships matrix, but are now used to indicate how important it might be for this credit to be attempted in order to meet the level of certification. There is no mathematical significance to these numbers, but again is simply a visual strategy to engage the owner in the process and to provide a simple method for understanding the difficulty of reaching each successive certification level and that some credits that the owner would not have pursued will now be needed if trying to reach the next level. Again analyzing the opportunities or necessities for LEED Platinum, it can be seen that nearly every credit may have to be attempted to accomplish 80 points, particularly if all the available points for the credits having a range of points are not achieved. In the Pre-Design HOQ, this matrix makes it simple to identify if a particular OPR is being adequately addressed by the design team. With the LEED HOQ this is simply providing insight into the difficulty of achieving certification.

One of the most valuable components of the LEED HOQ is the roof, as it represents the affects, either negative or positive, one credit has on another. It offers a quick visual for a CxA and owner to understand the impacts one discipline's decision will have on another discipline's work.

The roof is laid out to capture the relationship between any two LEED credits. If one credit is taken in a positive direction, meaning the design is attempting to maximize the points for that credit, the roof indicates the impact on another credit. If it has a negative impact a "-" is placed in the cell, positive impact a "+" is used, and if both positive and negative a "+/-" is used. The roof cannot be populated without an understanding of the requirements of achieving each LEED credit, design practices of architects and engineers, and general construction. To populate the roof each credit was evaluated and compared to each of the other credits. A determination was made as to how the credits impacted one another. Notice the roof is heavily populated with "+/-". This indicates that depending on which credit is taken to the side of maximizing points, the other credit will realize a positive or negative impact. The specific impacts will only be determined by the designers involved in each project, but this provides a quick reference for the CxA and owner to understand that conflicts do exist and if a +, -, or +/- is found in the cell then questions to the design team are warranted. This will be especially useful in selecting which credits to attempt (i.e. how will the decision to select one credit impact the scorecard as a whole?) and if late design changes are proposed (i.e. if the design change proposed changes one credit how does it impact the other credits?).

Some design decisions may affect or impact more than one design area or credit. In this situation a chain reaction of impacts occurs. An example might be: Sustainable Sites, Credit 7.2, Heat Island Effect – Roof, exposes a number of relationships that should be considered. There are many design strategies that may achieve this credit but let's look at the vegetative or "green" roof option. First, the cost to install a "green" roof would need to be compared to a more conventional roof which would also accomplish the credit (budget impact). Second, the "green" roof will likely have greater mass and may require an increased structural system in the building (budget impact and possibly a reduction of the interior volume, which reduces the available space for the building systems and occupants). Any roof that qualifies for SS Credit 7.2 will reduce the heating and cooling loads on the building and, therefore, reduce the amount of energy required to maintain thermal comfort (life-cycle cost). Another advantage with reduced heating and cooling loads is that the equipment required to heat and cool the building can be reduced (first cost reduction).

Since the HVAC system is smaller, so too will be the electrical system necessary to supply the equipment (smaller electrical gear and lower first-cost). This is a vegetative roof so it will require irrigation to keep the plants alive

(higher water usage and utility bill). This will negatively affect the water efficiency of the building (WE Prerequisite 1). With this there is an opportunity to plant indigenous vegetation and to attempt Water Efficiency (WE) Credit 1, Water-Efficient Landscaping or SS Credit 5.1, Site Development – Protect and Restore Habitat.

Adding a skylight(s) to this roof will reduce the area of the vegetation, the heat island effect will still be reduced, the required irrigation will be reduced, but now the additional sun introduced through the skylight will contribute to achieving Indoor Environmental Quality, Credit 8.1, Daylight and Views – Daylight. However, the insulating factor of the vegetative roof is now reduced and solar heat gain is introduced, which will increase the heating and cooling load, HVAC system requirements, and electrical system requirements.

The HOQ roof as designed for product development cannot take into account all of these impacts at one glance, but does still have the ability to expose the possible path of the affects and provides a method to navigate the possibilities. Knowing that one technical response will have an effect on another can still lead to the understanding that a third and fourth response is affected.

LEED certification will likely be only a small part of the OPR, but much of the design directed towards meeting the other OPR can contribute to meeting the LEED certification. Based on other OPR some of the LEED credits can or will be eliminated. For example, the owner may have decided that in no circumstance shall the new building be located on a property that is considered a brownfield site. This would eliminate LEED opportunity Sustainable Sites, Credit 3, Brownfield Redevelopment. This is a simple and obvious example, but as some credits are eliminated it reduces possible impacts that might be imposed on other credits.

Additionally, some credits may be eliminated because given certain circumstances they are impossible to obtain. Reviewing the LEED HOQ roof it can quickly be seen that nearly all of the Sustainable Sites (SS) credits will have positive or negative impacts on each other. The site selection is critical to many other credits and may be outside the control of the design team. Often an owner will have purchased a piece of property long before contacting an architect, design team, LEED AP, or CxA. The location and size of the property will immediately either eliminate the possibility of achieving or promote achievement of other credits. For example, if a site is selected in a rural setting, outside city limits perhaps, it is likely that it will eliminate the possibility of SSc2, Development Density and Community Connectivity and SSc4.1, Public Transportation Access. What begins to happen is that the list of possible credits shortens and the need to maximize points of other credits heightens. Looking at the relationships area of the LEED HOQ it can be seen that these numbers will have to increase as fewer possibilities are available. Now many if not all of the relationships will be rated as a 9. It may also be seen that it is impossible to achieve LEED-Platinum or even Gold.

When this process is complete and the LEED certification level and credits to be attempted have been determined, the credits are added to the OPR as a sub-requirement to the LEED level. The complete OPR, including the owner's preferred LEED credits, can be presented to the design team. Now the BoD presented to the owner by the design team will be directed towards meeting those specific LEED credits as well as the other OPR. It is recommended that the full LEED HOQ (all of the credits are listed) be kept intact for future review of impacts caused by late design change proposals. The CxA and owner can quickly go back to the roof and determine if a proposed change will negatively impact the original credits, thus providing a greater opportunity to determine if the change has value to the owner.

CASE STUDY

The complete Cx QFD model (the final three phases are discussed elsewhere) was developed to verify that the OPR and the needs of the downstream customers are adequately addressed by the previous team. It links each of the critical phase activities back to the OPR while working toward reducing issues at any phase of the project. The project issues of two recently completed buildings were investigated and applied to the model to determine when each issue would have been discovered or avoided and the expected savings associated. Each of the projects received Cx with differing results. All issues were considered, and included: RFIs, Change Orders, ASIs, Warranty Issues, Work Orders (after occupancy and the warranty period), and Cx identified issues.

Building 1 was a major renovation project that included a new addition of approximately 33% of the total 90,000 sq. ft. The project budget was $26M. Building 2 was also a major renovation of 30,000 sq. ft. and a project budget of $4M.

The issues and quantities of each are presented in Figure 6. Much of the Cx documentation for Building 1 could not be located. The major issues and the results of applying those issues to the model are presented in Figures 7 & 8. It can be seen that there are several issues that would have been eliminated in the pre-design phase using the model.

Building	# of RFIs	Change Orders		# of Warranty Issues	# of Work Orders	# of Cx Issues	
		Quantity	Cost ($ M)			Design Issues	Construction Issues
#1	312	173	$3.90	Note 1	75 Note 2	Note 3	Note 3
#2	23	34	$0.20	3	Note 4	263	44

1. The documentation regarding warranties was unable to be located.
2. Issued during the second and third year. The majority being HVAC and lighting related. Both systems have been a problem from building completion primarily due to the lighting controls and HVAC design and controls.
3. Documentation for Cx issues was not located.
4. The building is just out of the warranty period and no work orders have been submitted.

Figure 6, Issues and quantities

Building #1

Issue Type	Qty or Cost	Description of Issue	Identified by Methodology at	Savings
Request for Information	12	Expansion joint details missing	Design review	Associated change orders and project delays
	10	Lighting schedule deficiencies	Design review	
	63	HVAC	OPR / design review	
Change Orders	$44,000	Hydronic piping not on drawing	Design review	$44,000
	$245,000	Electronic door access	OPR development	$245,000
	$75,000	Electrical one-line drawing deficiencies	Design review	$75,000
	$99,000	Move generator and associated wiring	Design review	$99,000
Work Orders	75	HVAC, Lighting and door locks	Various phases	Hundreds of maintenance man hours with associated cost as well as lost opportunity
Documentation		Missing documentation: warranty items, all Cx documents, systems manual, functional performance tests.	Various phases	Improved response time, troubleshooting efficiency, preventive maintenance, and reduced system downtime.

Figure 7. Building #1major issues

Building #2

Issue Type	Qty or Cost	Description of Issue	Identified by Methodology at	Savings
Request for Information	23	Minor requests for details of electrical, ducts, concrete walks, and chilled water risers.	Design review	Associated change orders and project delays
Change Order	$65,000	Add data and VOIP to each space	OPR development	$65,000
	$38,000	Add five additional fume hoods	OPR development	$38,000
Cx Identified (design review)	263	Small issues with various building systems with little or no cost to resolve	OPR development	Associated change orders and project delays
Cx Identified (construction)	44	Primarily during functional testing: lack of system alarms, sequence programming,	Design/construction review of control logic	Associated change orders and project delays

Figure 8. Building #2 major issues

LIMITATIONS

The length of time and manpower to develop the Pre-Design HOQ could pose a problem for some teams. A very simple example was presented here, but the HOQ for a complete building will be sizable. Significant resources may need to be available to ensure other project activities are not delayed. To develop both the LEED HOQ and the OPR of the pre-design HOQ there will have to be a firm commitment by the owner to engage in the process and truly consider what is important in the completed project.

CONCLUSIONS

The HOQ can be used to assist the CxA in the Cx process for new-construction building projects, including those seeking LEED certification. The work presented here is the first phase of the Cx process of developing the OPR and verifying that the basis of design meets the OPR. With both the OPR and the BoD being living documents and subject to change it makes the verification that design meets the OPR more difficult. The HOQ will provide a means to evaluate and analyze any design change proposed by either the owner or design team quickly and efficiently. The decision to accept the change then can be considered for value addition and impact to the rest of the project.

The CxA will have documentation of the process to illustrate to the owner that the design is truly being directed towards meeting the OPR. Considering that the LEED 2009 for New Construction guideline is over 600 pages, this is an efficient method for bringing a large amount of information into a compact format for understanding the impact one design might have on another. The HOQ will visually display the project information in a clear and compact format and will promote improved coordination, cooperation, and communication amongst the team members.

The CxA can provide the completed HOQ and LEED HOQ to the design team for use in identifying the potential conflicts between LEED credits early in the design phase which will provide a greater opportunity for the design team and the CxA to be successful in delivering a completed building which meets the OPR and LEED certification goals. The adapted HOQs for LEED and the pre-design phase will reduce issues in the later phases of the project.

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Employee and Customer Cynicism: Strategic Engineering of Service Encounters for Effectiveness in Environments of High Cynicism

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ABSTRACT

The purpose of this research is to develop a theoretical model of employee cynicism and customer cynicism in the context of service environments and to propose suggestions on how to engineer the service encounter for effectiveness even in environments of high cynicism levels. Cynicism has reached high levels in consumers (Sheth & Sisodia, 2005) and high levels in many organizations and it may have important consequences (Andersson & Bateman, 1997; Bedeian, 2007; Patterson & Baron, 2010). The antecedents of employee and customer cynicism are proposed to be both distrust and also a certain level of ignorance about the context of the specific service encounter. Distrust is difficult to make movements (decrease) while contextual ignorance is relatively easier to make movements on (decrease). The resulting model suggests both direct and indirect effects on effectiveness in a given service encounter. Implications are provided for the design of service encounters in environments characterized as highly cynical.

Keywords: Cynicism, Employee Cynicism, Customer Cynicism, Quality Service, Service Design

INTRODUCTION

Designing effective service environment faces the very serious challenge of minimizing the negative effects of service providers who are cynical. Likewise, many customers are also cynical about the services they are purchasing. Yet, despite the cynicism of particular service providers and of particular customers, services continue to be offered and purchased (delivered) for a variety reasons. This yields a situation in which both the service provider and the customer are bringing cynical thinking to the service encounter. Thus there is a significant challenge to overcome the negative nature of these interactions.

What is cynicism? Dean, Brandes, & Dharwadkar (1998) develop the position that cynicism involves beliefs, affect, and behaviors and they define organizational cynicism as "Organizational cynicism is a negative attitude toward one's employing organization, comprising three dimensions: (1) a belief that the organization lacks integrity; (2) negative affect toward the organization; and (3) tendencies to disparaging and critical behaviors toward the organization that are consistent with these beliefs and affect" (p. 345). Beyond specifically "organizational cynicism," Andersson and Bateman (1997) propose that cynicism can be defined as both a general and specific attitude, characterized by disillusionment, frustration, and negative feelings and distrust toward a person, institution, social convention, group, or ideology. They point out that cynicism toward work is a specific attitude conveying work as oppressive, unrewarding, and unworthy of effort. They also explain that cynicism toward an institution is easily generalized to other objects, such as to other similar institutions. Thus, cynicism can be directed at a specific person or institution or can be generalized to multiple people or institutions. Employees and customers may have

both generalized and specific directions of cynicism that entails characteristics described in multiple definitions of cynicism. This creates opportunities for companies to stand out by providing services in environments of low cynicism.

PROPOSED FRAMEWORKS FOR EMPLOYEE AND CUSTOMER CYNICISM

Cynicism is widespread and over the past 20 years appears to be increasing in organizations throughout the U.S. (Bedeian, 2007; Dean, Brandes, & Dharwadkar, 1998; Kanter & Mirvis, 1989) and in Europe and Asia (Kouzes & Posner, 1993). Work environments don't have to be arenas of great cynicism. In fact, work environments can offer empowering and rewarding opportunities for contribution, growth, and development arising out of dynamic and caring leadership in combination with the content and context of the work needed to be performed. Put another way, work experiences, including the social, intellectual, and cultural environment and the task-related challenges/opportunities, can be beneficial to the employees. The positive effects for employees can be realized even while the employees are being very effective and productive and, as such, providing great benefit to the company and shareholders. This view almost seems to characterize what would be the complete opposite of the characteristics of a cynical workplace.

However, work environments can also be arenas of employee degradation, abuse of power, unethical behavior, deceit, and can be characterized as "toxic" (DeAngelis, 2007; Reinhold, 1996). Cynicism grows out of a combination of experiences, events, and observations and individuals' responses to these. Of certain importance are the reports of the misbehavior of many managers, some of which result in big scandals and rapid declines in market capitalization of companies. For example, high levels of executive compensation combined with poor organizational performance contribute to higher levels of cynicism (Andersson & Bateman, 1997). Some additional research on the antecedents of cynicism is described below.

Cynicism Origins

Cynicism originates in ancient Greece, where a group of philosophers developed what is known as the Cynic school of thought and way of life. Dean et. al. (1998) explain that the term itself probably derives from the Greek town of Cynosarges where the Cynics had their school. Cynics believed that individuals and not organizations were the natural unit of human life and that all institutions and organizations were unnatural. As such, they had great contempt for all forms of organization including religion, government, work organizations, and others.

Cynics of ancient Greece criticized society's relentless pursuit of materialism, power, and wealth (Goldfarb, 1991). They had contempt for man-made conventions and wore basic, rough clothing, drank out of their hands, avoided material wealth/accumulation, and rejected most societal standards. The Cynics would often use humor as a vehicle for communicating their disdain and contempt of institutions (Dean, et. al., 1998). Perhaps the most well-known of the Cynics is Diogenes of Sinope, who is known for carrying a lamp in daylight to highlight his search to find one honest man. Cynics believed themselves more moral than others.

We can draw some parallels and identify differences between these ancient Greek "Cynics" and modern day cynical people in their roles as service providers or customers. First, the Greek Cynics lived their lives shunning the institutional consequences for people. While it can be argued that they were recipients of benefits associated with institutions of the time, such as government, they did not directly attempt to gain personal benefit from institutions. Today, organizational cynics are employees or customers of the organizations and receive the very direct benefits associated with being members, such as paychecks or the service being purchased. Yet, the contempt for institutions and those who manage them is clearly similar among the Greek Cynics and today's organizational cynics. The moral position of the Cynics seems greatly, or even fully, eroded for today's cynics given their full participation in, and benefit from the institutions they hold in contempt. Greek Cynics of past centuries and modern day cynics attempt and often succeed in undermining organizational efforts, institutions, and leaders (Goldfarb, 1991).

Modern Cynicism in Organizations

Cynicism has been conceptualized in many ways in contemporary research literature. Albrecht (2002) conceptualizes it as a "pessimistic attitude," particularly within the context of a proposed change. Dean et. al.

(1998) identify five major distinct conceptualization foci including personality focus, societal/institutional focus, occupational focus, employee focus, and organizational change focus. When researchers use the personality focus, cynicism is described as more of a negative perception and hostility towards others and is a broader negative overall outlook on life.

The focus of the societal/institutional cynicism research is on the unmet expectations of society and takes on sociological importance in terms of antecedents and interventions and efforts to reduce levels of cynicism. Researchers who take the occupational focus of the concept of cynicism tend to focus on work cynicism related to the profession or occupation, such as police officers being cynical about the profession. An employee focus on cynicism is described by Dean et. al., (1998) as deriving from the research in attitudes. This perspective focuses on business organizations, executives, and, as an example, violations of psychological contracts. Other researchers identify a cynicism focus more narrowly, driven primarily by the specific context of organizational change efforts.

Taken together, there seem to be three main precursor directions for thinking about and conceptualizing cynicism. There appear to be personality related drivers of cynicism, wherein there are rather permanent characteristics of some individuals to be cynical. There also appears to be an important attitudinal driver of cynicism wherein one's attitudes (which change more readily and frequently than personality characteristics) result in more or less cynical thinking. Finally, some researchers focus on the environmental settings, thus presenting more of a situational approach to the drivers of cynicism.

Employee Cynicism

The research findings discussed in the preceding paragraphs help to identify some of the factors contributing to cynical thinking in organizations. Figure 1 shows three major influences on employee cynicism of situational, attitudinal, and personality-based factors that create distrust and contribute to a certain level of ignorance concerning decisions being made.

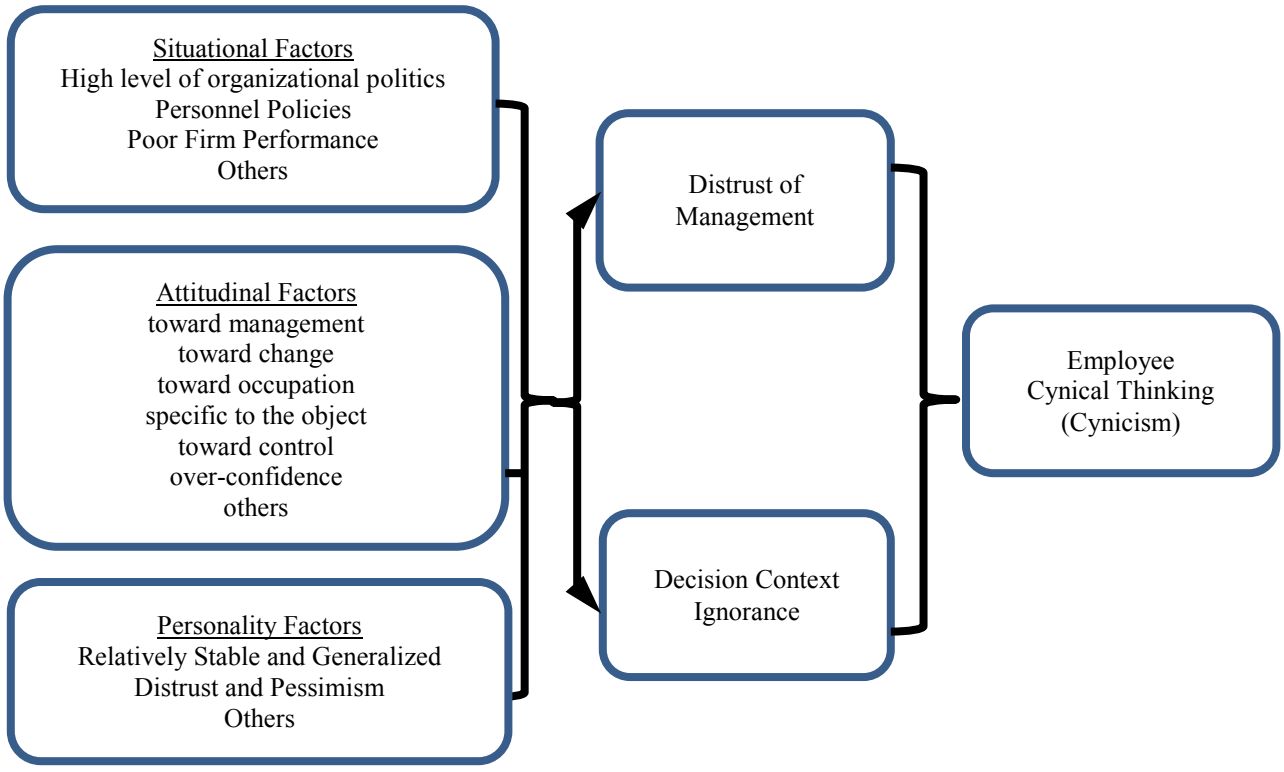

Figure 1: Proposed Framework for Employee Cynicism

Customer Cynicism

The research discussed previously also leads to the proposed framework for customer cynicism as shown below in Figure 2. People can be cynical about certain things or in a more generalized manner. These people may be employees or may be customers. Thus, there is a great deal of similarity in what leads to customers having cynicism and employees having cynicism. The figure shows the same three major categories of situational, attitudinal, and personality influences on customer cynicism through distrust and ignorance of the service context. Thus there is a parallel structure in the frameworks depicting antecedents of cynicism for employees and customers.

To work on reducing the cynicism of service employees and customers, we need to look at the dimensions of service quality and then work on situational factors, attitudinal factors, personality factors, distrust, and contextual ignorance. These efforts should be focused on the specific aspects of cynicism, rather than generalized cynicism.

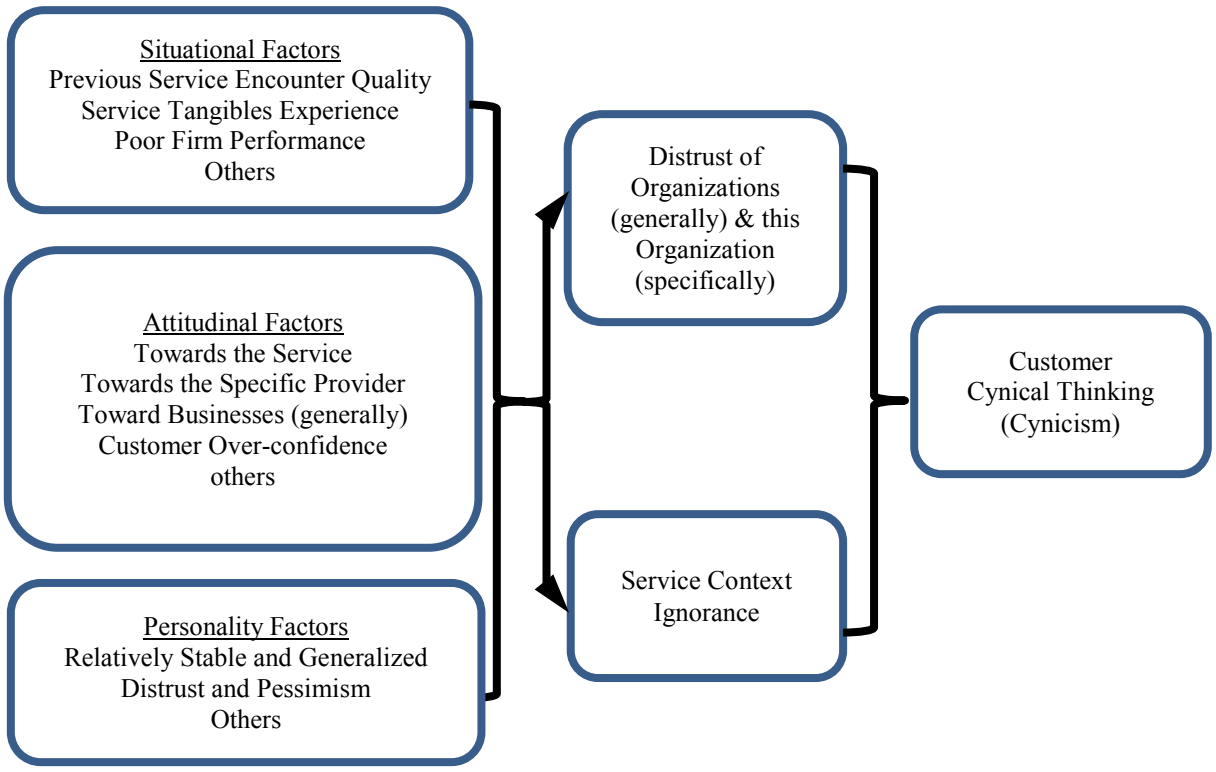

Figure 2: Proposed Framework for Customer Cynicism

SERVICE QUALITY AND CYNICAL EMPLOYEES AND CUSTOMERS

Parasuraman, Zeithaml, and Berry (1985) clearly identified a set of "determinants of service quality" that have become well-recognized as important characteristics of a quality service encounter. Service quality is more difficult for a service customer to evaluate than a goods quality. Quality assessments appear to be a comparison between expectations and performance. In one sense, we don't want our customers to have inflated expectations – or they will be more likely to be dashed and result in evaluations of a lower quality. However, we also don't want customers coming to the service environment with pre-conceived expectations of the untrustworthiness of the service provider or the company. Several of the determinants of service quality are proposed here to be influenced by employee and customer cynicism and provide a framework to overlay the cynicism frameworks to yield some insights about creating better service environments where high cynicism has been prevalent. Briefly, the determinants of service quality are reliability, responsiveness, competence, access, courtesy, communication, credibility, security, understanding, and tangibles. The following definitions/explications of the characteristics are from Parasuraman, Zeithaml, and Berry (1985), although not in order.

Tangibles

Tangibles are the physical evidence of the service including such things as the physical facilities, appearance of personnel, tools or equipment used to provide the service, even other customers in the service facility. The tangible elements of the service environment can be influenced by and influence both the service employee and customer. The tangibles are primarily a situational factor that may influence trust and cynicism. For the employee, the physical environment and the required uniforms can have an effect on their perception of trust in the organization. To reduce employee cynicism, the appropriate tools and equipment with an inviting physical workplace should increase employee trust in their own organization. But tangibles are likely most relevant to improving customer cynicism. If the customer is not trusting of the organization providing the service, it might be due to tangibles that the customer is encountering. Appropriate facilities and appearances can help to build the trust in the organization.

Credibility

Credibility is at the heart of trust and cynicism. It is a critical determinant to service quality and to the cynicism associate with service encounters. Credibility involves trustworthiness, believability, honesty, having the customers best interest in mind. Clearly, to keep the customers level of distrust down, and therefore reduce the level of cynicism regarding the purchased service, we should work to build credibility. Credibility can be related to the company's reputation – which can be difficult to change quickly. However, each high quality service encounter will build up the trust in the service. Organizations may also want to communicate in various ways the credibility of their services. This can include all forms and channels of communication. Credibility will be hurt, though, if promises or claims are made that are then not fulfilled. Trustworthiness requires fulfilling promises and obligations. Organizations can invest more in service providers in ways to reduce service provider turnover. In so doing, the service providers will be more likely to build credibility.

Understanding/Knowing the Customer

Understanding/knowing the customer involves making an effort to understand the customer's needs including such things as learning the customer's specific requirements, providing good attention to the customer, and recognizing a regular customer. We can design our service encounters to be more likely to contribute to trust as well as help improve on the level of employee and customer ignorance on the contextual factors influencing the service. To do so requires training of employees on the importance of trying to understand the customer's specific needs from the service. Also, as the employee better understands the context of the service from the company's perspective, their ignorance of the context within which decisions pertaining to the delivery of services will decrease. As employees better understand the decisions, lower levels of cynicism should be operating. This is another reason it would be helpful for organizations to reduce turnover in the ranks of service employees. A service provider who is experienced is more likely to recognize repeat customers and more likely to know the customer compared with newly hired employees.

Reliability

Reliability involves consistency of performance and dependability. This requires that the service is provided appropriately the first time, honors it's promises, is accurate in order taking, preparing the tangibles and intangibles of the services, is secure with information (although security is also another distinct dimension of quality service). Increasing reliability of our services should lead to higher levels of trust, which will be helpful for both employees and customers. Again, developing longer-term employees who know how to do the work should improve the dependability of the service in many ways. Longer term employees also have less decision context knowledge and will understand better the performance requirements.

Courtesy

Courtesy involves politeness, respect, consideration, and friendliness of service employees and is likely directly affected by the service provider's level of cynicism. This deals more with the effects of cynicism than the causes of cynicism. However, if we are considering how to design a service encounter to encourage politeness, respect, and friendliness then we will likely be also considering how to minimize cynicism levels. Customer politeness may also influence service provider politeness so some consideration of how to maintain and/or enhance the "courtesy" level of the customers may be an additional positive influence on the employee's level of politeness and friendliness. Requiring the expression of friendly, polite, positive emotions can lead service workers to display "surface acting"

which is both detectable and not appreciated by consumers and also a source of stress to the employees (Grandey, 2003). Consideration must be given to actually creating a positive environment at work.

CONCLUSION

Today's business environment for service organizations includes a great deal of cynicism from both the service employees and the service customers. While cynicism is a form of bias in preconceived judgments, there are some things managers can do to work towards improving the situation. The proposed model demonstrates that mistrust and lack of knowledge concerning the context of the decisions involved in a service encounter are immediately influential on cynicism. Improving the service environment can occur through efforts at increasing trust and reducing contextual ignorance, along with improvements in several situational and attitudinal factors. The determinants of service quality provide direct channels for efforts at determining where and what to change and how to reduce cynicism to improve the service environment.

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Using Bill of Services (BOS) to Achieve Effective Service Delivery

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ABSTRACT

Services are usually performed at the exact moment that the customer demands it. Therefore, a service business must have optimal resources available in terms of skill and experience, at the right time and place. In order to achieve valuable service delivery, service organizations must develop supportive infrastructure so that the process of creating and delivering the service will be accomplished efficiently and effectively. Thus, the discipline of service design becomes a basic element in the development of services. Organizations must develop services that will meet customers' expectations, requirements, and demands, to be delivered when needed, to the complete satisfaction of the customer. Bill of Services (BOS) is a novel management tool designed to support service organizations in developing their services and planning resources to satisfy management's strategy. This paper presents a methodology for configuration of the BOS in a manner similar to configuration of the Bill of Materials (BOM) in a manufacturing organization. The BOS assists management in the day-to-day planning and control of activities, and facilitates a professional management infrastructure in service organizations. Based on the BOS, the necessary resource capacities can be planned and service costing can be performed according to predefined service levels for each service characteristic.

Keywords: Bill of Services (BOS), service organizations, service specifications, service level, service costing

INTRODUCTION

In order to achieve valuable service delivery, service organizations must develop supportive infrastructure so that the process of creating and delivering the service will be accomplished efficiently and effectively. Thus, the discipline of service design becomes a basic element in the development of services. Organizations must develop services that will meet customers' expectations, requirements, and demands, to be delivered when needed, to the complete satisfaction of the customer. In order to preserve customer loyalty, organizations must consider the costs related to the service delivery process. Salvendy & Karwowski (2010) discuss the issue of service capacity while providing services. Excess capacity causes extra costs for workers that are not utilized effectively, while insufficient capacity can cause long customer waiting times. Thus, effective management of resource capacity in service delivery is a major issue that management must address.

The purpose of the paper is to design a management support tool for capacity and cost planning for service organizations. The paper attempts to adapt the Bill of Material (BOM) from the field of engineering design to service development and management. The integration of engineering and management is particularly relevant for the development of new services. The paper presents the Bill of Services (BOS), a tool for assisting service organizations in developing their services by identifying the resources needed to provide the service and the capacity of each resource. BOS is borrowed and adopted from the manufacturing field, enabling organizations to calculate quantities of the resource capacities needed in order to deliver the service elements emphasized by the service

concept (Goldstein et al., 2002). Zeltin & Mandelbaum (2008) have developed a service operations management planning model to assist managers of service organizations in efficient allocation of their resources in order to meet customer demand. Dietrich (2006) reveals that the lack of a standard method for representing resource requirements for business services and resource capabilities used for delivering business services makes it difficult to directly apply the analytic tools developed for manufacturing and supply chains to business services. For conventional goods, each unit of production is typically associated with a well-defined set of resource requirements. In business services, the "unit of sales" is typically a contract describing business functions (e.g. banking services) that will be performed by a provider for a client over a specified period of time; a payment structure; and related obligations of the client and the provider. Exactly how the business functions will be provided, or what resources will be used and when they will be used, should be characterized by the service provider in order to satisfy customer demand on time and in an efficient manner (Dietrich, 2006). Sampson (2012) introduces the Process Chain Network (PCN) Analysis framework for service operations management (SOM). PCN analyzes the complexities of service operations in a systematic way, by depicting services as a specific type of resource/process configuration.

The BOM is a structured management mechanism that contains all the elements of the product. Product elements should support the product concept. When designing services based on the organization's strategy, the concept developed defines the service categories and characteristics and the service level for each service characteristic. Similar to the BOM, the BOS is a structured management tool that contains all the service elements. Based on the BOS, the necessary resource capacities can be planned and service costing can be performed according to predefined service levels for each service characteristic. The novelty of the approach is by enabling service organizations to design a detailed structure of the various services delivered to the customer and derivate the respective resources capacities needed to satisfy customers' needs and expectations. The BOS is a managing tool that allows the service designer to define for each service characteristics various service levels and make the respective cost effective computations in order to verify what should be the appropriate resource capacities.

In this article, the focus is on service design with the BOS as a supportive management mechanism to conduct service resources capacity planning and to verify service costing.

METHODOLOGY

Service Design

Service design is concerned with systematically applying design methods and principles to the design of services. It assumes the customer/user as the starting point or lens into a specific service, and considers how the service can be performed through the use of creative, human-centered and user-participatory methods models (Holmid & Evenson, 2008). Furrer, (2005) states that in order to ensure service quality, the service delivery process should be well-designed and well-organized. The design of a service can have significant impact on an organization's key metrics, including costs, revenue, brand perceptions, customer satisfaction and loyalty, and employee satisfaction and loyalty (Ostrom et al., 2010). A commonly mentioned technique in service design is service blueprinting (Bitner et al., 2008). A typical service blueprint has five components: "Customer actions" include the steps that customers take as part of the service delivery process. "Onstage/visible contact employee actions" are actions of front-line contact employees that occur each time they cross the line of interaction with the customer. "Backstage/invisible contact employee actions" are nonvisible interactions with customers (e.g. telephone calls) and any other activities that contact employees do in order to prepare to serve customers. "Support processes" refer to activities carried out by individuals and units within the company who are not contact employees and that need to happen in order for the service to be delivered. "Physical evidence" means the tangibles that customers are exposed to that can influence their quality perception. In the physical surroundings of a service (“servicescapes”), customer cognition, behavior and experiences are influenced by the following dimensions: ambient conditions; spatial layout and functionality; signs, symbols and artifacts; and service typology and environmental dimensions (Bitner, 1992).

Service Concept

The service concept is the starting point for the development of an operating strategy (Johnston et al., 2012).The service concept defines and characterizes the "skeleton" of the BOS. Drejeris and Zinkeviciute (2010) proposed a model for one stage of the development of a service concept feasibility assessment and designing of a service system. Every idea can be developed by several concepts. The application of the suggested model allows choosing the best concept of a new service.

Service Specifications

A service specification is an extension of the service concept. The service concept provides a broad description about the service provided, the customer experience and its outcomes. This in turn should either be based on the needs, requirements and expectations of customers, or a perceived future need or desire for it. The service specification takes the elements of the concept and identifies the quality factors associated with each. It details the standards to be achieved and the necessary procedures to ensure conformance to this standard (Johnston et al., 2012).

Service specifications are designed using two dimensions: A. Service characteristics define the various service components (e.g. time waiting to sight the host in a restaurant). They may be defined by time units, tolerance on the time axis, and yield of a service activity (e.g. yield of the admission process in a hospital department). B. Service level is the second dimension of service specifications (e.g. a 2-minute waiting time in a bank versus a 6-minute waiting time). Different service levels require varying resource capacity in order to comply with a given service characteristic. Service specifications are defined to comply with customer expectations, but should satisfy management ability to allocate the needed resource capacities, or in other words, the budget needed to satisfy the service characteristics. In addition, most business services involve a significant labor component. Effective labor resource planning requires defining the attributes used to categorize human capital, modeling the role of social capital, and analyzing the value of flexibility within organizations and workforces (Dietrich, 2006).

The General Structure of the BOS

With the BOM, the final product is the basic starting point which occupies level "0." For services, level "0" is the organization itself – although it could also be the department/service category under consideration. This is explained below. As our example, let us consider a Geriatric Hospital (any service organization would do). The hospital's level 1 BOS is presented in Figure 1.

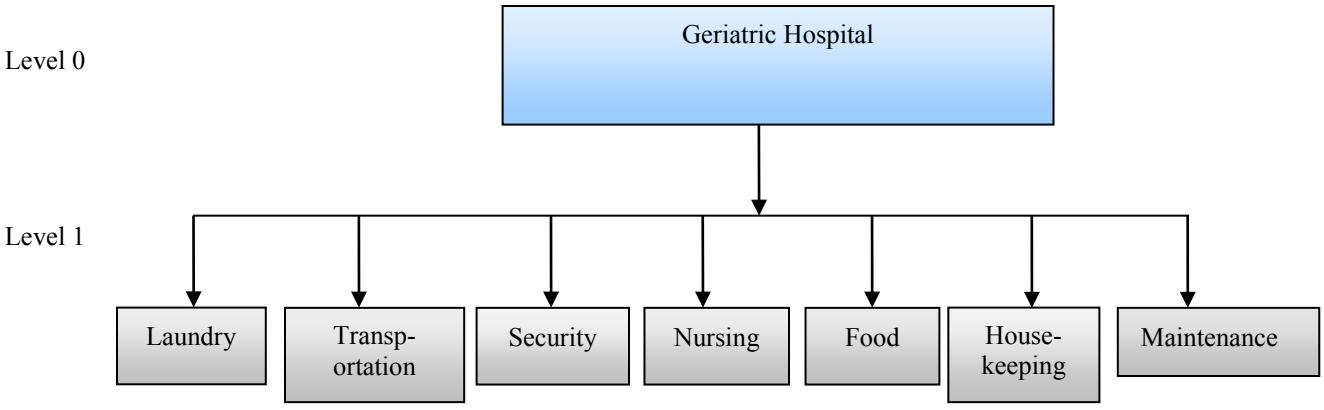

Figure 1. The hospital's level 1 BOS

Figure 1 shows the hospital at level 0 (the service organization). Level 1 (service category) includes the service categories provided by the hospital: Laundry, Transportation, Security, Nursing, Food, Housekeeping and Maintenance. If we so desire, we could assign each of these service categories their own BOS with Level "0," as in Figure 2. In such a case, capacity requirements and costs would be assessed for each service category separately.

Let us assume we use the style shown in Figure 1 for Nursing (level 0). In level "1," we classify the various types of services provided (e.g. medical services) then in level 2 we define the service characteristics and the service level for each service type. For example, for the drugs administration service, the service characteristics might be defined as: Prepare personal drugs lists, Collect the prescribed drugs, and deliver the drugs to patients. Then the service level may be defined as: Three times a day (before meals or if otherwise needed. Similar definitions should be defined for all service types in level 1, with the goal of constructing a service tree containing all the characteristics and their

corresponding service levels.

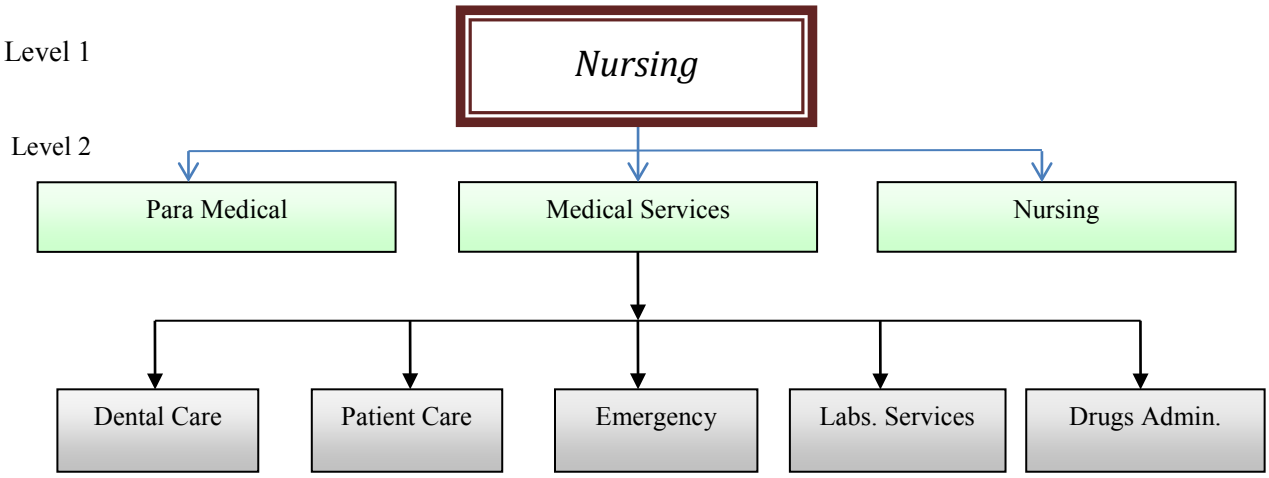

Figure 2. Medical services – BOS level 2

Resources Capacity Planning

Resources are the capabilities (tangible and intangible) of the service provider that must be in place in order to provide a service. Service provision is usually the availability, on a limited time basis, exclusively or shared, to the consumer of a resource belonging to the provider. Sometimes, offering a service mainly involves combining the supplier's own resources with those of third parties (Karakostas & Zorgios, 2008).
Capacity is the ability to deliver services over a particular time period. Capacity is determined by the resources available to the organization in the form of facilities, equipment, and labor (Fitzsimmons et al., 2014). A major target of any business organization is to create an optimal resource capacity, such that the derivative costs are minimal but the customer receives the expected service level. Implementing the BOS as a regular management mechanism may support the achievement of optimal resource capacity.

After all service specifications are defined and the service tree is formulated, we may derive the resources capacity needed for complying with the BOS. For a given service specification (a given checklist), we may run simulations with different service levels as independent variables and resource capacity as dependent variables. Thus, the BOS supports the management in the decision related to capacity planning.

We will illustrate this with a simple example. When we observe the Medical Services BOS in figure 2 and focus on Patient Care Services we may calculate the capacity needed to maintain a given service level. For a 100 beds hospital and a policy of hourly rounds (service level) at five minutes per patient we would need to allocate 500 minutes per hour times 24 hours resulting with the need of 200 hours of labor. This means that we need to allocate about 9 nurses per a shift of eight hours. If the hospital policy is to monitor twice daily then it means that we need a total of 500 minutes times two resulting with about 16 hours of labor resulting with the need of only one nurse.

The same procedure is repeated in order to verify the necessary capacity of all the resources associated with all the service characteristics defined in the BOS. Finally, the BOS summarizes the total capacity of all resource types, thus supporting hospital management in the decision regarding total capacity of employees and facilities/equipment needed for a given BOS.

Service Costing

For a given BOS, we may calculate the service cost based on the resources allocated to fulfill the service characteristics and the related service levels. To do so, we multiply the working hours of the various employee types by the hourly rate. Thus, the BOS supports management by aiding the costing process. Using the example of Patient Care Services we may calculate the respective costs of maintaining a service level of hourly Patient Care versus twice daily.

A DETAILED ILLUSTRATION OF A BOS APPLICATION

Table 1 presents a detailed BOS for a geriatric hospital showing all sub-levels based on the one-level BOS of Figure 1. In level 0, we define the hospital's services as a whole (service organization). Level 1 presents the service categories: nursing, housekeeping, food, security, transportation and laundry. We may then develop each category further, adding more levels as needed according to the service characteristics. Table 1 details the service characteristics for each service category, defines the service level with the relevant responsiveness and calculates the total capacity needed for each service characteristic. For example, the service category "Nursing" in level 1 is further developed to the level 2 service characteristics of Medical, Para medical and nursing. Figure 2 illustrates the characteristics for Medical services. Table 1 details for each service characteristics the service level (e.g. 24/7 or twice weekly) and/or the responsiveness assigned (e.g. 40 min for room service or upon request for transportation). Observing service category "Nursing" and service characteristics "Para medical" it may be noticed that Physiotherapy and Social services are scheduled daily where Occupational therapy is scheduled twice weekly. The definition of service level derives the resource capacity needed for each professional discipline. The main resource type is human resources but we should pay attention to physical resources like area needed for various activities or vehicles needed for transportation or material needed for occupational therapy. Also, it is clear that management may conduct simulations for different service levels and conduct the economic evaluation until finally decide what is the compatible service level.

This detailed example illustrates four steps of a generic methodology for defining the capacity of the various resources utilized when providing services:

a. Define the service categories that the organization supplies (level 1).

b. For each category define the detailed characteristics of the services (levels 2, 3….).

c. For each service characteristic, define the service level/responsiveness (considering varying demand levels depending on time of the day, day of the week, or season).

d. For each service type, calculate the resource capacity (work force, equipment and technology) based on the service characteristics, the required service level and the demand.

Once management constructs a BOS, they may use it to run simulations to verify the quality of services delivered for a given resources capacity or the resource capacity needed to achieve a given service strategy.

GENERAL BOS APPLICATIONS - DISCUSSION

The number of organizations that provide services is rapidly expanding. Examples include call centers, importers/exporters, law firms, clinics, health centers, fire departments, police stations, government services, restaurants, universities, schools, and hotels. Today’s manufacturing organizations are also heavily involved in providing services. These include quality assurance, inventory, production planning and control, costing, purchasing, inventory control, human resources, and warehousing. Figure 3 illustrates a general methodology of the service industry.

Table 1: BOS details for a geriatric hospital

Service Category / Characteristics		Service Level		Capacity Needed	Remarks
Service Category	Service Characteristics	Service Level	Responsiveness		
Nursing	Medical: Dental Care	Twice weekly	Schedule	16 mh	mh-man hour
	Patient Care	24/7	Schedule	8 nurses	
	Emergency	24/7	1 min.	2 nurses	
	Drugs Admin.	24/7	Daily	1 nurse	
	Labs.	24/7	Upon request		
	Para Medical: Physiotherapy.	Daily	Schedule	16 h	Per day
	Social Services	Daily	Schedule	4 h	Per day
	Occupational Therap.	Twice weekly	Schedule	10 h	Per week
	Nursing: Medical Tests	24/7	As needed		
	Washing	Daily			
	Bedding	Daily	Schedule	4 nurses	Assistance nursing
	Dress Care	Daily			
	Reporting	Daily			
Food	Dining Room	Breakfast/lunch/ dinner	Schedule	48 mh	Daily
	Room Service	08:00-20:00	10-40 min.		Excluding weekends.
Laundry	Personal	Daily	24 h	24 mh	Week days
Transportation		08:00-24:00	Upon request		Week days
Security		24/7		24 mh	Per day
Housekeeping	Cleaning: Patient Room	Daily		32 mh	Daily
	Public Area	Daily			
	Supply	Daily			
Maintenance	Patient Room	24/7		24 mh	Daily
	General				

The service process initiates with the customer who creates needs and expectations, and continues with the service provider that defines related service specifications based on company strategy and the service concept. For each service specification, we must define service characteristics, and for each set of service characteristics, we must assign the service level. Now we are at the stage where we can construct the BOS, enabling us to calculate resource capacity and the related costing.

Finally, we may check whether the constructed BOS complies with customer needs and expectations by conducting a survey to verify customer satisfaction

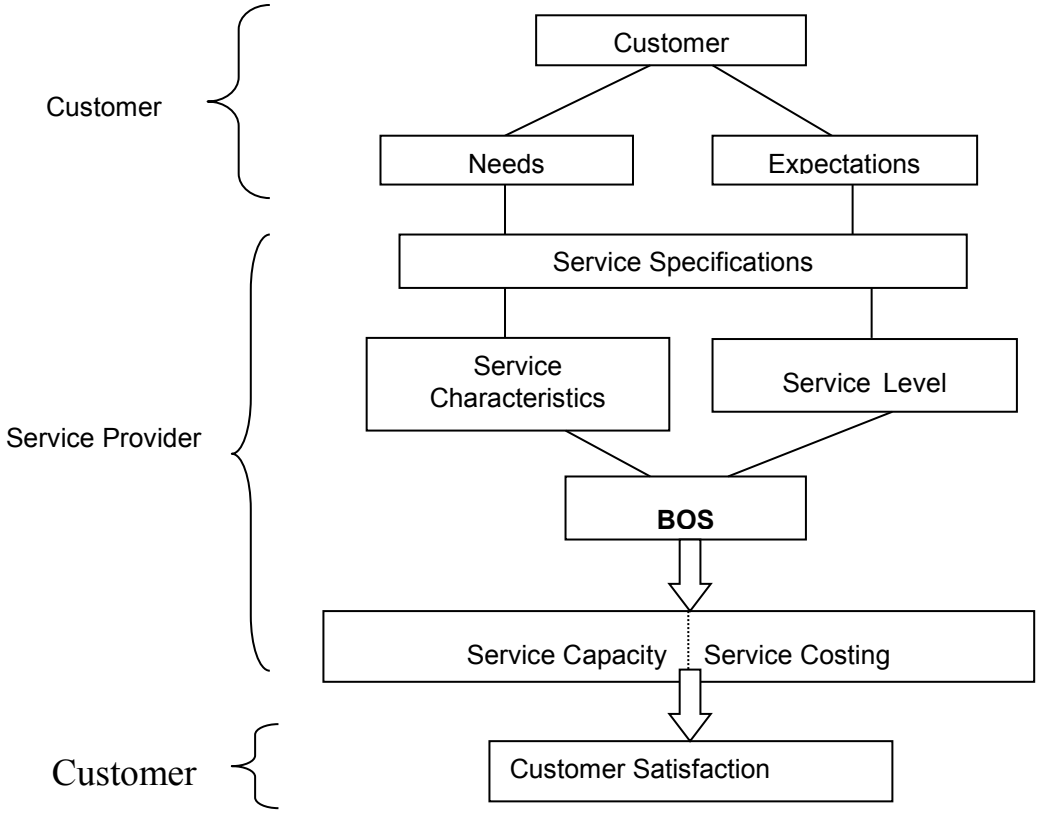

Figure 3. General methodology of the service industry.

BOS IMPLEMENTATION IN SERVICE ORGANIZATIONS

We chose to use a hospital as our example, but any type of service organization can implement the BOS management tool. These may include educational institutions and libraries; police departments; supermarkets; restaurants; transportation companies: airlines, trains, buses; law firms; banks; government services; municipal organizations; volunteer organizations; and charities.

As stated earlier, implementing the BOS method may support management in creating a service delivery infrastructure that ensures the customer gets what he needs, according to his expectations, at the right time and intensity, assuring effective usage of resource capacities (minimum idle resources).

Based on the organization's service strategy, management defines the service concept, and then develops the respective BOS as a step-by-step technical procedure. The strict analogy to a BOM is again relevant here. In manufacturing organizations, a product cannot be assembled without a reliable and accurate BOM. It assures that all the needed components are available at the right time and in the right amount, ensuring delivery to the customer of a specific order characterized by product type, quantity and delivery date. Service organizations benefit similarly

through implementation of the BOS, which defines the right capacity for all resources in order to respond effectively to customers demand. As in manufacturing, the service organization may use subcontractors to deliver any or all of the services defined in the BOS.

CONCLUSIONS

The major purpose of a service provider is to satisfy customer needs and expectations. Customer needs should create service specifications and characteristics, and customer expectations must be fulfilled by the service level assigned.

Each of the service organizations mentioned above may create its own BOS that will support management decisions regarding capacity planning and costing for a given service specification.

We note that for any service characteristic, the related service level must have a quantitative figure. We cannot define service in relative terms such as "good" or "bad". Rather, service must be defined in terms of compliance (or non-compliance) with service specifications (both service characteristics and related service levels).

To the best of our knowledge, most service organizations do not specify or define written service specifications, related characteristics and the assigned service level for each service characteristic. Without defined service specifications and corresponding service levels, the organization has no professional way to plan and control the services provided to the customer. The result is that the organization must address customer complaints and service recovery activities.

The BOS is a valuable management tool for supporting the development of a reliable and appropriate infrastructure to deliver the right response at the right time to the customer. It is a planning and control mechanism enabling management to run simulations that will produce accurate answers to vital what/if questions. The managerial implications of implementing the BOS are very important for service organizations. It is a methodological and consistent managing tool enabling a professional design of the related services without missing any issue that may damage the service delivery process.

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Defining a Serviceability Architecture Framework

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ABSTRACT

The application of Serviceability as an integral part of the server and network product development process and the complete lifecycle of a product requires a methodology that can accurately and consistently identify and measure product serviceability issues and provide a means to measure change throughout. Cisco has developed a Serviceability Architecture and Design Framework (SADF) that can be used to conduct product serviceability audits and provide feedback into the product development and support process in a consistent, longitudinal manner. The SADF is composed of three main components; 1) Serviceability Architecture Framework, 2) Design Functions and Requirements, and 3) Process for Utilizing the SADF. The focus of this paper will be to introduce and describe the history of the Serviceability Architecture Framework (SAF) which is the foundation of the SADF.

The Serviceability Architecture Framework is composed of 8 subsystems; Deployment Design, Installation, Configuration, Monitoring, Notification, Diagnostic, Troubleshooting, and Learning Engine. The subsystems are augmented by a set of services that are common across the subsystems (centralized management, documentation, logging, hardware, user experience, and application programming interface (API). Finally the architecture identifies the sources of information that provide input into the different architectural components and the desired outputs for the subsystems operating on the inputs.

This paper will introduce a system process model that identifies the scope of serviceability areas in the context of customer product acquisition and system deployment and management. The architecture subsystems will be described in the context of this model and the details of the subsystems, their interdependencies, and their inputs and outputs will be introduced and discussed.

Keywords: Serviceability, Architecture, Framework

INTRODUCTION

Services plays a key role in the deployment and management of most information systems in large and medium size business and poses unique business and technical challenges due to the integration, customization, and management of the components that makeup the system. In order to successfully deploy these systems the customer requires a service organization (either internal to the customer, a vendor organization or a 3rd party) to understand the customer's business requirements, their deployment environment and to help the customer understand the capabilities and limitations of the system to be deployed. System vendors must provide capabilities that meet the needs of the customer (features, scale, and performance) as well as those of the services organization (configurable, usable, and learnable). As a provider of business solutions it is important for Cisco to ensure that their systems meet the business needs of the customer as well as those of the service organizations in place to deploy and manage them. Our organization is responsible for overseeing the ability to service products across Cisco's product portfolio. It was recognized that in order to provide a consistent method for identifying, communicating, and addressing serviceability needs across the wide range of products offered by Cisco a "serviceability architecture" needed to be defined and corresponding "serviceability design functions" or "foundational serviceability requirements" identified to achieve this goal. This paper describes the serviceability architecture framework (SAF) that was developed as part of a comprehensive product serviceability program at Cisco.

SERVICEABILITY ARCHITECTURE FRAMEWORK OVERVIEW

The goal of the Serviceability Architecture Framework (SAF) project was to develop an architecture that identified a dynamic and user-friendly system environment that the field, support, engineering, and quality assurance organizations can use to identify an optimal set of serviceability functionality from a set of defined serviceability functions. This optimal set of serviceability functionality could then be incorporated into product and system specifications. SAF provides the foundation for defining the serviceability functions following a tried-and-true method for building technology architectures.

The scope of the SAF includes serviceability functionality internal to a system such as hardware and software and also functionality external to a system. External serviceability functionality includes training, documentation, customer support, community support groups, certifications and processes for using, and maintaining and updating the framework.

The SAF provides a common vocabulary and object space to identify and describe the different aspects of a system that a service organization uses during design, deployment, and management. In addition the architecture identifies capabilities that should be included or supported in a wide range of products, providing the flexibility of including capabilities in the product explicitly (such as troubleshooting tools) or external resources (such as troubleshooting guides).

SERVICEABILITY ARCHITECTURE FRAMEWORK

Service Deployment and Management Overview

A general purpose model of the process that IT systems follow from initial customer business requirements gathering to deployment and management was developed and is was used as the foundation of the serviceability architecture framework (see Figure 1). It is important to recognize and identify the serviceability and usability factors the impact the eventual deployment and management of a service and to drive the design and construction of the system to streamline and optimize for those factors. The process of service/system deployment begins with a service provider engaging the customer in the understanding of their business requirements. These requirements drive the hardware and software features of the service and also identify the target service customers, capacity and performance requirements, applicable reference architectures, etc. These early decisions have a significant impact on all of the processes that take place during deployment and can also be invaluable to product development. The ability to service a product, to construct an implementation plan, implement that plan and manage the operation of the service is highly dependent on maintaining the thread of the business problem it is intended to address throughout the product lifecycle and providing the tools and processes to easily and effectively use the service. Feedback within the different steps in the process is important to both continually improving the underlying product and ensuring a proper working service.

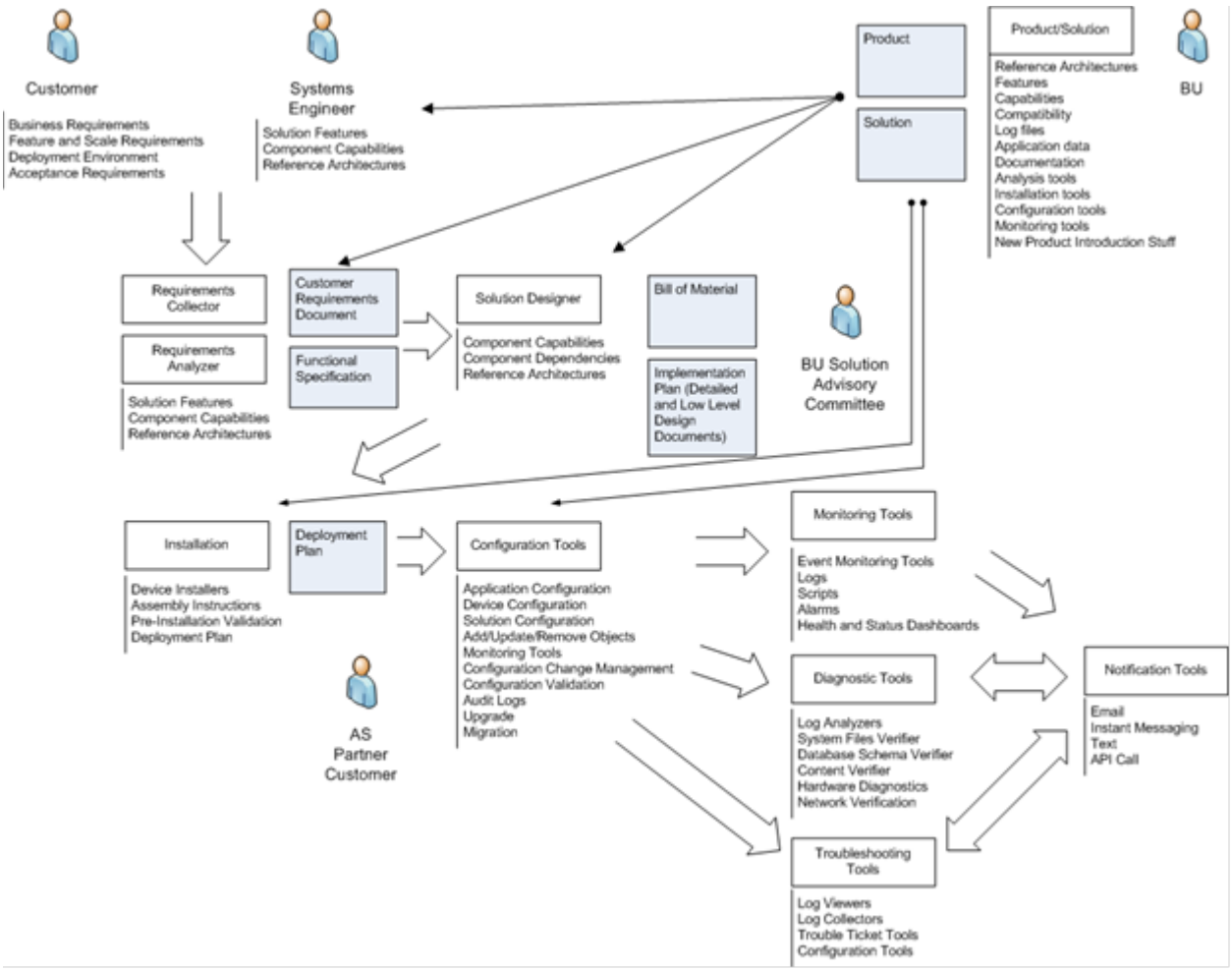

Figure 1: Service Deployment and Management Overview

The serviceability architecture is composed of eight subsystems that work together to provide the facilities to design, deploy, and operate a service/system (see Figure. 2). The term subsystem is used to identify the different architecture components in order to differentiate one class of functionality from another and is not intended to represent the architecture necessary to implement a serviceability solution. While the architecture is represented using structures common to software develop design process we do not intend to suggest that this is strictly a software model and a typical service deployment will be a hybrid of humans and systems providing the functions.

Guiding Principles

There are a number of concepts that are less architectural and serve more as principles that should be considered when addressing the serviceability concerns of a service/system. They are included separately from the subsystems in order to establish a mindset that is applicable across all of the subsystems.

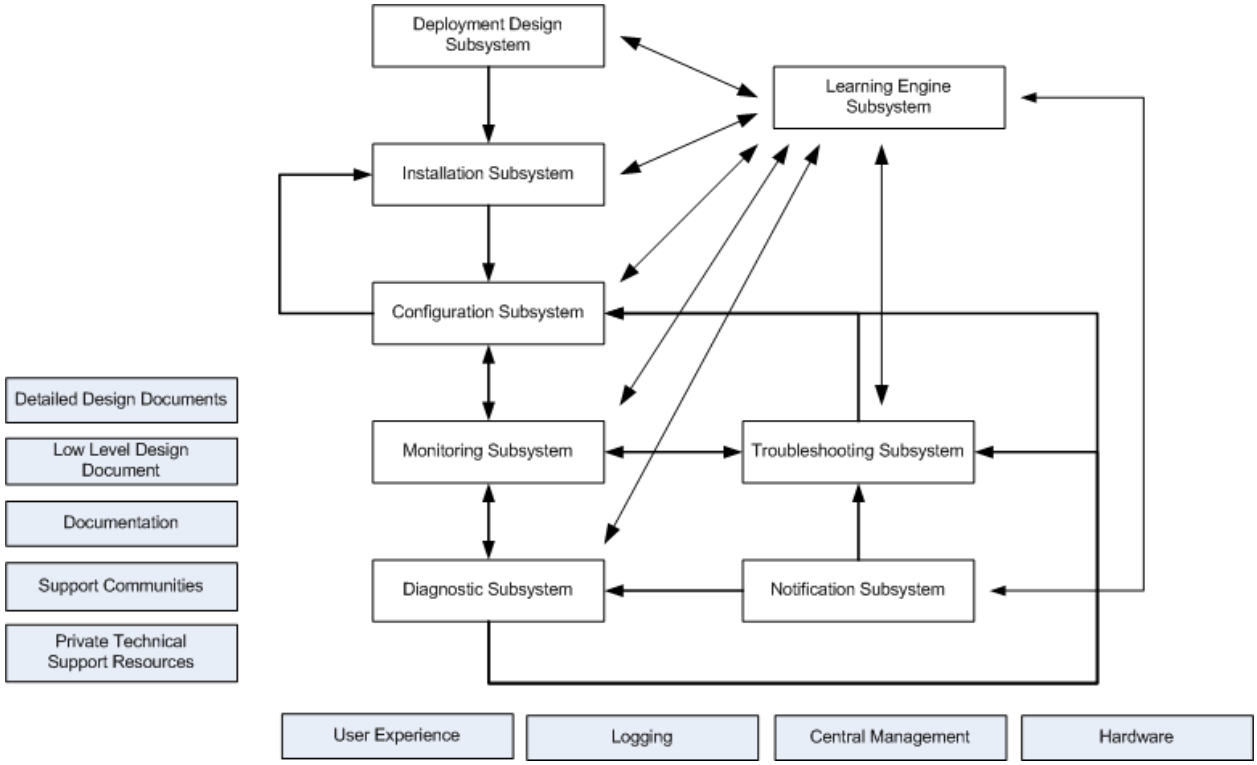

Figure 3. Serviceability Architecture

Central Management

Consolidating the installation, configuration, monitoring, and notification capabilities across the different hardware and software components that make up a service into a single location greatly impacts a customer's ability to both manage and troubleshoot a service. This principal should not be construed to mean that the hardware and software components should not provide these capabilities themselves, however, that they should provide the ability to be consolidated into a centralized capability. The principal also encompasses associated directives such a utilizing a common set of terms, interaction models, log locations, documentation access, etc.

User Experience

Providing a common, consistent customer user experience is important to a serviceable service/system. The application of generally accepted design principles will dramatically improve the overall efficacy and utility of a service. Such principals include the use of an object-action interaction model, progressive disclosure, common vocabulary, task-oriented flows, etc.

Documentation

The traditional methods employed in constructing, delivering, and accessing documentation do not transfer well to the delivery of services and systems in the age of distributed, multi-component solutions that are aggregates of multiple vendor products. Documentation should be task-oriented (installation, configuration, troubleshooting), accessible via the system, support tagging (with a common set of tags), and be modular to support ease of use.

Logging

The content, structure, and location of system log files for the components of a service system should be common. Users should not require a decoder ring to decipher the contents of log files and all acronyms, error codes, etc. should be accessible from within the context of the log files, either through co-location or through the user of a log file viewer.

Application Programmable Interface (API)

Providing alternative access to system component operations (non-GUI or CLI based) is important for supporting centralized management and integration with existing centralized management systems. It is recommended that all subsystem components provide access to common actions and relevant monitoring data through an application programmable interface.

Hardware Security

The ability to configure and manage the hardware components of service/system should not be overlooked. Proving basic hardware health and status monitoring, remote management, easy installation and replacement, etc. impact the overall serviceability of system and the services running on it.

Support Communities

Utilizing community-based support communities benefits both the customer and service vendor. These communities can benefit from the knowledge and experiences of service customers as well as provide streamline facilities for delivering content to customers.

Deployment Design Subsystem

The deployment design subsystem encompasses the processes associated with identifying the business problem the customer is trying to address, the environment in which the solution to the problem will be implemented, and an implementation plan that includes the hardware and software that makes up the solution and how to deploy them. Properly capturing the relevant customer information in the form of features, performance expectations, capacity requirements (present and future) and information about the customer's network, storage, and compute environment and the locations where the solution will be deployed and having this information available to the original and future solution designers as well as to other serviceability subsystems will enable more robust solutions and feedback to customers and support personnel when a service/system approaches or exceeds their original values.

The deployment design subsystem is composed of the following components: Requirements Collection, Functional Analysis, Implementation Plan, and Reference Architectures. There are a number of concepts that are less architectural and serve more as principles that should be considered when addressing the serviceability concerns of a service/system. They are included separately from the subsystems in order to establish a mindset that is applicable across all of the subsystems.

Requirements Collection

The requirements collection component embodies the identification and collection of information from a customer that directly impacts the final system deployment design. This information can be classified into four categories: features, performance, capacity, and deployment environment.

> **Features** – a distinguishing characteristic of a system, one that the system is purported to provide and something that a customer would be interested in applying to a business problem they are trying to solve.
>
> **Performance** – measure or perception of how well a system is able to successfully complete the operations that it was designed for. Performance can be measured objectively in terms of speed of completing a single operation, the average of multiple like operations, etc. or subjectively such as a user reporting the system is operating slowly.
>
> **Capacity** – the number of things (e.g., network packets, call center agents, virtual machines) that a system can support while performing at the expected level.
>
> **Deployment Environment** – a characterization of the customer's environment (network, storage, and compute) that is the target into which the system will be deployed.

Functional Analysis

The functional analysis complement utilizes the data captured from the requirements collection component to determine the different elements and their number that should be included in the implementation plan. Product features, system performance by capacity data and heuristics are used to in the analysis process. As with

requirements collection the knowledge and experience of the person performing the functional analysis has a direct impact on the outcome of the analysis and utilizing tools that embed the analysis logic will improve the accuracy of the results of this process.

Implementation Plan

The implementation plan component is responsible for constructing the design of the system to meet the needs of the customer taking into account the outcome of the functional analysis as well as the customers exiting environment. Referred to as a detailed design and low level design by Cisco Advanced services the resulting plan would include specific configuration information or guidelines that match the new hardware/software with the customer's existing network, storage, and compute environment.

Reference Architectures

Reference architectures provide a template solution for implementation of an architecture particular to one or more capabilities (e.g. unified communication, IP network, server virtualization) that are based on generalization from a number of prior deployments. The reference architecture provides a common set of components, connectivity, and terminology with which to describe the deployment. A set of capabilities (solution) could have multiple reference architectures that share common components but differ in terms type of component providing the same capability to address capacity.

Installation Subsystems

The installation subsystem addresses the serviceability issues that begin with the customer receiving system product(s), covers the unpacking, racking, and cabling hardware that is part of the system and ends with the installation of the base software/firmware required to enable the product(s) for configuration.

Pre-Install Validation

The pre-installation validation component addresses the activities that occur when a customer or customer representative receives the products that have been ordered in support of the deployment plan. Standard operating procedures dictate that the customer must verify that they have received all of the items that were purchased. In order to efficiently accomplish the verification process the customer must compare a list of ordered items against the set of items received; historically this has been a manual process, however increasingly technology is replacing the manual operations utilizing handheld scanners, bar codes, electronic purchase orders, and inventory management systems.

Assemble/Racking/Cabling

The assembly, racking, and cabling of systems can result in a number of problems resulting in calls for support for instruction, replacement components, cables, etc. This component addresses the need for proper user instructions, labeling, packaging, component placement, cabling and cabling systems, and the racking of components.

Component/Device Discovery

The component/device discovery component addresses two types of discovery: 1) the self-discovery that a component/device performs that detects the presence of add-in modules, blades, cards, memory, etc. and 2) the discovery of components/devices by a centralized management system.

Software Installation

The Software Installation component addresses the installation of the base server operating system or firmware on the device. The base installation is intended to prepare the component/device for configuration as a standalone entity or as part of a larger system. The component is also used to add applications, drivers, and to update the software/firmware on servers and devices that have already been installed. The component provides an infrastructure to collect responses from users, files or other components in response to input demands by the software being installed, these inputs can be validated against the rules contained within the validation engine at different times during the installation process. Techniques and technologies included within this component are:

attended installation, silent installation, unattended installation, self-installation, headless installation, network installation and virtual installation.

Upgrade Engine

The upgrade engine component provides the logic that supports the installation of new versions, drivers, and patches to servers and devices. The logic contained in the upgrade engine focuses on determining the compatibility issues associated with modifying an existing installation with new software as well as understanding the dependencies and update ordering issues among the different components in a system. The upgrade engine can direct and orchestrate the upgrade process automatically through interfacing with the installation component or can guide the user through the upgrade.

Validation Engine

The validation engine component evaluates the inputs provided by a user or other components against a set of rules and heuristics. See Validation Engine below.

Configuration Subsystems

The configuration subsystem focuses on the initial configuration and subsequent post deployment configuration changes. The subsystem makes use of the shared validation engine during the configuration process as well introduces addition components to track system changes, archive configurations to support recovery, and managing licenses.

Device Discovery

The device discovery component is similar to the discovery component employed by the installation subsystem but is mainly focused on the discovery of new devices added to a deployed service. This component monitors the environment and recognizes changes related to the presences of new devices and passes that information to the configuration component in order to make it available for configuration. This component is responsible for walling off the newly discovered device from impacting the health of the service/system until such time as it is properly configured.

Configuration

The configuration component manages the make-up of the devices, operating systems, applications, and solutions that combined constitute the service/system. The configuration process is simply the set of steps and the information needed by the target element to properly configure it in order for it to perform its intended function. Interdependences among and between components are managed within the process which utilizes information contained with the validation to manages the configuration flow.

Archive

Archiving this history of changes made to the configuration of a service/system is managed by the archive component. This component manages the information stored, where it is stored, how often/when it is stored, and provides methods to restore stored configurations.

Change Management

The archive component manages storing system configuration the change management component captures and stores the changes made to the service/system configuration. The change management component captures the change made, who made the change, and when the change was made. In addition this component provides the ability for a user or system to view this information. The component may also provide the ability to export and replay a set of changes made on a different system in support of problem troubleshooting.

License Management

The license management component provides the capabilities to identify, delegate, and manage the licenses with the

deployment of a service/system. In addition, the component can provide reporting capabilities along with notifications of pending license expirations.

Validation Engine

The validation engine component evaluates the inputs provided by a user or other components against a set of rules and heuristics. See Validation Engine below.

Difference Between Troubleshooting and Diagnosis

The difference between troubleshooting and diagnosis is not distinct or easily distinguishable. For the purposes of the serviceability architecture, troubleshooting is defined as a “hands-on” activity which may entail the disassembly of a system, hardware and software, to help identify defective components, requires the use of measurement and test tools that are not part of the system, and will result in system downtime and higher cost. Diagnostics are performed remotely, using information that can readily be obtained from the system and involves the analysis of discrete information and trends, and is facilitated by the understanding of the relationships between the system components and the performance of the system.

Diagnostic Subsystem

The diagnostic subsystem is responsible for determining whether a system is operating normally or whether it appears to be approaching a condition where it may fail to operate normally. When such a situation is suspected the subsystem attempts to identify the cause of abnormal or unexpected behaviors, to mitigate problems, and to provide solutions to system operations issues. The methods used to perform these functions require the orchestration of information obtained from the monitoring, notification, configuration and troubleshooting subsystems. This information is applied to system operation models in the form of algorithms, heuristics and techniques in order to determine whether the behavior of the system is correct. When a system is found to be functioning incorrectly the same or additional logic is used to determine which part of the system is behaving abnormally and the type of fault that is suspected of causing the problem. Advanced diagnostic systems, in conjunction with the troubleshooting subsystem, provide the ability to perform automatic corrective action once the cause has been accurately identified. The corrective actions may include instructions to change system configurations, advice/direction to administrators, reverting system changes, etc. The subsystem can encompass diagnostic procedures that are manual, interactive, and autonomous.

Reactive Diagnostics

The reactive diagnostics component is responsible for monitoring and responding to events and alarms generated by the notification subsystem and directly inspect the (sensor) data captured by the monitoring subsystem with the goal of reacting to abnormal or unexpected system behaviors. The reactive diagnostics component must be configured with fault frames. A fault frame is an information structure that identifies conditions representative of "stereotyped situations." In the case of system diagnostics a fault frame represents the set of events and data that correspond to specific conditions within the system that are associated with abnormal behaviors and failures. A fault frame may include the ability to seek out additional data that is not readily available from the monitoring subsystem (such as configuration data) or algorithms (scripts) that can be executed to test for specific conditions or acquired sensor data that is not captured as part of routine monitoring in support of identifying the source of the problem. A fully defined fault frame would include remediation required to address the identified fault. When the conditions of a fault frame have been met the reactive diagnostic component will send a message to the Orchestrator component notifying it of the fault and providing the remediation information contained the fault frame.

Predictive Diagnostics

The predictive diagnostics component operates similarly to the reactive diagnostics component with the primary exception being that with predictive diagnostics the fault frames are defined to predict system abnormal behavior and to make system corrections to prevent the problem from occurring. Operational models are developed using historical data used to identify the system events and monitor values that are correlated with abnormal system behaviors. Through repeated observations of the relationship between data measurements and system performance the suspected cause and effect relationships can be formed into predictive models. The relationship between

monitored values and how the system performs can be modeled in a fault frame, but unlike a reactive diagnostic fault frame, the predictive fault frame will look to match events and sensor data that may not have an obvious relationship to the problem it is trying to prevent. In addition the remediation that might be included in the fault frame may not be targeted at services associated with the problem.

Orchestrator

The orchestrator is responsible for managing communication across the different SAF subsystem; see the Orchestrator section in the Shared Architectural Components for more information.

Self-Healing Engine

The self-healing engine component is responsible for taking instruction from the orchestrator (provided by other subsystems) and implementing those changes; see the Self-Healing section in the Shared Architectural Components for more information.

Scheduler

The scheduler component is responsible for managing the execution of scheduled activities across the different SAF subsystem; see the Scheduler section in the Shared Architectural Components for more information.

Troubleshooting Subsystem

The troubleshooting subsystem is responsible for supporting the logical, systematic search for the source of a problem so that it can be fixed and the system made operational. Troubleshooting processes are critical to maintaining systems where symptoms of a problem can have many possible sources. Troubleshooting requires the identification of system malfunctions through the use of monitoring data, events, and alarms. Troubleshooting is most often a process of elimination, potential causes of problems are identified and potential causes are discounted or confirmed. Confirmation that a problem was the cause of a malfunction typically comes in the form of restoration of the system to a normal working state.

A system can be described in terms of its expected, desired or intended behavior, its ability to provide a set of services based on the availability of resources and proper configuration. A model of how the system should operate under normal, proper condition is essential in order to be able to identify when it is not performing as it should, events and inputs to the system are expected to generate specific results or outputs. When a problem occurs, it can be described in terms of symptoms of a malfunction (a deviation from expected behavior) and troubleshooting is the process of isolating the specific cause or causes of the symptom. Efficient troubleshooting requires a clear understanding of expected behavior and the relationship between the symptoms of a problem and the set of prospective causes that could lead to the symptoms. The progressive elimination of the possible causes until the root cause is found characterizes the troubleshooting process.

Typically the troubleshooting process ends when the problem is resolved. This is due to the nature of the processes needed to eliminate possible causes, in order to test whether a specific condition has caused the malfunction the suspected problem has to be remedied and then the system monitored to see if it returns to a normal working state. Depending on the state of the system this process can lead to spurious changes to the system that do not fix the problem and could lead to additional problems. Backing out changes that do not address the problem being investigated is important to ensuring that the changes made during the troubleshooting process that did not fix the problem are reverted in order to avoid unexpected consequences.

Troubleshooting is the process of finding and eliminating the cause of a problem. The process is an iterative one that can be characterize by the steps below:

1) *Monitoring information is collected and analyzed by system or user,*
2) *A failure or performance anomaly is identified,*
3) *Possible causes of the problem are identified,*
4) *One of the possible causes of the problem is selected and a fix for the problem is implemented,*

5) *The system is monitored to determine if the fix has resolved the problem. If the system returns to normal state the problem is determined to be fixed, if not then another possible cause for the problem is selected and the fix for that cause is implemented. This process is repeated until the system returns to normal state.*

The efficiency of the troubleshooting process is a function of a number of factors ranging from the fidelity and accuracy of the errors reported by a system when an error is identified to the expertise of the user or system involved in the identification of possible causes of the problem.

Troubleshooting Methods

There are a number of troubleshooting methods that may be supported within a troubleshooting subsystem and those included will impact how the system reacts to and solves problems. Examples of troubleshooting methods to consider are 1) frequency of incidence, 2) system bisection, 3) flow charts, 4) checklists, 5) procedures, and 6) root cause analysis.

Fault Identification

The fault identification component is responsible for identifying when faults occur in a system. The component is configured to look for events that are indicative of a problem in the system. The fault identification registers with the notification subsystem to be notified when specific events occur within the system; the set of fault cases that are registered with the troubleshooting subsystem identify the events that are registered. When the fault identification component is notified that a fault event took place the component will identify the fault cases that have this event defined as a condition of presence and send those fault cases to the orchestrator for disposition of the fault case.

A fault case can have multiple events that need to be present in order for the fault to be considered to have occurred. The fault identification component needs to contain logic in order to coalesce the presence of the events, manage the temporal relationships among the different events within a fault and to clear faults from consideration based on expiration periods and other dependencies (such as a reboot, etc).

Cause Isolation

The cause isolation component is responsible for paring the set of fault cases that have been identified as possible causes of a fault. This component possess the logic to analyze the properties of the set of fault cases passed to it by the orchestrator component and to identify attributes and their values that distinguishes them from each other. The distinguishing attribute values can then be collected, using the symptom collection component, and the results can then be used to eliminate fault cases from the set of possible fault cases when they do not match the expected values.

Symptom Collector

The symptom collector component collects monitoring and configuration information from system components in response to requests made to it by the cause isolation component. The symptom collector is configured to be able to access monitoring and configuration information from the different components that make up the system. It must be able to support the different industry standards for remote access and must be able to support changes to the configuration without disrupting current processes. The system must allow remote access to configuration information and so this information needs to be in a machine readable format that does not require heroic effort to access.

Orchestrator

The orchestrator is responsible for managing communication across the different SAF subsystem; see the Orchestrator section in the Shared Architectural Components for more information.

Self-Healing Engine

The self-healing engine component of the troubleshooting subsystem is responsible for taking problem remediation instructions from the orchestrator and implementing those changes. The instructions usually take the form of modifying system component configuration values but can include sending instructions to the user via an application

user interface or resetting a device. The self-healing engine contains a library of command sets that are associated with a system component and commands that can be used to manipulate that component, through a supported interface such as an API (application programmable interface), a user interface (CLI or GUI), SNMP, etc. The system component would provide support for the interface and the self-healing engine would construct the set and execution order of configuration and management programs to utilize those interfaces.

Solution Verification

The solution verification component is responsible for verifying that the system has returned to normal or expected operation when instructed to do so by the orchestrator, the post-corrective state is defined within the normal operations model for the system or within the fault case if the solution will put the system in a non-optimal/normal state. The orchestrator will provide the set of "tests" that the solution verification component is to perform to make the determination, which will usually involve operations such as determining the status by comparing monitored values with normal system operation values, and looking for specific events/messages in component log files. The outcome of the execution of each test is returned to the orchestrator in order for the orchestrator to capture and report them to the notification subsystem.

Notification Subsystem

The notification subsystem is responsible for passing along the alerts and events identified by the monitoring subsystem to the appropriate subsystems, user interface or API. The notification subsystem is composed of a configuration, engine, and delivery component.

Notification Configuration

The notification configuration component is used to identify the alerts and events that should be passed along, the components they should be passed along to, the protocol to be used, and the method to be used to verify delivery.

Notification Engine

The notification engine component uses the configuration information defined in the notification configuration component and the messages received from the monitoring subsystems and determines what notifications should be sent to where.

Notification Delivery

The notification delivery component performs the mechanics of connecting to a notification target, transferring the message, enduring delivery, and verifying the receipt.

Learning Engine Subsystem

The learning engine subsystem represents the higher level cognitive functions performed by humans such as reasoning, generating and verifying hypotheses, pattern recognition, etc. These capabilities are found in various forms in different industries and while applicable to the SAF they have not been adequately evaluated for inclusion.

Shared Architectural Components

Chapter contains the discussion of components that can be found in multiple subsystems and may be implemented as a single component shared across subsystems.

Scheduler

The scheduler component is used to manage the execution of operations that have be configured to occur on a define frequency. A schedule item will identify the activity to be executed, the frequency of execution, time of day to be run, and the maximum time to run. The scheduler supports the ability to monitor the execution of scheduled activity and to terminate an activity should it not be completed by the maximum time to run. The scheduler should prevent

two of the same activities from executing at the same time. The engine will report to the orchestrator the successful completion or failure to complete the set of instructions provided.

Orchestrator

The orchestrator is responsible for managing the communication and interplay between SAF subsystems. Messages are passed between subsystems through the orchestrator which is configured to control how it responds to these inputs. The orchestrator is configured with order and dependency rules in order to properly order message passing and to manage communication.

Validation Engine

The validation engine evaluates the inputs provided by a user or other components against a set of rules and heuristics. The engine provides or establishes simple field level validation (such as regular expressions), field-to-field validation (if value X then user must provide value Y), object/page validation (all data provided for object Z), and solution level validation (all required components have been properly configured). A common validation engine underscores the importance of a common set of logic and infrastructure to validate installation of individual components and their interdependencies.

Self-Healing Engine

The self-healing engine is responsible for taking instruction from the orchestrator (provided by other subsystems) and implementing those changes. The instructions take the form of modifying system component configuration values but can include sending instructions to the user via an application user interface or resetting a device. The self-healing engine contains a library of command sets that are associated with a system component and commands that can be used to manipulate that component, through a supported interface such as an API (application programmable interface), a user interface (CLI or GUI), SNMP, etc.

CONCLUSIONS

This paper introduced a serviceability architecture that can be used to describe a common process model for deploying service solutions and identified the serviceability capabilities that should be considered. A vocabulary for describing the architecture and its components is introduced. This model can be used in evaluating the serviceability capabilities provided by solutions as well as in the development of those solutions. There have been a couple of efforts within Cisco to apply the serviceability architecture in the development of a taxonomy for an internal support community (Allen, 2013) and the evaluation of customer focused content for smart services products.

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Section 8

Research on Human Behavior, Ethics and Decision Making in Smarter Service Systems

A Study on BEMS Based on Behavioral Economics for Small and Medium-Sized Buildings

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ABSTRACT

The authors have researched and developed Building Energy Management Systems (BEMS) to promote energy-savings in small and medium-sized office buildings. In order to accelerate the installation of BEMS into these buildings, it is important to develop BEMS which meets the following two requirements;

1) To achieve the system configuration through the ease of installation.
2) To have functions of inducing energy-saving behaviors of people in the office.

For the purpose of developing practical BEMS, it is essential to examine the above from a viewpoint of the human side. In this paper, a concept of the system developed by the authors is briefly introduced, and followed by the discussion on users' energy-saving behaviors induced by the information providing method. First, the outline and features of the system are introduced. Next, the research on the information providing method for inducing energy-saving behaviors is explained. Finally, based on these researches, we propose a design policy for the information providing method to induce energy-saving behaviors. It is to provide information that increases the motivation before actions are taken and to reduce the occurrences of dissatisfaction after taking such actions. Currently, the effects of the system are under validation regarding whether it maintains and induces energy-saving behaviors.

Keywords: Energy Saving Behavior, Information Providing Method, Air Conditioning System, BEMS

INTRODUCTION

In recent years, global climate changes caused by global warming have become a serious issue. Carbon dioxide (CO2) emissions produced by the consumption of fossil fuels have been considered as one of the causes of global warming. It is clear that developing energy-saving systems is essential for preventing global warming. From such a background, many energy-saving systems are proposed and installed into buildings (Hashimoto et al., 2008). However, many small and medium-sized buildings have failed to make progress in saving energy (Ministry of Economy, Trade and Industry, 2013). One factor behind the failure is that these buildings, different from larger buildings, are not subjected to stricter legal regulations and lack operators with expertise. Operators of small and medium-sized buildings also fail to identify the sources of energy loss or promptly devise improvements. These actions are difficult to be taken for such buildings.

The authors have researched and developed Building Energy Management Systems (BEMS) to promote energy-savings in small and medium-sized office buildings (Nishino and Hashimoto, 2013, Suzuki et al., 2013). Figure 1 shows a positioning of new concept of BEMS. In order to accelerate the installation of BEMS into these buildings, it is important to develop BEMS which meets the following two requirements;

1) To achieve the system configuration through the ease of installation
2) To have functions of inducing energy-saving behaviors of people in the office

For the purpose of developing practical BEMS, it is essential to examine the above from a viewpoint of human side. In this paper, concept of the system developed by the authors is briefly introduced, and followed by the discussion on users' energy-saving behaviors induced by the information providing method.

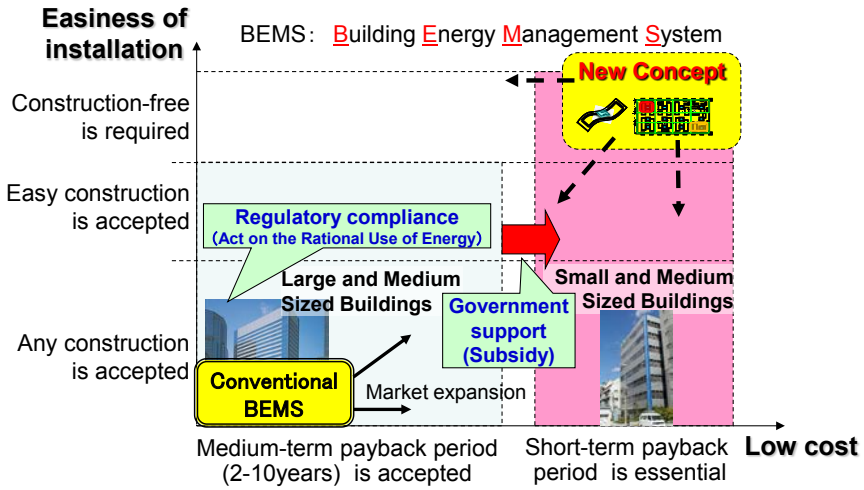

Figure 1. Positioning of new concept of BEMS

BEMS FOR SMALL AND MEDIUM-SIZED BUILDINGS

Outline and Features of Proposed BEMS

We have proposed a concept of new BEMS (proposed BEMS). That is “to visualize energy losses in real time by only attaching sensor terminals to ceilings” and “to propose countermeasures to promote energy-savings”. Figure 2 shows an overview of the system. Figure 3 illustrates its concept. The outline and features of the system are below;

- This system is composed of ultra-small sensor terminals and visualization application.
- The sensor terminal is easy to install by simply attaching it to the ceiling since a tiny photovoltaic panel is integrated with the wireless sensor.
- The application notifies where the energy loss occurred and how to save energy in real time, which were unclear in conventional BEMS.

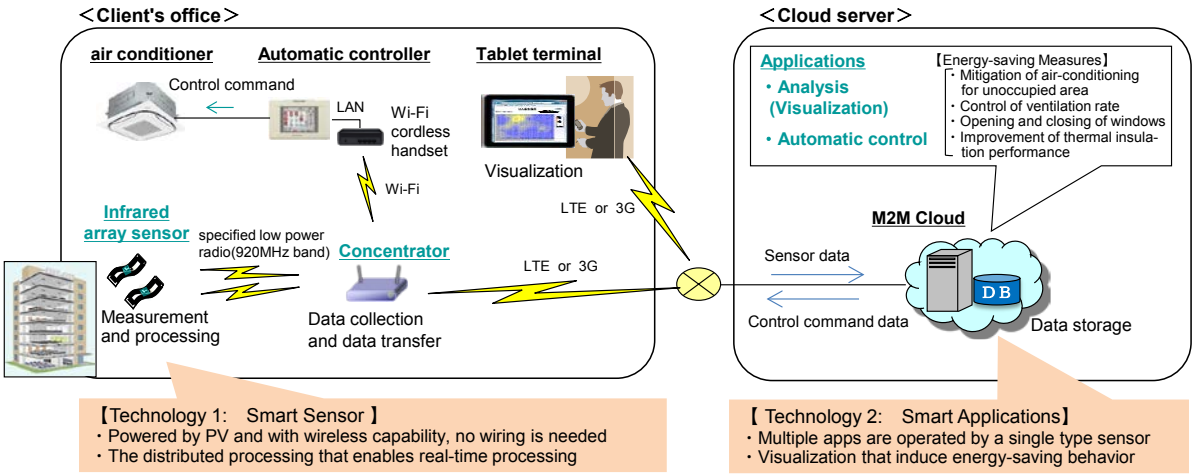

Figure 2. System configuration of proposed BEMS

To establish the above, the team had collaborated with sensor suppliers and developed a new infrared array sensor (M.Suzuki et al, 2013, Honda and Tanaka, 2013). Figure 4 shows an overview of the prototype sensor. It monitors not only the temperature, but also the locations of occupants. Since a tiny PV panel was integrated with the wireless sensor, wiring installation for power supply and communication were eliminated. The sensor is very small; at the size of only 2 cm x 5 cm. With multiple sensors, the entire room can be overlooked like the "bird's-eye view". By using this information, the energy-saving measures are proposed. For instance, by displaying occupants whereabouts within the same room through monitors, unnecessary air-conditioning and ventilation can be easily determined at a glance, enabling the construction of optimum environment. We estimated the effect of energy-savings by introducing this system, and obtained data that shows an approximately 10% reduction of energy consumption can be expected. Currently, the effects of the system are under validation regarding whether it maintains and induces energy-saving behaviors.

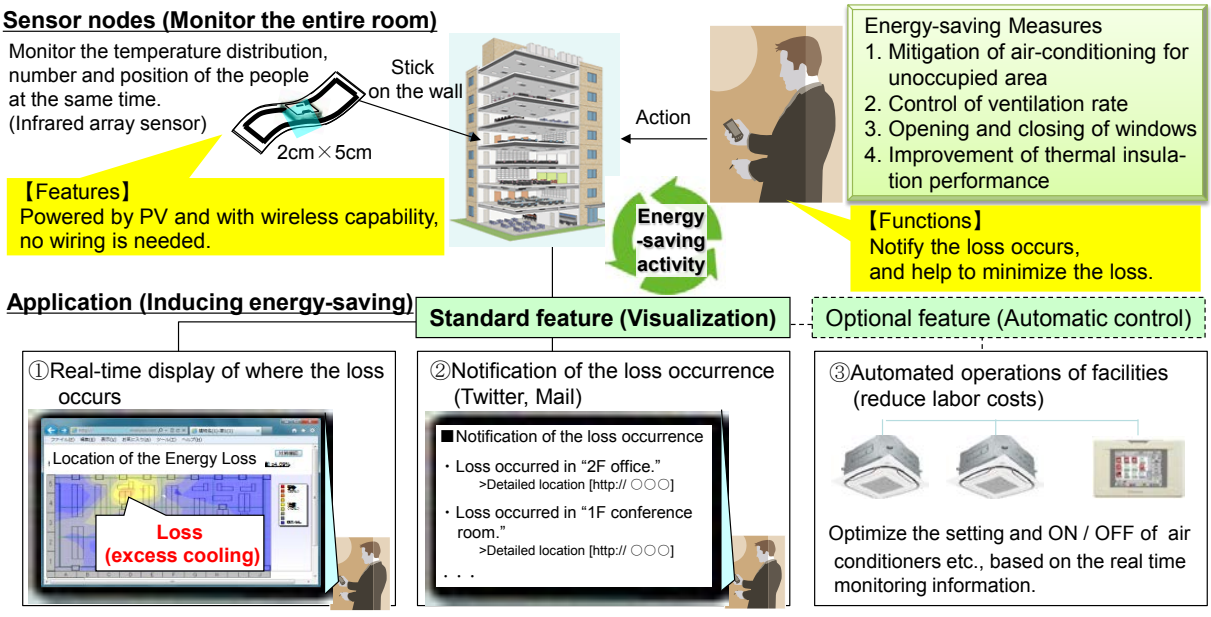

Figure 3. Concept of proposed BEMS

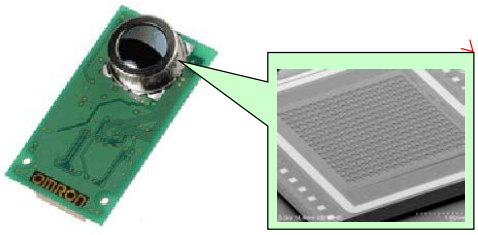

Figure 4. Prototype of infrared sensor array

Visualization Application of Proposed BEMS

Figure 5 shows an overview of the visualization application. It notifies where the energy loss occurred and how to save energy in real time, which the information was unclear in conventional BEMS. It consists of a summary report and four kinds of detailed reports to inform the area where the energy loss occurred. The summary report shows the indoor temperature distribution and position of the occupants. As for areas where the energy loss has occurred, it superimposed one or two icons above the locations. Furthermore, in order to induce energy-saving behaviors, guidance shown in Table 1 is presented in the lower column. Finally, the four kinds of detailed reports show the following information.

- Area where excess cooling or warming occurred and guidance on how to improve it.
- Area where excess ventilation occurred and guidance on how to improve it.
- Guidance for open-window recommendation with information of outdoor and indoor temperature displayed.
- Area where heat insulation degradation occurred and guidance on how to improve it.

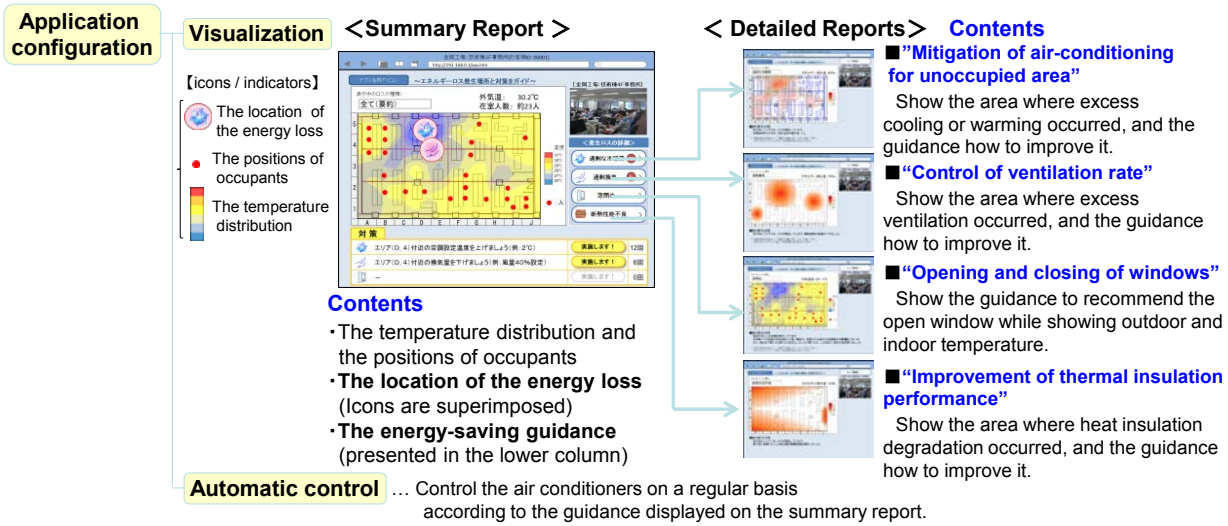

Figure 5. Overview of visualization application

Table 1. Examples of the guidance for inducing energy-saving behaviors

Energy-saving Methods	Guidance (examples)
"Relaxation of unoccupied area"	Excess cooling is occurred around the area of (D, 5). The set temperature of the air-conditioner should be raised (e.g. +1°C)
"Control of ventilation rate"	Excess ventilation is occurred around the area of (D, 4). The air volume of the ventilation fan should be turned "Low."
"Opening and closing of windows"	The outside air temperature is cool enough. Windows should be opened, and the air-conditioners should be turned off.
"Improvement of thermal insulation performance"	Heat insulation degradation is occurred around the area of (A, 1). Implementation of the thermal insulation renovation should be considered.

INFORMATION PROVIDING METHOD TO INDUCE ENERGY-SAVING BEHAVIORS

For the purpose of developing practical BEMS, it is essential to examine the above from a viewpoint of human side. In this section, in order to clarify insufficiencies of conventional BEMS, two researches on the information providing method for inducing energy-saving behaviors are introduced. One is the interviews regarding the proposed BEMS. The other is a survey on recent studies of information providing method based on behavioral economics. The summary of these researches is below.

Summary of Interviews Regarding Proposed BEMS

The interviews on the summary report and detailed reports shown in Figure 5 were performed to the visitors at the exhibition to introduce products such as BEMS. It was asked to the visitors whether the proposed reports can induce energy-saving behaviors more than conventional BEMS. The summary of the interviews is presented in Figure 6. The main comments are below;

- In conventional BEMS, actions for saving energy were barely initiated since there was no information regarding where the lost occurred and how to reduce further loss. On the contrary, it was improved by the proposed reports.
- Users tended not to initiate actions actively since there were no reward gimmicks for persons who saved energy. In this issue, the proposed report also did not improve it. New approach to improve motivation is required.

These comments suggest the necessity for the introduction of behavioral economics.

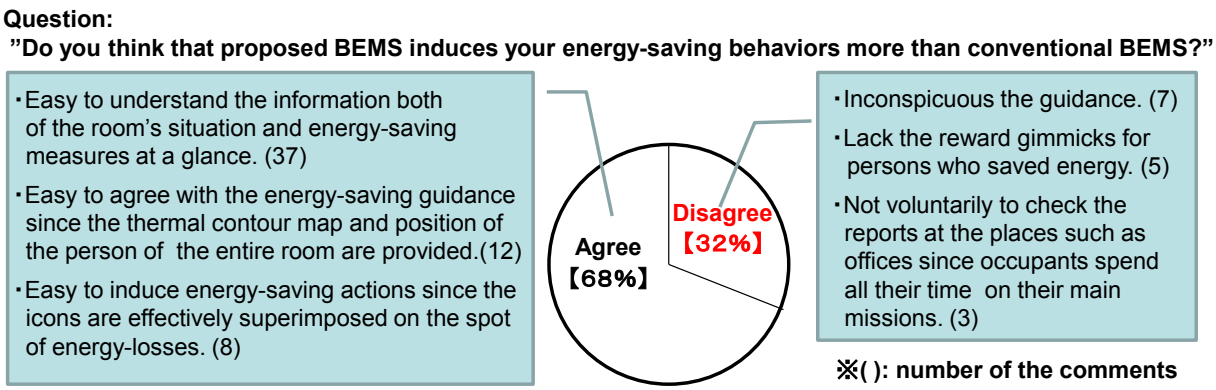

Figure 6. Result of interviews about required improvements on BEMS

Recent Studies on Information Providing Method based on Behavioral Economics

Recently, in order to induce energy-saving behaviors, information providing method based on behavioral economics has been studied. Behavioral economics explores why people sometimes make irrational decisions, and why and how their behaviors do not follow the predictions of economic models. It is important how information is provided, how information is understood by the people, and how motivation of energy-saving action is improved. Summary of the recent studies is below.

In the demonstration test for household energy-savings in the U.S, their innovative combination of feedback and normative data can achieve low-cost energy savings of 1.2 to 2.5% (Alcott, 2009, Ayers et al., 2009). This approach provides households with monthly Home Energy Reports including; 1) Household level data on current and comparative historical energy consumption, 2) Semi-tailored energy saving tips, and 3) Information concerning the energy consumption patterns of other households similar to their own. The third component gives households the social or normative valuation basis for comparing and assessing their own energy consumption patterns. Households can evaluate whether their consumption was abnormally high or low and spontaneously save energy as necessary.

In Japan, the energy-saving system for office is introduced, which allows office workers to choose the control target from air conditioning equipment or lighting equipment (Dazai et al., 2012). The system releases control for air-conditioning via occupants' actions to turn off the lighting. As the result, the occupants are able to obtain more comfortable environment by turning off the light. It means that gives non-economic incentives such as comfortable environment. In other words, it is suggested that occupants become more cooperative for the energy-savings to avoid uncomfortable environment.

Effective information for household energy-savings is reviewed by ACEEE (Karen et al., 2010). This report summarizes a more useful feedback method. Figure 7 shows the summary. It is suggested that Real-time and Real-time Plus Feedback become an increasingly viable and cost–effective approach.

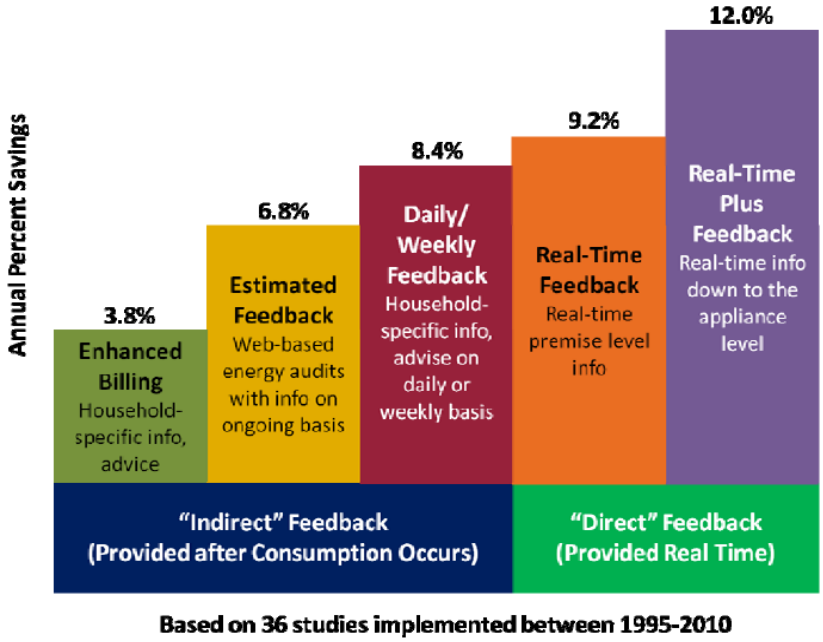

Figure 7. Average Household Electricity Savings (4-12%) by Feedback Type (Karen et al., 2010)

・Standard Billing – An energy bill that displays the monthly kilowatt-hour(kWh)of consumption and the unit rate ($/kWh), the corresponding total cost and other billing charges, as well as the total amount due. This form of feedback generally lacks comparative statistics of any detailed information about the temporal aspects of consumption

・Enhanced Billing – Provides more detailed information about energy consumption patterns, and often includes comparative statistics –comparing the most current monthly electricity usage and expenditures together with historical consumption and/or a comparison to other households.

・Estimated Feedback – This approach uses statistical techniques to disaggregate the total energy usage based on a customer's household type, appliance information, and billing data. The resulting feedback provides a detailed account of electricity use by major appliances and devices. These most commonly take the form of web-based "home energy audit" tools, offered by a utility to its customers.

・Daily/Weekly Feedback – These reports use averaged data and often include consumer self-read studies (in which individuals read their meter and record the energy usage themselves) as well as studies in which individuals are provided with daily or weekly consumption reports from the utility or research entity.

・Real-Time Feedback – In home energy display devices that provide real-time or near real-time energy consumption and energy cost data at the aggregate household level.

・Real-Time Plus – In home energy display devices that provide real-time or near real-time energy consumption and energy cost data disaggregated by appliance.

Moreover, the use of motivational elements such as goal setting, competitions, and commitments could be much more practical and effective when it comes to information providing method for small and medium-sized buildings. To summarize their researches, it is important to contain the following information;

- Real-time feedback concerning energy loss.
- Competitive elements concerning the energy consumption.
- Giving choices concerning the thermal environment.

As noted above, we propose a design policy for the information providing method.

Design Policy for the Information Providing Method

Based on the above, we propose a design policy for the information providing method to induce energy-saving behaviors. It is to provide information that increases the motivation and reduces the occurrences of dissatisfaction. The contents are as follows;

(1) Notify where the loss occurred and how to save energy as soon as the loss occurred (Real-time visualization)
(2) Display the amount of the loss in comparison with the office where a behavior pattern resembles (Comparison with the similar offices)
(3) Display the temperature distribution of the area for individuals to choose a preferable temperature zone (Giving choices)

A model of inducing energy-saving behaviors by using this design policy is shown in Figure 8. It is explained below:

The vertical axis shows the energy-saving effect induced by the information providing method, and the horizontal axis shows the degree of the users' motivation induced by it. The conventional BEMS is positioned at the lower left as "Standard BEMS", and the system at the upper right is valued as a more effective system to induce energy-saving behaviors. A right up solid line arrow means the increase of the energy-saving behaviors, and a left down dashed line arrow means the decrease of that behaviors.

The information (1) which is mentioned above corresponds to the first right up solid line arrow. By being informed what action can save energy at present, it becomes possible for the users with no expertise to save energy, which the information was not provided by the conventional BEMS. The contents of it are shown in Figure 5 and Table 1. The necessity and the effectiveness of that information are suggested by the summary of interviews regarding proposed BEMS and the report by ACEEE mentioned above. The "Standard BEMS" is improved as the "Effective BEMS" by adding this information.

The information (2) which is mentioned above corresponds to the second right up solid line arrow. The aim is to utilize the competitive psychology by showing a rival that can be compared with easily. Specifically, the office where a presence rate of occupants is nearly the same can be chosen as a rival. It is suggested by the result of the demonstration test mentioned above taken place in the U.S. that competition is one of the means for motivating behavioral changes. By adding this information, the "Effective BEMS" is improved as the "More effective BEMS".

The information (3) which is mentioned above corresponds to the curved arrow at the upper right side. The aim is to defuse users' feeling of dissatisfaction and prevent such users from becoming less cooperative so that their energy-saving behaviors are not decreased. The effectiveness of this information is suggested by the study in Japan mentioned above.

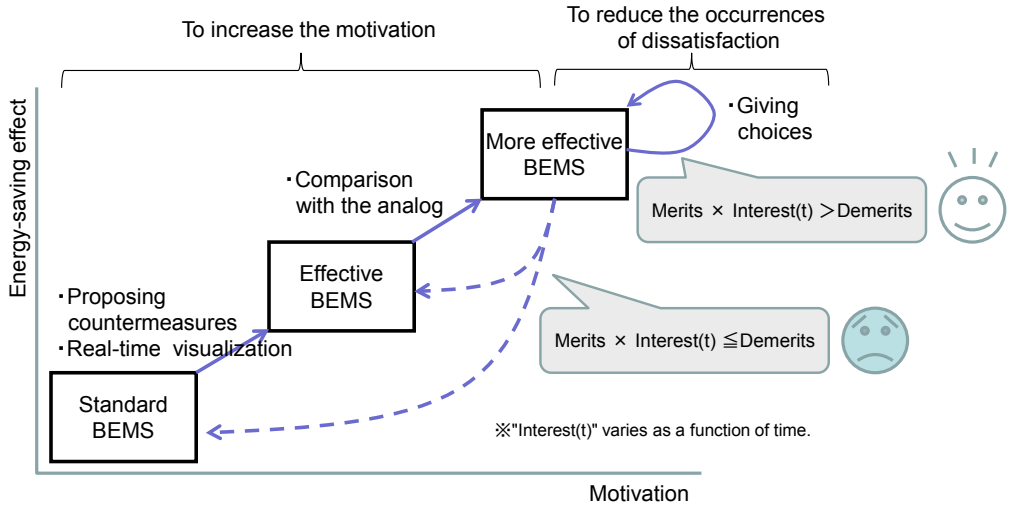

Figure 8. Model of inducing energy-saving behaviors

By providing this information successfully, occupants' energy-saving behaviors are induced as shown in Figure 9. The information providing method has the role as the trigger for energy-saving. First, the occupants confirm this information. Then, they notice the loss and moves to the notified area. Subsequently, they take actions to minimize the loss according to the guidance informed by the system. At this point, it is important to take means for catching occupants' eyes in order to provide the trigger successfully. One of the means is to locate the information monitor near the place where occupants are likely to be gathered (e.g. near the copy machine).

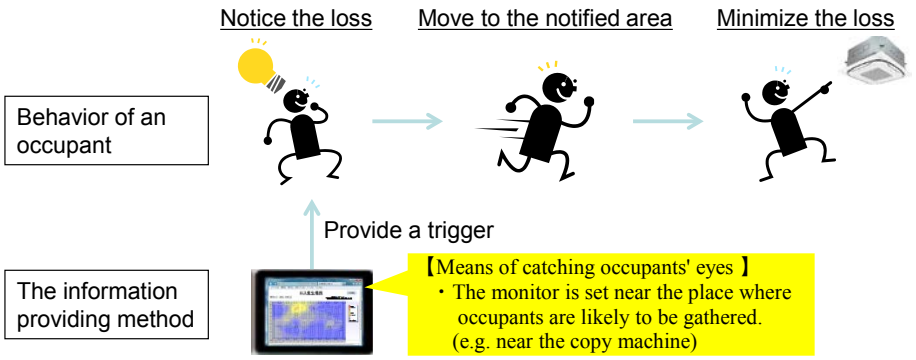

Figure 9. Action flow of an occupant required to save energy

However, even if the information such as above is provided, there are some users who may not transform it to energy-saving behaviors. Generally, behaviors or actions are taken when their merits are greater than their demerits. However, such pattern is not always followed even when the merits are greater than the demerits. One of the reasons is considered that the merit is judged small because of the lack of the users' interest. For instance, they may initiate energy-saving behaviors from their curiosity at initial stage, but that may decrease with time. The interest varies as a function of time. It is important to keep the interest in order to maintain the energy-saving behaviors. As the means of keeping the interest, some approaches are proposed as follows; changing information regularly, giving attractive rewards, and proposing incidental actions. Currently, the concrete methods about these approaches are under examination.

CONCLUSIONS

The concept of the Building Energy Management Systems system developed by the authors were introduced, and followed by the discussion on users' energy-saving behaviors induced by the information providing method. Based on the result of interviews regarding the proposed BEMS and the recent study applying behavioral economics, a design policy for the information providing method to induce energy-saving behaviors was proposed. It is to provide information that increases the motivation and reduces the occurrences of dissatisfaction. The contents are as follows;

• Notify where the loss occurred and how to save energy as soon as the loss occurred (Real-time visualization)
• Display the amount of the loss in comparison with the office where a behavior pattern resembles (Comparison with the similar offices)
• Display the temperature distribution of the area for individuals to choose a preferable temperature zone (Giving choices)

Currently, the effects of the system are under validation regarding whether it maintains and induces energy-saving behaviors.

ACKNOWLEDGMENT

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Discourse Analysis of Voice-Based Computer-Mediated Communication in Distributed Work

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ABSTRACT

Computer-mediated remote voice communication among care providers is analyzed by a newly proposed discourse model. Nursing and care are central to healthcare services, and improvements in the quality and efficiency of healthcare processes are important issues. Effective communication support that does not interfere with normal operations is an urgent need. Here we examined a "smart voice tweet system" intended to overcome this problem by supporting collaboration across different sites. We field-tested this system at an elderly care facility in Japan for 5 days in 2013. We observed the activities of groups of care workers during residents' lunch and dinner and collected data on use of the system. By discourse analysis based on the proposed model, we confirm the validity of the voice tweet system as a support for remote voice communication among staff collaborating to achieve tasks. The findings can be used to design rules for estimating the ongoing status of collaborations and classifying voice tweets by purpose to decide whether they should be sent or just recorded. This research is based on joint research conducted by the Toshiba Corporation, the Shimizu Corporation, and the Japan Institute of Science and Technology with support from the Japan Science and Technology Agency.

Keywords: Voice, Communication, Collaboration, Discourse, Model, Exchange structure

INTRODUCTION

The aging of Japan's population is a major issue, one urgent aspect of which is caring for elderly persons with disabilities. At present, care services are often provided through the devoted efforts of care staff at long-term care facilities. Care services are characterized by what we call "action-oriented intellectual services." Care staff makes many decisions regarding medical care that require specialized knowledge. They also assist elderly persons with disabilities in many activities of daily living. The care service staff is made up of many professions and specialties, and care services must operate at all hours all year round. Successfully doing so requires a high degree of information sharing among staff, such as ensuring that proper records of care are kept.

Lemonidou C., Plati, C., Brokalaki, H., Mantas, J., and Lanara, V. (1996) pointed out that medical staff spends a significant amount of time on indirect care, including recordkeeping and information sharing. Conventional IT systems are fundamentally designed for deskwork, however, and do not support hands-free and eyes-free operation suitable for action-oriented intellectual services.

Uchihira, N., Torii, K., Uchihira, N., Chino, T., and Iwata, K. (2011) and Torii, K., Uchihira, N., Chino, T., and Iwata, K. (2012) have proposed a "voice tweet system," which is being developed to overcome these problems. In that system, "voice tweets" spoken by a staff member are tagged with the staff member's location and motion, spoken keywords, and associations with background knowledge. On the basis of these tags, the tweets are automatically delivered to an appropriate staff member. This system provides semi-hands-free and eyes-free communication among medical and care staff. Developing such a system requires knowing what kind of speech communication will support cooperative work in the medical and care domains. We therefore performed field studies at an elderly care home in Japan to analyze cooperative work and speech interaction among care staff.

Chino, T., Torii, K., Uchihira, N., and Hirabayashi, Y. (2013a, b) reported on field studies in which the voice tweet system was used to support staff assisting with bathing tasks at an elderly care facility in Japan.

In this paper, we report the results of another field study and an analysis at the same site on another task, feeding assistance. A new discourse model is proposed to clarify the validity of the voice tweet system from the point of view of supporting computer-mediated remote voice communication among the staff.

The remainder of this paper is organized as follows. The second section gives an overview of the voice tweet system, and the third section proposes a discourse model. The fourth section describes the field study site and the tasks examined. The fifth section discusses the results of the field studies. Finally, the sixth section gives our conclusions and proposes some areas for future study.

VOICE TWEET SYSTEM

Overview

The voice tweet system consists of a smartphone application, which is run on smartphones carried by nurses and care staff, and additionally a supporting application running on a smart voice tweet server. This voice tweet system allows nurses and care staff to input care records, make memos for themselves, and compose voice messages to other staff.

Figure 1 shows an outline of the system architecture, which consists of a smartphone application and a server application. The voice interface of the smartphone application enables hands-free or semi-hands-free message composition. Several sensors on the smartphone continuously collect data around the nurse or care staff as a background process, and the application periodically sends the data to the system server. Several estimator processes on the server estimate the state (context) of each staff member who is carrying a smartphone. The states estimated by each estimator are called "tags." Tags include, for example, keywords included in utterances, the location where

the staff member composed a voice tweet, the task the staff member was executing at the moment the voice tweet was made, the time, and the staff member's identity. Tags have two important functions. First, they improve comprehensibility of voice tweets, so that nurses and care staff need not vocalize everything in a voice tweet. For example, the staff member can leave out contextual information (who, when, and where). The system also uses tags to decide the type of delivery of voice tweets and to automatically deliver them to an appropriate destination according to whether they are a message for other staff, a reminder for oneself, or input to a database of nursing records.

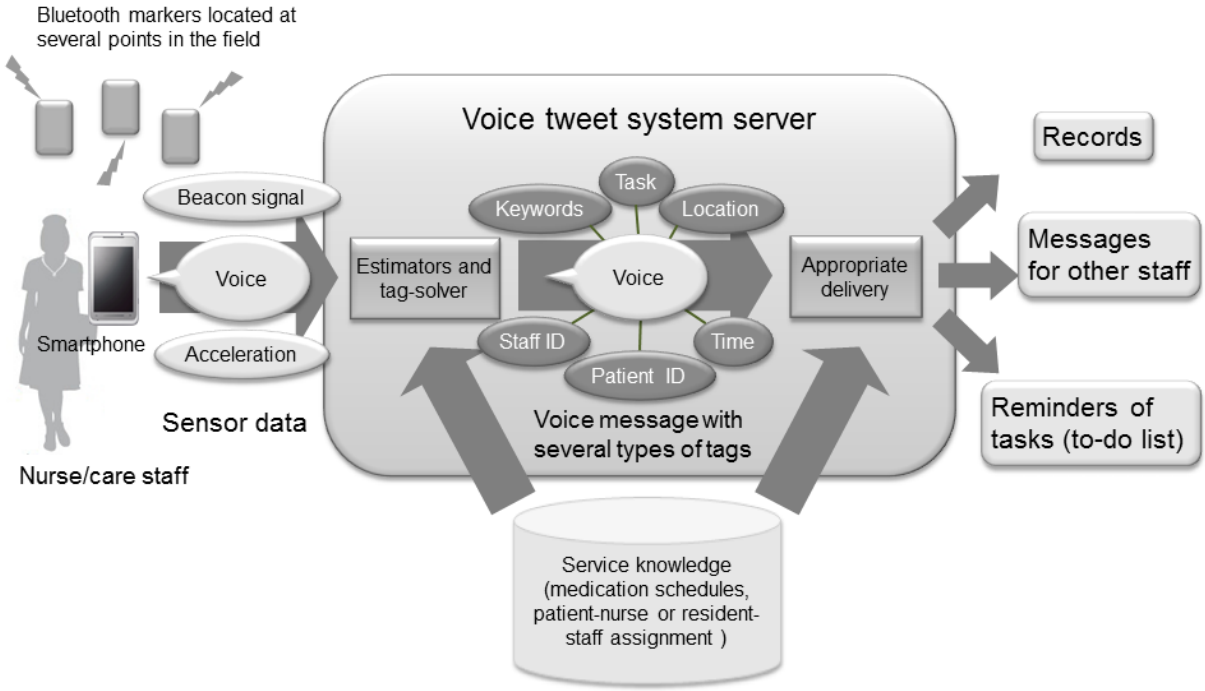

Figure 1. Architecture of the voice tweet system (Adapted from Torii et al., 2012)

Typical use cases

Figure 2 illustrates typical use cases for the voice tweet system. Nurses and care staff can compose voice tweets regarding topics such as patient pain complaints or patient questions about care processes by using a single hand at the bedside. Tags are automatically attached to the voice tweets. For example, a resident's question regarding bathing can be delivered to the care staff member who bathes the patient, allowing staff to easily provide appropriate assistance. Since tweets are automatically categorized according to tags, nurses and care staff can efficiently deliver the required information.

The aim of the voice tweet system is to support the work of staff in the medical and care domains. Because the system is used by staff, not by patients or care recipients, problems such as developing a computer–human interface for elderly persons are beyond the scope of this research.

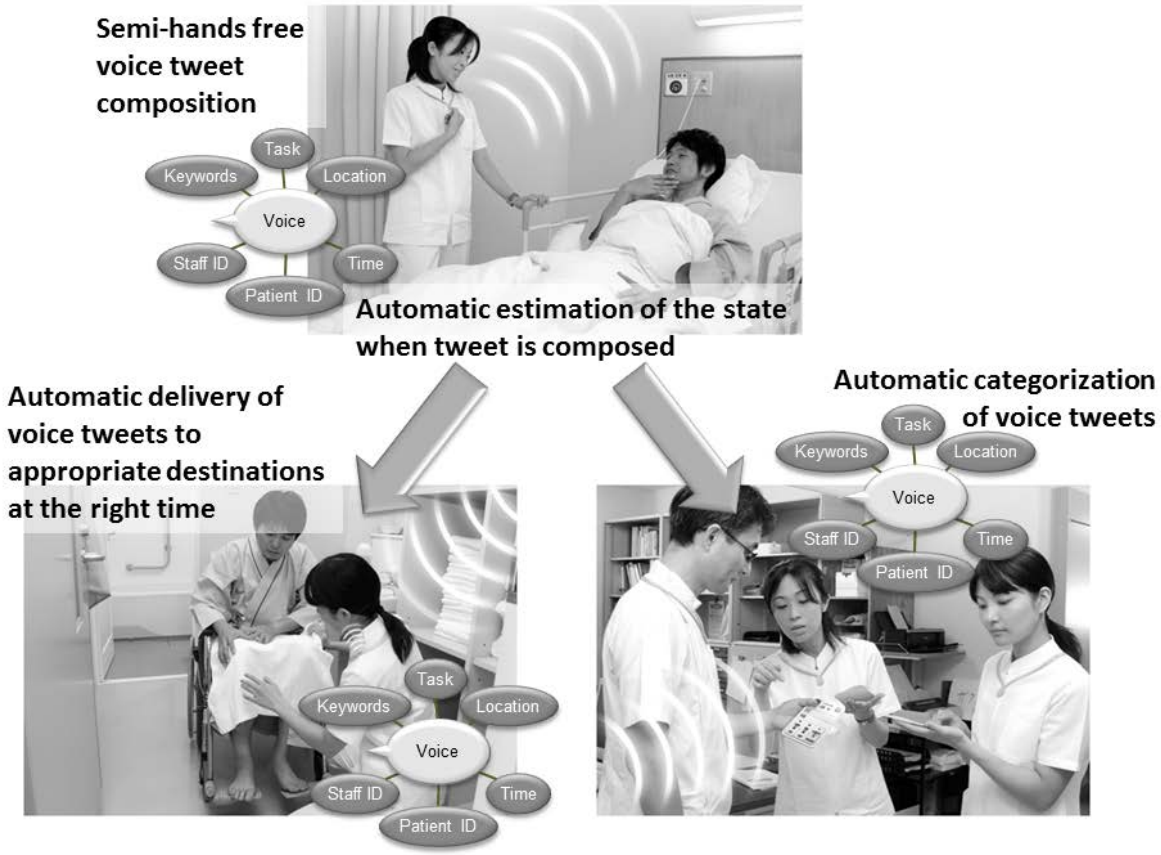

Figure 2. Typical use cases of the voice tweet system (Adapted from Torii, Uchihira et al. 2012)

DISCOURSE MODEL

Exchange structure

Sinclair and Coulthard (1975, 1991) proposed a discourse model called *exchange structure* to investigate the structure of classroom interactions. In this model, discourse in the classroom is analyzed by using multiple layers (*lesson*, *transaction*, *exchange*, *move*, and *act*). Although it can be regarded as a powerful descriptive tool for discourse analysis, as Coulthard and Brazil, (1981, 1991) pointed out, the original model was too specific to pedagogy and too complex for wider use. For example, the model introduced 26 acts, some of which are difficult to distinguish among because of ambiguities in the original definitions. Coulthard et al. (1981, 1991) proposed a revised and simplified model to address these problems.

Based on the work of Sinclair et al. (1975, 1991) and Coulthard et al. (1981, 1991), we propose a new discourse model for analyzing computer-mediated remote communication among multiple staff (participants) in action-oriented intellectual services work distributed across multiple work fields.

In our model, there are only three elements of discourse: *exchange*, *move*, and *discourse act. Exchange* is the basic unit of interaction among participants (here, staff). An *exchange* consists of a sequence of more than one *moves* by participants. A *move* corresponds to one utterance in a face-to-face communication or one computer-mediated voice message in a remote communication. A *discourse act* corresponds to one intention, or speech-act. Therefore, multiple discourse acts can be realized in one *move*. In the following subsections, the details of these elements are described.

Moves

Moves are classified into 3 types: *Initiation (I)*, *Response (R)*, and *Feedback* (F) in our model with some extensions. An *exchange* is defined as a sequence of *moves* of the types, in order, *Initiation–Response(s)–Feedback(s)*. We also introduce subtypes of each type of *move*. All *moves* are also classified as one of two subtypes according to whether a response is required *(rq)* or optional *(op)*. Therefore, the following six combinations of types and subtypes are possible.

- *Initiation (I)*: A *move* spoken by a speaker (an initiator speaker, *Si*) to initiate a communication with the others in an *exchange*.
  - *I(rq)*: an *initiation move*, with *response(s)* required.
  - *I(op)*: an *initiation move*, with a *response(s)* optional.
- *Response (R)*: Arbitrary numbers of *move(s)* by speakers other than *Si* (*So(s)*) in response to the *initiation move* from *Si*.
  - *R(rq)*: a *response move* that was requested by the corresponding *initiation move*.
  - *R(op)*: a *response move* that was not requested by the corresponding *initiation move*.
- *Feedback (F)*: Arbitrary numbers of *move(s)* spoken by *Si* to give feedback to the responses from *So(s)*.
  - *F(rq)*: a *feedback move* in reply to a corresponding *response* move that was requested by the *initiation move*.
  - *F(op):* a *feedback move* in reply to a corresponding *response* move that was not requested by the *initiation move*.

Discourse act

Each *move* can contain (or realize) an arbitrary number of *discourse acts*. We define the following four *discourse acts*:

- *Eliciting (elc)*: to request verbal responses; to seek information from the intended hearer(s).
- *Directing (dir)*: to request non-verbal responses; to affect actions of the intended hearer(s).
- *Informing (inf)*: to provide new information to intended hearer(s).
- *Acknowledging (ack)*: to confirm, deny, or evaluate the corresponding move spoken by the intended hearer(s).

As summarized in Table 1, an *exchange* always starts from a single *initiation move* spoken by an initiator speaker (*Si)*, followed by arbitrary numbers of *response moves* from other speakers (*So(s)*). Each *response move* may be followed by arbitrary numbers of *feedback moves* by *Si*. No *feedback moves* need to be followed by any *moves* in the *exchange*. Only limited combinations of the *move* types, subtypes, requirement for responses and *discourse acts* specified in Table 1 are possible. Given a combination of *move* type, subtype, requirement for responses, and *discourse act*, there is a prediction preference (no: not permitted;, weak: possible; or strong: likely) for the next discourse act, as shown in Table 1.

Table 1: Summary of proposed discourse model

Table 1.
Summry of elemnets of proposed discourse model,i.e. exchange, move types (I=initiation, R=response, or F=feedback type) , speaker(Si=an initiator, speaker, or So=other speaker(s) than Si), order of move types, requirement for responce moves (op=optional or rq=require), and discourse acts (inf=informing, elc=elicitating, dir=directing or ack=acknowledging).

Elements of discouse model										
	Move					Discourse act				
	Type	Speaker	Order of move types		requirement for response(s)	Possible discouse acts	Predicted (following discourse acts)			
			proceeding	following			ecl	dir	inf	ack
Exchange	I	Si	–	R(s)	op	elc	no	no	strong	weak
					rq	dir	no	no	no	strong
						Inf	no	no	no	weak
	R	So(s)	I	F(s)	op	inf	no	no	no	weak
					rq	inf	no	no	no	weak
						ack	no	no	no	weak
	F	Si	R(s)	–	op	ack	–	–	–	–
					rq	ack	–	–	–	–

STUDY LOCATION

Care facility

We performed field studies at a Japanese elderly care home over 5 days during May 2013. The building has four stories, about 40 private resident rooms, 1 common living room, and 2 dining rooms (one is on the first (i.e., ground) floor and the other is on the second floor), 1 care station, 1 bath area, and various other rooms and spaces. Corridors, elevators, and stairways connect the rooms. About 35 residents were living in this building during our field study. We selected feeding assistance as the task to study.

Residents with disabilities

We classify residents into the following groups.

- Residents with slight disability are independently mobile with the aid of a device such as a cane, walker, or wheelchair, and can eat without assistance. They eat lunch and dinner in the first-floor dining room.
- Residents with moderate disability require a wheelchair and staff assistance to move around, but can eat without assistance. They eat lunch and dinner in the first-floor dining room.
- Residents with severe disability require a wheelchair and staff assistance to move around and cannot eat without assistance; they therefore require full assistance from a staff member. They eat lunch and dinner in the second-floor dining room.
- Bedridden residents cannot eat ordinary meals and receive individual care in their own rooms.

Care teams and target tasks

A team of 5 to 8 care staff members, including a staff leader, performs the following routine around lunch time and dinner time.

1. Residents with slight disability come to the first-floor dining room without assistance.
2. One care staff member goes to the room of each resident with moderate disability to help them to the first-floor dining room.
3. One or more care staff members go to the room of each resident with severe disability to help them to the second-floor dining room.

4. Two or more care staff members provide mealtime assistance to residents with slight or moderate disabilities in the first-floor dining room.

5. Three or more care staff members, including the staff leader, provide feeding assistance to residents with severe disabilities in the second-floor dining room.

6. One or more care staff members take individualized meals to the room of each bedridden resident and provide individualized care.

7. Two or more staff members assist residents with slight or moderate disability as they move from the first-floor dining room to the second-floor living room for relaxation after the meal.

8. All staff members assist any resident who requires movement help from either of the dining rooms or the living room to their own private rooms after their meal or relaxation, and staff members assist with oral health care after lunch and dinner, and with night care (e.g., changing into sleepwear) after dinner.

METHODOLOGY

Data collection

We asked all participating staff to carry a smartphone with a voice-tweet-system client application and a headset device during feeding assistance. All voice tweet inputs and estimated location data with participant identifier and time information are automatically recorded by the server application of the voice tweet system. Human observers were also monitoring the activities of the participants.

Instructions and system settings

We asked the participating staff to use the voice tweet system to communicate with other staff members during tasks. We did not restrict conventional communication among staff (face-to-face conversation, phone calls, memos, mail, etc.). We instructed participants on a small number of key phrases to control distribution of their voice tweets to other staff members. For example, if a participant says “please” at the last part of their voice tweet input, then the voice tweet will be distributed to other staff members. Almost all linguistic variations of the underlying key phrases are automatically categorized into the appropriate key phrases.

Topologies of communication network

Two topologies of communication network, shown in Figure 3, were tested. In the star topology, all voice tweets of staff members are distributed to only the staff leader, and voice tweets uttered by only the staff leader are distributed to other staff members. In the fully connected topology, all voice tweets are distributed to all staff.

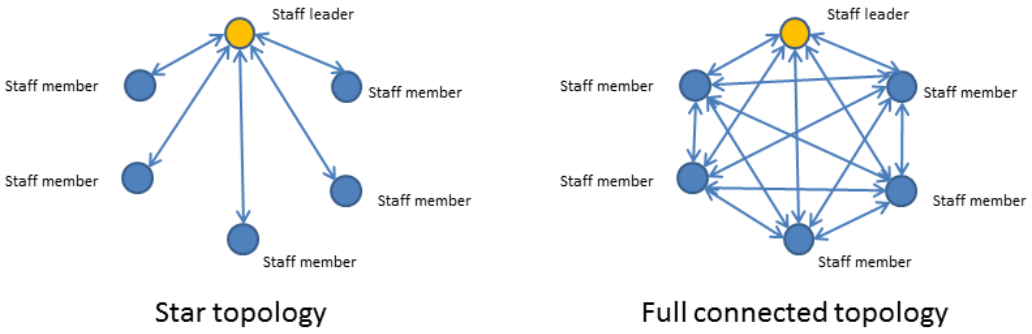

Figure 3. Topologies of communication networks

DISCUSSION

Collected voice tweets

Table 2 summarizes the trials and conditions. During our field studies at the care facility, 10 trials of more than 22 hours by 62 participants (1,267 person-hours in total) were performed: 5 trials during lunch time and 5 trials during dinner time. The star topology was used for 4 trials, and the fully connected topology was used for 6 trials. Each trial involved 5 to 8 participants. In all, 62 participants took part in the experiment. The elapsed times of trials vary from just over 1.5 hours to nearly 3.5 hours, depending on how busy each meal was. Table 2 also summarizes the collected voice tweets, with 636 voice tweets automatically collected by the tested voice tweet system. The average number of voice tweets per person during a meal time was 10.3. The average interval between voice tweets was about 2 min. The computer-mediated remote communication by the voice tweet system during the lunch time trial on the day 3 can be regarded as the most active, since it had the highest average number of voice tweets per participant (14.6) and the shortest average intervals (1 min 3 s). The influence of topology on the collected voice tweets was relatively smaller than the difference between lunch time and dinner time. We conclude that the fully connected topology is better suited to the tested situations (i.e., tasks, physical environment, number of users, duties and distribution of staff, etc.).

Table 2: Summary of trials, conditions, and collected voice tweets

Table 2.
Summary of trials and cconditions (day, lunch or dinner, star topology or full connected topology, and number of participants, and experiment durations), and statictics of collected voice tweets.

Trials and conditions					Collected voice tweets		
Day	Lunch or dinner	Topology	Number of participants	Duration	Number	Average number per perticipant	Average intervals
Day 1	lunch	star	6	2:28:16	64	10.7	0:02:19
	dinner	star	5	2:05:28	31	6.2	0:04:03
Day 2	lunch	star	6	1:33:16	76	12.7	0:01:14
	dinner	star	6	3:23:53	47	7.8	0:04:20
Day 3	lunch	full	8	2:03:06	117	14.6	0:01:03
	dinner	full	6	2:11:13	80	13.3	0:01:38
Day 4	lunch	full	7	2:34:03	61	8.7	0:02:32
	dinner	full	6	1:58:32	58	9.7	0:02:03
Day 5	lunch	full	6	1:58:24	63	10.5	0:01:53
	dinner	full	6	1:52:19	39	6.5	0:02:53
All 5 lunch trials			33	10:37:05	381	11.5	0:01:40
All 5 dinner trials			29	11:31:25	255	8.8	0:02:43
All 4 star topology trials			23	9:30:53	218	9.5	0:02:37
All 6 full connected topology trials			39	12:37:37	418	10.7	0:01:49
All 10 trials			**62**	**22:08:30**	**636**	**10.3**	**0:02:05**

Extracted elements of exchange structures

Table 3 summarizes the elements of exchange structures extracted from the 636 collected voice tweets. Because each voice tweet corresponds to a move in our model, 636 moves were extracted, as well as 735 *discourse acts*. Thus, each *move* contains 1.16 *discourse acts* on average. Almost all *moves* (95.1%) were classified as *initiation*. Most of the other *moves* (4.5% of total) were classified as *response*, and *feedback* was rare (0.4% of total). Although only a few (3%) of *initiation moves* without response required received one or more *responses,* almost half (46.4%) of *initiation moves* with response required received at least one *response.* This can be regarded as evidence for the

validity of the voice tweet system in this task situation (i.e., computer-mediated remote voice communication among staff performing feeding assisting tasks at an elderly care facility). Almost all *feedback moves* appear as replies to *response moves* when no response was required, or as replies to additional (2nd or later) *response moves* for an *initiation move*. This may mean that the *feedback move* was used to express appreciation for the extra effort by the voluntary responders. In addition, all *feedback moves* were from a staff leader. Some of them may be positive rewards for extra efforts by responders.

Table 3: Summary of extracted exchange structures, moves, and dialogue acts

Table 3.
Average number of extracted elements of exchange structures, i.e. move (I=initiation, R=response, or F=feedback type) , requirement for responce moves (op=optional or rq=require), and discourse acts (inf=informing, elc=elicitating, dir=directing or ack=acknowledging) per trial and

Trials conditions	Average number of extracted elements of exchange structurs per trial								Average number of discourse acts	
	Initiation moves (I)			Response moves (R)			Feedback moves (F)			
	op	rq		op	rq		op	rq	per participant	per move
	I(op/inf)	I(rq/elc)	I(rq/dir)	R(op/inf)	R(rq/inf)	R(rq/ack)	F(op/ack)	F(rq/ack)		
Lunch trials	81.6	1.8	1.2	2.6	1.8	0.4	0.2	0.4	13.6	1.18
Dinner trials	52.6	0.6	2.0	1.4	0.0	0.4	0.0	0.0	9.8	1.12
Star topology trials	69.8	0.3	1.8	1.5	0.3	0.5	0.0	0.0	12.9	1.36
Full connected topology trials	65.3	1.8	1.5	2.3	1.3	0.3	0.5	0.0	11.3	1.05
All trials	**67.1**	**1.2**	**1.6**	**2.0**	**0.9**	**0.4**	**0.1**	**0.2**	**11.9**	**1.16**
Distribution (all trials)	91.3%	1.6%	2.2%	2.7%	1.2%	0.5%	0.1%	0.3%		
		3.8%			1.8%		0.4%			
	95.1%			4.5%						

Examples of extracted exchange structures are shown in Table 4. Ten voice tweets (*moves*) uttered by two participants (staff leader A and staff member C) during 1 hour of lunch on day 4 are extracted. There are two *initiation moves* from A, 6 *Response moves* from C, and 2 *feedback moves* from A. Two sequences of *initiation–response–feedback*, and four sequences of *initiation–response* are formed by these 10 *moves*.

Table 4: Examples of extracted exchange structures.

Table 4.
Examples of extracted exchange strucutures during 10:30–11:30 on day 4. The original Japanese utterances are transcribed and translated into English. The phrases "please" at the end of the utterances are predefined key phrases to distriute the message to other staffs.

Voice tweet ID	Speaker	Extracted elements of exchange structures			Ttranscription (in Japanse) and translation (in English)
		Move type	Requrement for responses	discouse act	
Ta1:I(rq/ecl)	Staff leader A	I	rq	elc	U歯科の様子教えてくださよろしくお願いします。 "Report the progress of Dentist_U. Please." (The last "Please" is a signal to send the message.)"
Tc1:R(rq/inf)	Staff member C	R	rq	inf	今、Vさんが治療に入ってまして。あとをWさん、Xさん 口腔ケアでYさんとZさんが残ってます。お願いします。 "Now, treatment for Mr. V is in progress. Ms. W is waiting. Ms. X, Ms. Y, and Ms. Z are also waiting for dental care. Please."
Ta2:F(rq/ack)	Staff leader A	F	rq	ack	わかりました。よろしくお願いします。 "Ok. Please."
Tc2:R(rq/inf)	Staff member C	R	rq	inf	今、Wさん治療に入りました。お願いします。 "Treatment for Ms. W has just started. Please."
Tc3:R(rq/inf)	Staff member C	R	rq	inf	これから、Xさん治療に入ります。お願いします。 "Treatment for Ms. X will be starting just now. Please."
Ta3:F(rq/ack)	Staff leader A	F	rq	ack	了解しました。よろしくお願いします Understood, Please.
Tc4:R(rq/inf)	Staff member C	R	rq	inf	口腔ケアのYさんが今から入りました。お願いします。 "Dental care for Mrs. Y has started. Please."
Tc5:R(rq/inf)	Staff member C	R	rq	inf	口腔ケア最後のZさんが入りました。お願いします。 "Ms. Z, the last for dental care, is being treated. Please."
Ta4:I(rq/elc)	Staff leader A	I	rq	elc	本日のXX、えーと、診察はこれで終わりでしょうか。よろしくお願いします。 "Today's dental care, umm, treatments are all finished, yes?, please"
Tc6:R(rq/inf)	Staff member C	R	rq	inf	はい全て終了です。お願いします。 "Yes, all set. Please."

Figure 4 describes the same example of extracted exchange structures with the estimated physical movements of each staff member in the study field. The horizontal axis represents time of day, and the vertical axis represents the estimated location of each staff member. Short dotted lines denote physical movement of each staff member during the displayed time. Large red triangles denote *initiation moves*, large red circles denote *response moves*, and large red squares denote f*eedback moves*. Long red dotted lines denote each sequence of moves that forms an exchange structure. As can be seen, in some included cases, the effect of one *initiation move* may persist for a relatively long time and initiate multiple exchanges. Especially in such cases, the positions of participants in one exchange structure may change during the course of the exchange. The voice tweet system is designed as a semi-real-time (i.e., asynchronous) communication system because the network connection quality between the server and each staff member may vary by location. In these examples, however, 2 *feedback moves* are sent almost immediately after a r*esponse move* (within about 1 min).

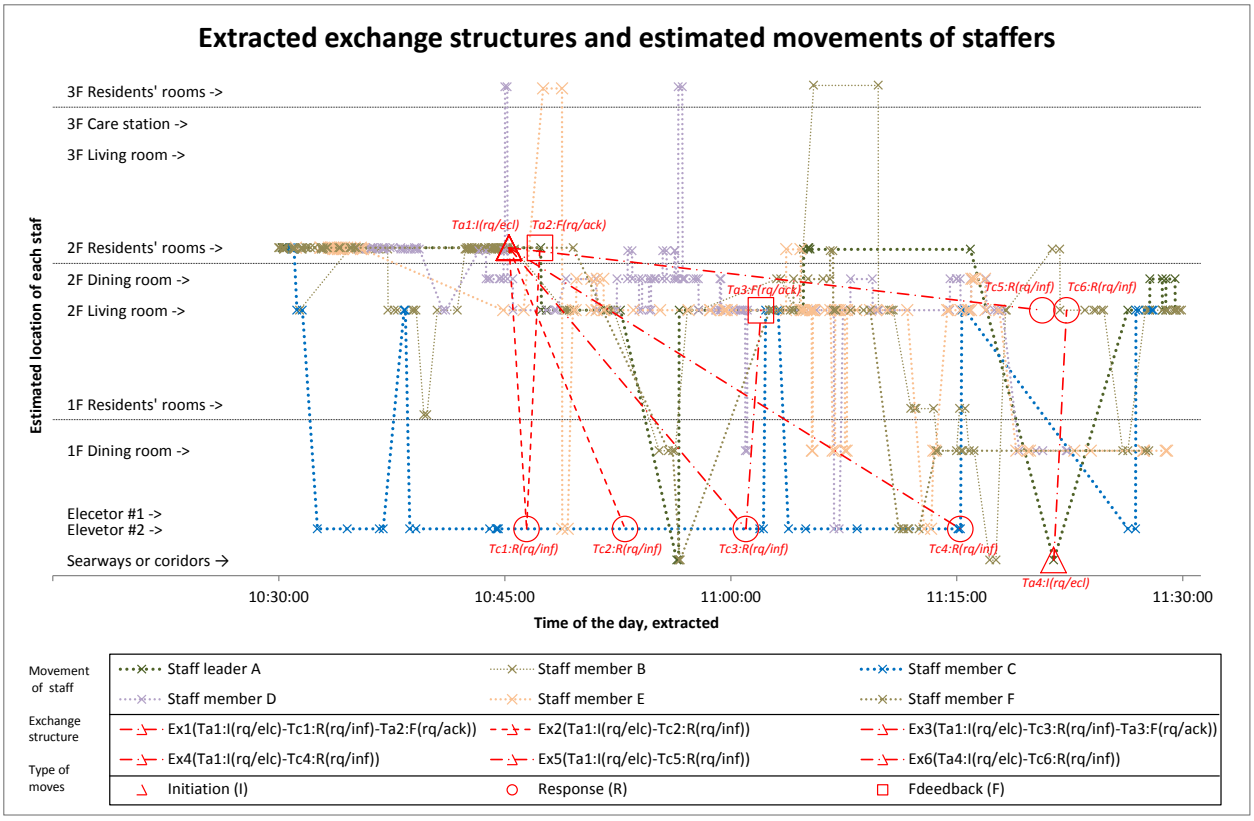

Figure 4. Example of extracted exchange structures and estimated movements of staff

CONCLUSIONS

This paper is one in a series about field studies at an elderly care facility in Japan. In this study, our voice tweet system was tested as a computer-mediated remote voice communication support system for staff. During the trials, the staff assisted with feeding tasks and sent voice tweets via the system to communicate with other staff members. During 10 trials at lunch and dinner times, 636 voice tweets were automatically collected by the system.

A new discourse model based on exchange structures is also proposed for use in analyzing the computer-mediated remote voice communication among the staff. The following insights were found by using the proposed model to analyze the collected voice tweets. Almost all moves (voice tweets) initiated an exchange. Most other moves served as responses. Moves were only rarely used for feedback. Some portion of responses and feedback may have been given in the usual face-to-face manner, rather than through the computer-mediated voice message system, because the staff members moved around the work site and had chances to meet. While only a few *initiation moves* without a response required received at least one *response*, almost half of *initiation moves* with a response required received *responses*. This can be regarded as evidence for the validity of the voice tweet system in this task situation (i.e., computer-mediated remote voice communication among staff performing feeding assistance at an elderly care facility). The usability of the proposed discourse model is also confirmed by finding complex sequences of computer-mediated remote voice communication that allowed achieving collaborative activities among the staff participants in the study.

FUTURE WORK

An integrated analysis to gain other insights and collect data such as staff interviews may be a useful project for future work. Application of the proposed discourse model to data acquired from other tasks, in this domain and in other domains, is another candidate for enlightening future work.

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Re-thinking the concept of Ethics for Public Corporate Identity

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ABSTRACT

In current debate a pertinent question pivots on how service systems can develop sensitivity to ethical values. In this perspective, we can assert that, sensitivity to ethical values is fundamental and corporate government (as observer) in designing service systems dynamics and addressing behaviors generally tends to transfer its own values, attitudes, beliefs and knowledge. As a result, observation requires contextualizing.
Considering that the e*thical issue* is a *subjective issue*, it might be more appropriate to discuss observation in terms of ethical judgment. If we analyze a *service system,* its behavior and observer perceptions of its behavior, it emerges that ethical judgment depends on observer ethics with reference to observed behavior.
The aim of this paper is to interpret subjective ethical behavior guided by the values individuals live by and share, in order to foster lasting and defendable corporate competitive advantage from a service system perspective. By confronting this issue, we believe that re-thinking the concept of ethics could contribute to the development of a "healthy culture" in Public companies which would lay the foundations for the shaping of a strong corporate identity.

Keywords: Ethics; Values; Identity; Service Systems.

INTRODUCTION

The concept of corporate ethics is most certainly a widely debated issue. Compared to the profound changes facing enterprise in a global and networking world in the XXI century, growing interest is emerging for the so-called "sensitive issues", which include relevant topics such as corporate culture and corporate identity. The breadth of such interest obliges us to consider each element or event that impacts on enterprise which, by virtue of its nature as a complex social system, tends to create an image within itself (and in its context of survival) which is the

expression of a sedimented culture of distinctive capacity. The shaping of the identity of public corporate identity and its cultural development presupposes, in particular and by virtue of the changing conditions of viability (Golinelli 2000, 2010) in social scenarios, a greater awareness of values and ethical principles. In this respect, reflections for debate are suggested by various elements outlined below:

1. a growing number of proactive consumers/users sensitive to moral issues are beginning to subject companies to critical public opinion and pressure with regard to activities that are questionable in ethical terms;

2. a dearth in guidance (direction) in terms of universal values (ethics) not only at national but also at international scale, (changing values, pluralism, diminishing influence on the part of traditional value-transmission agencies such as the Church);

3. extended Public company governance, i.e. networking, presupposes strong *ethical* links with related suprasystems– *in primis* users – in order to guarantee the system recognition and legitimation (i.e. identity);

4. a renewed interest for human values. Consequently, a focus on subjective and/or collective, *personality*, shifts the onus onto obligations which Public companies must respect to ensure ethically appropriate service delivery capacity and corporate survival;

5. the need to design a politico-economic and politico-social regulatory framework at national and international scale by means of collective synergic commitment;

6. economic-social scenarios often dominated by characters having 'scarce respect for the rules' demand measures to boost moral integrity and individual and institutional respect for the law both in public and private sector enterprise.

These conditions represent the areas of intervention essential for redefining corporate ethics and undoubtedly, for developing a 'healthy' culture in Public companies which in turn, constitutes the basis for the shaping of a reputable *corporate identity*.

THE CULTURAL SYSTEM AS A SYSTEM OF VALUES

Public companies are not associations, technocratically and arbitrarily conceivable, destined to pursue a scope but on the contrary, social systems characterized by a cultural identity reflecting that of the individuals who steer their course in terms of governance and of those who are an integral part of the organization.

This assumption focusing attention on the human component, refers individually and collectively to the concept of value (*wertbezogen*). In philosophical-anthropological terms, Max Scheler (Scheler, 1973) for example, defines the individual as epitomizing 'referential value' by virtue of the fact that man:

- is the bearer of the greatest human value: dignity;

- has a "natural" need for values in order to give support, direction and sense to his existence,

- has at his disposal the capacity to "perceive value" and to "recognize value" and is capable of judging existing values critically.

It is this latter capacity above all that throws a new light on man as a mediator between the different (sub)cultures and their respective values. To the extent that individuals identify themselves with their organization, they too become bearers of collective values (corporate values) and thus, the values themselves become tools of guidance by means of which synergic action and uniform behaviour in the company can result.

In the same way, values also represent the starting point for the informed shaping and development of a corporate culture. The specific element of personality consists precisely in an individual's capacity to judge the range of natural impulse, models of grounded behavior and sociocultural influences and subsequently to decide for himself in which direction his life should go. At the same time, this capacity for independence, a constituent element of

individual freedom, together with the faculty for recognizing values, also enables the individual to question, reject or accept the periodically dominant values in the social system in which he lives and works with their relevant influence on a specific culture.

It is a truism that whatever is valid with respect to an individual's personality is also valid with respect to the culture of social systems such as Public companies. The corporate culture of an organization defies any external influence and cannot passively absorb conditioning. On the contrary, it can only adapt to influence on the basis of the company's objectives, propositions and judgements. In this sense consequently, values are the focal point for defining and qualifying the viability of a Public organization, legitimated by its relevant suprasystems guiding it in ethical terms, in the direction of re-organizing corporate culture and corporate identity.

The concept of an *ethical* Public company starts from an informed awareness of individual and collective values. In other words, an ethical stance aimed at shaping a social identity represents the necessary condition under which a Public organization or one not necessarily Public, can combine awareness of its independence with professional commitment to adopt clear cut, shared rules of behaviour (Parfit, 1984). In this respect, what is needed is a common intent to devise a regulatory definition of ethical values in order to bind and regulate the social system as a whole and as a consequence, Public companies.

ETHICAL SELF-COMMITMENT AND IDENTITY

The extent to which members of social systems declare themselves in favor of ethical guidelines and adhere to them determines the reliability of reciprocal expectations concerning actions and behavior (Putnam H., 1978). Reliability is a decisive factor in trust building and in an economic sense, cuts the costs of transactions that derive from having to put in place mechanisms of surveillance and control. An ethical conscience consequently, has to be intrinsic to the Public system and its subsysystems in order for them to work smoothly and efficiently. Coherently with this functional element, it should also be underlined that a number of 'good reasons' exist for Public companies to embody ethical commitment and corporate identity.

Since enterprises are in themselves social systems interacting with other social systems and with individuals, clearly, ethically relevant behavior strategies should fundamentally find their reason for being in natural inclination albeit expressed through various forms of interest and social participation (Walzer, 1987). Such capacity for recognizing or perceiving Public organizations as part of global social context and interlocutor of other social systems, represents a decisive step towards the shaping and/or re-positioning of corporate identity (Trout, Rivkin, 1972).

Ethically oriented and clearly *identified* companies become systems that are 'capable of acting' in a viable sense wherein members of the organization put their own cultural and moral heritage at the disposal of the corporate community. 'Productive' action consequently, represents merely one aspect of action *tout court* which finds its legitimation and consensus both in ethical and moral terms. To the same extent and for the same reasons underlying a company's capacity to act, it is also rendered morally responsible by virtue and effect of the personality and ethical status of its components (Wiggins, 1987).

Man is not only the subject of ethical acts, but also the interface of moral responsibility. Companies therefore have moral obligations both towards their *partners* and other external groups of reference – clients, suppliers, public opinion, the natural environment – as well as towards their own company members.

Hence the recognition and observance of basic ethical principles such as the consideration and safeguarding of a person's dignity, respect for individual freedom, self determination and related human rights. From this pathway, non-negotiable rights and moral duties emerge which regardless of cost and benefits, are *a priori* valid to the same degree for all the *stakeholders* involved, including Public companies (Sciarelli, 2002).

Public corporate identity is envisaged as an 'ethical custom' or routine which hinges on voluntary self-commitment and – in line with Kant (1959) – on appropriate ethical action (Heidegger, 1981).

As for individuals also for Public companies ethical self-restraint is one of the factors determining corporate identity: in enjoying freedom which is positive by means of adapting governance to ethical standards, i.e. 'moral laws' the independence of an organization and a framework of its human resources emerge. By transferring this relation to Public companies, ethical self-commitment, evident by virtue of coherent behavior, can contribute to

strengthening corporate identity in a context of high impact objectives, content and social aims. Public companies as viable organizations well aware of the weight of their morally responsible role, have however, not always been capable of expliciting an ethical pathway, perhaps due to problems with governance or obstacles in terms of service management. This has hindered their building and establishing a corporate identity that reflects clear moral and social substance. The crux of the problem can obviously be attributed both to the way of *conceiving,* and of traditionally *interpreting* Public companies. In other words, the difficulty in building an *ethical Public corporate identity* can be traced to corporate policies which have rendered *management* lax and inefficacious. This stresses the crucial importance of attitude towards system *governance*, the only tool capable of delineating Public corporate identity and influencing corporate behavior in ethical terms. Where efforts to put in place morally responsible governance of a Public company do not become an integral part of its administrative policy, individual attitudes can soon risk negative outcomes and quite often provoke loss of integrity and questionable moral behavior (Resnik, 1987). To avoid unproductive outcomes from ethical commitment in Public companies, conflicting outlooks on corporate goals should obviously be resolved. In this respect, ethical value expressed through corporate identity cannot be detached from best practice addressed to the goal of 'creating widespread profit for the common social good' (Hartman, 1949).

Consequently, a responsible attitude and self-commitment on the part of Public companies as a whole, should on the one hand be anchored to the company's corporate *commitment policies* and on the other, to its *public corporate ethics* istitutionalized by means of adequate measures for translating theoretical into practical ethics (Lecaldano, 1995). Only under such conditions can ethical commitment unfold and be substantially deployed in the process of building credible Public corporate identity.

ETHICS AND IDENTITY

At first sight *ethics* and *identity* appear as two contradicting concepts. For example, if we intend corporate identity as nurtured by processes of particularization and differentiation and ethics as an element of universal value, then we would be hard pressed to create *public corporate identity*.

This apparent contradiction however, is easily reconciled in an opportune shift from a perspective of simple conceptual analysis to the explanation of behavior induced in individuals and/or organizations in their contexts of reference (Di Toro, 1993).

Public corporate identity has to stem from behavior embedded within a system of relations, linked by action that is both *ethical* and '*engineeristic'* (Sen, 1987).

In its 'ethical', sense, identity links up with the capacity on the part of Public organizations to address their economic-social action to goals of social wellbeing and the common good, regardless of standards of efficiency. In its '*engineeristic'* sense on the contrary, identity is associated to governance of a technical and deterministic nature, addressed to ascertaining the efficiency of the ways and means of achieving social wellbeing (Catturi, 1990).

Evidently, taken independently, the two approaches – *ethical* or '*engineeristic'*– cannot guarantee Public corporate identity. What is needed therefore, is balance as concerns behaviors where one approach compensates for deficiencies the other and thus contributes to the concreteness and depth of a recognizable ethical identity. We can quite legitimately maintain that ethics and identity represent fundamental characteristics of social systems; the one is capable of reconciling the different various situations in the context, achieving widespread consensus; the other enables clear cut and recognizable imprinting in terms of corporate behavior.

It is worth noting that specific culture is also a constituent element of Public corporate identity that can be traced to regulatory systems of behavior and to the ethical values that characterise its members.

What is needed in short, is a recognized code of ethics that defines a series of corporate values which in turn, determine corporate identity, and reflects the particular identity of the organisation. Public company ethics has to be seen from an *integrated* perspective or in other words, in the culture and individual behavior of its human resources and in the corporate culture and behaviour characterizing the organization as a whole, within its context of reference.

In short, an ethically conceived Public company is capable of enhancing its integrity, legitimation and recognition status.

In any event, the issue still remains in terms of devising a framework of Public companies envisaged from a traditional perspective transposed to a Public social organization, ethically oriented towards widespread social wellbeing. What is required is the devising of an effective mode of representing the effective ethical dimension within an adequate framework underpinning the particular context in which the company operates and to map behavioral frames in order to reconcile efficiency and meeting the relevant supra-systems expectations.

CONCLUSION AND IMPLICATIONS FOR FUTURE RESEARCH

It is evident that Public companies are sensitive to acquiring social status, which is associated to the prestige they are attributed outside the firm. That is why greater respect for the environment and integrity in their dealings are some of the goals to aim for, in short, (Corporate) Social Responsibility ©SR.

©SR/(Corporate) Social Responsibility indicates a shift in focus towards a service system that interacts with the social environment and is, in other words, in harmony with social needs (values and emotions).

In order to devise an innovative interpretative key in terms of ethics in service systems, it can be assumed that the average increase in scale of ethics for any individual is strongly influenced by the average increase in scale of ethics for their related suprasystems. This means that we have to distinguish between g*overnment in an individual sense,* where linked suprasystems are underpinned by human (constraints) and *government as such* where specific supra-systems are not linked but imposed by contextualized systems (rules).

It should be pointed out that the limits of our research lie in the fact that the study at present is merely descriptive, not being grounded on empirical findings.

However, it is our intention in future studies to illustrate and analyze an integrated framework based on the SSME+D (Spohrer et al., 2007; Spohrer and Maglio, 2008; Maglio et al., 2012) and the Viable Systems Approach (VSA) (Golinelli 2000; 2010) proposing the same as an innovative interpretative key for *service system viability* in order to qualify ethical behavior.

In particular, we intend to show how the integrated framework is characterized by subjective understanding. This means that it is not possible to grasp reality in its objectivity and entirety as such, but only as a subjective and approximate understanding of the notion. In other words, *service systems viability depends on the cognitive variety of the observer* (Barile, 2009).

The reason for deciding on such an approach stems from our belief that it suggests a potential response to a relevant question: How can service systems develop sensitivity to ethical values? From our perspective, we argue that the growing *risk of dissonance* between service systems might depend on categorical values and interpretative schemes, but above all on the particular articulation of the informative variety model proposed in a relational context.

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Towards the Inclusion of Executive Coaching Concerns for the Improvement of Training in Service Development Companies

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ABSTRACT

Economic expansion and globalization have greatly increased the value associated to teamwork, thus promoting personal development and learning as distinguishing skills, especially in service development companies. This encourages workers to gain adaptability to changes due to a higher need of reaction capacity, particularly among supervisors and managers who demand more training according to their characteristics. In this regard, conducting *in-company* training is globally agreed as a possible solution. Such training activities are developed in a flexible way, varying both in the content and the level of the participants. Advanced training techniques such as *mentoring* or *coaching* (or its professional counterpart: *executive coaching)* have permitted the application of practices and processes that boost learning, improving the performance of the training. Although *coaching* has an individual focus, it also enhances the development of interpersonal skills such as leadership, assertiveness or teamwork, among others. This paper presents a statistical analysis of the evaluations conducted on a total of eight groups incorporating an *in-company* training activity performed in 2011. The work has focused on comparing assessments of participants in training for a large multinational company working in the field of service development. The main goal of the technical training was the improvement of service-software development processes incorporated in the company throughout the completion of various activities. These training activities were based on the application of *executive coaching* techniques so as to progressively improve the fulfilment of the expectations of the technical course. After the courses we analysed several evaluation questionnaires fulfilled by each of the participants in each group. The result of such analysis exposed a vast improvement in meeting the expectations of the training and even an overall improvement of the course.

Keywords: Executive coaching, In-company training, Course improvement, Learning analysis.

INTRODUCTION AND MOTIVATION

Economic expansion and globalization have greatly increased the value associated to teamwork. The tendency towards promoting collaborative work has thus encouraged personal development and learning as distinguishing skills (Zeus & Skiffington, 2001). This is especially important in service companies where interaction among stakeholders and governance interaction are key concerns for value co-creation (Spohrer et al. 2008). In addition, acquiring collaborative skills has been especially noticeable in the improvement of software development processes (Dyba, 2005). This entails constant changes and adaptations by workers, who demand more responsive and adequate training initiatives according to their characteristics (Sherman & Freas, 2004). Moreover, as mentioned in (Friday et al., 2004), the return on investment of proper training is now considered a valuable resource.

In this regard, conducting *in-company* training is usually acknowledged as a possible solution, with custom development of high-level training solutions varying in their content and in the flexibility of their formats. However, there still exist strong barriers to the incorporation of new knowledge in companies. The variable experience gained by workers derived from their daily activities in the company can be listed among other obstacles. We have identified numerous factors that influence the degree of acquisition of knowledge by the employees of the

companies including goal settings, collaborative problem solving issues, feedback obtained from participants, etc. (ICF, 2011).

The evolution of training techniques such as *coaching* (Sherman & Freas, 2004) or *mentoring* (Olivero et al, 1997) have permitted application of practices and processes that promote learning thus improving the performance of the training. In this context, one can find several alternatives based on different and novel techniques. Among them we have focused on *coaching* and, more specifically, on *executive coaching*. The *International Coach Federation* defines *coaching* as: "partnering with clients in a thought-provoking and creative process that inspires them to maximize their personal and professional potential" (ITF, 2011). As a consequence, coaching is closely related to learning activities in the way that it involves reflexion but more focused on the formulation of the appropriate questions rather than to the provision of answers (Sherman & Freas, 2004).

Although coaching has an individual focus, it generally aims to develop interpersonal skills such as leadership and teamwork, among others (Sherman & Freas, 2004). In fact, coaching is one of the personal development practices that have major impact not only over individual behaviours but also on business results, achieving a return of more than five times the cost of investment (Bunse et al., 2006). In business training environments, the technical content of the training is less important when the audience consists of managers with many years of experience in the same company. In that sense, giving feedback to participants and stimulating collaborative problem-solving (two basic aspects of *executive coaching*) are more important. According to (ITF, 2011) in *executive coaching*, students at a company have the opportunity to interact with teachers personally what creates a safer environment for deepening the knowledge acquired.

This paper presents a statistical analysis of the evaluations gathered from a total of eight groups that participated in *in-company* training experiments conducted in 2011. Throughout the various training activities, techniques associated with executive coaching were incorporated progressively. By doing so, it has been possible to check the effects of the addition of these practices in subsequent editions of the course. The results of the analysed data showed a vast improvement in the accomplishment of the training expectations and even an overall improvement of the course itself.

The following sections of the paper are organized as follows: Section 2 describes the conditions and characteristics of the training activities performed, the method used and the good coaching practices chosen to include in such activities. In Section 3 the evaluation method followed by students is described. Section 4 describes and analyses the results of the evaluations gathered from the students. It also includes the results related to the progressive inclusion of good practices from executive coaching. Finally, Section 5 concludes the article.

CHARACTERISTICS OF THE TRAINING ACTIVITY

This section describes the insights of the training activity together with all the prior preparation as well as the good practices incorporated from the use of executive coaching techniques.

Description of the training activity

As anticipated in the introduction, the training was carried out in eight groups with 7 to 10 participants. The courses were sequentially carried out between February and April of 2011, with a course per week. At the time of their participation, the 84 participants were working as managers and middle-level managers from a large multinational company working in the field of service development with over 1000 employees in the city of Madrid. Among the total participants, 40 were female and 44 male. The average age of the participants was 38 years old, with an average of 10 years' experience. Figure 1 shows a graphical summary of this information.

The training target and goal has been the same for the eight groups: to take a course to improve service-oriented software development processes. The theoretical content and study material were identical for the eight groups, as well as the amount of time devoted to each of the theoretical sections. The methodology used was based on giving master classes for 3 days, 7 hours each, and conducted by an external consultant to the company. After the completion of the course, the participants completed an evaluation questionnaire which will be described later.

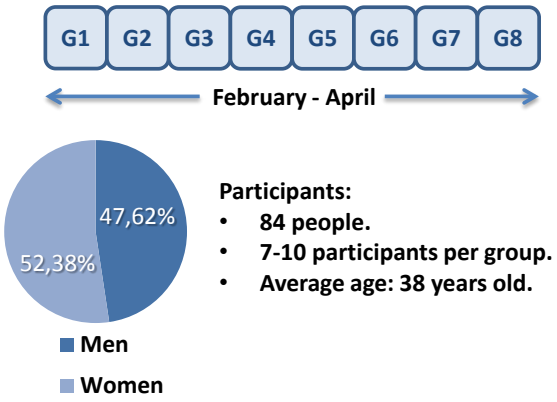

Figure 1. Overview of the training setting.

Situation before training and preparatory tasks

Prior to the start of the course several interviews took place with the training supervisors of the company. During these interviews the risks of the training were analysed. The risks found were mainly two: rejection of training and lack of fulfilment of the expectations of the participants. Table 1 shows such risks together with additional information useful to cope with them (following the good practices recommended in (Thach, 2002)). The origin of these risks was primarily grounded on the completion of previous courses of poor quality. Also, it is important to remark that the aim of the preceding courses was to strengthen an organizational change undertaken by the company a few months ago. This fact could have increased the possibility of rejection and a lack of commitment.

Table 1. Risk of the training activities.

Risks	Occurrence probability	Consequences	Risk origin
Lack of commitment of participants	Medium	High	An average of one month annual courses. The course content often could not be used in everyday activities.
Not meeting the expectations of the participants	High	Medium	Rejection of training for process improvement, as a threat to their way of working.

Apart from analysing the potential risks of a new training effort, before the start of the activities it was carried out an improvement and customization of the documentation. This way it was possible to ensure that the eight groups will be using the same documentation. Finally, a study of the potential good practices required to implement coaching techniques along the courses was conducted. These best practices will be explained later on.

Phases of the training activity

A total of three phases were defined to study the impact of using executive coaching techniques for in-company training. The first phase involved two groups of training and the following two phases consisted of three groups each. The instructor has been the same for each of the groups during all the phases. Obviously, apart from having technical knowledge, the instructor had expertise on the executive coaching techniques to be employed.

The dynamics of the progression in use of good practices of coaching techniques during the training were as follows: during the first two groups of the training no issues associated with coaching good practices were added. Then, during the formation of groups 3, 4 and 5 two good practices, confidentiality and feedback, were added. Finally, during the formation of groups 6, 7 and 8, two additional good practices were added, goal setting and collaborative problem solving. All in all, the training was completed with the inclusion of four good coaching practices (see Figure 2).

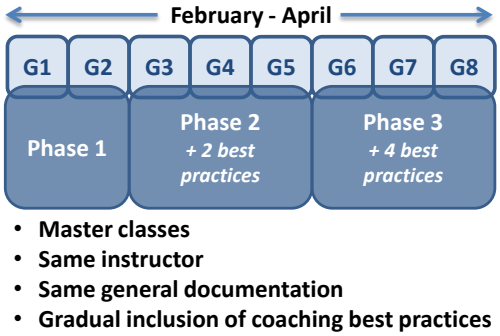

Figure 1. Phases of the training.

Choosing and applying best practices

The best practices used in phases 2 and 3 of the training are explained next. To include these best practices in the training some explanations were decreased in time and detail, and some exercises were modified (Table 2 shows a summary of the implementation mechanism for each practice). In any case, the changes performed did not substantially modify the theoretical or practical content of the exercises used for the courses.

Table 2. Summary of implementation of coaching best practices.

Best practice	Application	References
Confidentiality	Initial daily discussions to reinforce the idea of mutual confidence. Opinion questions during the exercises, to promote inner debates.	(Paige, 2002) (Grant, 2003) (Stevens, 2003) (Gyllensten & Palmer, 2005) (Goldstein, 2001)
Feedback	Role-play games and exposition of personal experience from each of the participants. Feedback from all other participants.	(Paige, 2002) (Grant, 2003) (Stevens, 2003) (Wexley, 1991) (Reigeluth, 1999)
Goal or target setting	Establishing the objectives of each participant at the beginning of the course. Review the objectives at the end of each day.	(ITF, 2011) (Stevens, 2003)
Collaborative troubleshooting	Brainstorming exercises. Collaborative environment.	(ITF, 2011) (Brufee, 1998) (Montgomery, 2004)

Confidentiality

According to many sources (Paige, 2002; Grant, 2003; Stevens, 2003; Gyllensten & Palmer, 2005; Goldstein, 2001), a crucial factor to achieve successful results in training is to keep the confidentiality between the coach (who directs the training) and the coachee (the person receiving the training). In the case of the presented training activities, confidentiality between the instructor and the participants was also considered a key aspect, especially taking into account the risk of lack of commitment from the participants. In this context, both (Grant, 2003) and (Gyllensten & Palmer, 2005) agree that an external instructor is more useful than one internal, because neutrality increases. Therefore, to achieve greater confidentiality, we opted for giving a short speech at the start of each day discussing the strict confidentiality of the course. Opinion questions were also included in the exercise sets to facilitate discussion plus gathering the opinions about the current activities of the organization. This way, we sought to improve the mutual confidence of the participants regarding the instructor.

Feedback

Feedback refers to the provision of valuable information to the coachees derived from their efforts towards improvement. In some related articles, as in (Paige, 2002) or (Grant, 2003), feedback is considered as a positive aspect of coaching because it allows participants to be exposed to a constant evaluation. Also, Stevens (2005), Wexley (1991) and Reigeluth et al. (1999) refer to feedback as a positive practice.

In our case, groups 3, 4 and 5 of the training were the first ones using this good practice. To get benefits from feedback, role-play games were performed, adding questions about the experience gained in the exercises. The

feedback obtained from participants in each group, throughout the activities and the role-playing, was shared in every group by all participants. Finally, discussions and opinions among participants were encouraged.

Goal or target setting

According to Grant (2003) the process of coaching has the ultimate goal of helping coachees to regulate and guide their resources to achieve goals. Olivero, Bane, & Kopelman (1997) argue that the act of setting goals not only contributes directly to the process itself, but that it encourages the coachee to move forward. He advocates that the goals are useful, specific, measurable, assignable, realistic and time-bound (what is known as the "SMART model").

For groups 6, 7 and 8, the initial and final talk of each day was changed to add the goal setting. Early in the course each of the participants were asked for individual goals, encompassing them to look for specific and realistic objectives. Finally, at the end of each day, they performed a review of the objectives.

Collaborative troubleshooting

The main objective of this technique is to develop problem solving capabilities as a team from the active participation and mutual respect among team members (Brufee, 1998). Other authors have also included this best practice because of its importance (McGovern, 2001). This technique seeks to maximize collaboration between participants of a team, using an integrated environment, encouraging an active participation of each team member. It also enhances the exploration and analysis of content, encouraging diversity of views. This good practice is also quite used in the field of education (one example can be found in (Montgomery, 2004)).

In groups 6, 7 and 8 we added an exercise of brainstorming, promoting the respect for the turn of communicating ideas thus looking to foster a collaborative environment. Moreover, the end of each exercise was modified to incorporate debates and include the different views of the participants.

METHOD OF EVALUATION

We now step on the explanation of the evaluation method before starting with the analysis of the results of the evaluations made by the participants. Upon completion of the three days of training, we handed out a survey among the participants consisting of 13 evaluation items. These items were divided into 3 different groups: evaluation of the performance of the instructor, usefulness of the course and evaluation of the documentation. The survey ended up with an additional item for overall course evaluation and a blank space left for additional comments. Regarding the scores of items, these ranged from 1 to 10, being 10 the highest.

The description of the features evaluated can be seen in Table 4. The first column shows the aforementioned categories followed, in a second column, by the description of the features in which each of them has been divided. The third column defines an identifier used to ease the subsequent process of analysis. Note that the last characteristic evaluated in the category of instructor also acts as an overall assessment of the entire category.

Once the surveys were handed out, the instructor left the classroom, thus reinforcing the premise of providing complete anonymity to the evaluation process. Evaluations were placed in an envelope without being seen and sent afterwards to a supervisor of the instructor for a further comprehensive analysis. This pursued to prevent changes in the content or bias in the form of interpretation.

Table 4.Description of the characteristics of the evaluation.

Category	Feature	Ref.
Instructor	Clarity of exposition	C1
	Theoretical technical training of the instructor	C2
	Practical technical training of the instructor	C3
	Rhythm of exposure	C4
	Overall assessment of instructor	C5
Course	Clarity of the course	C6
	Quality of content	C7
	Relationship to occupation	C8
	Fulfilment of expectations	C9
Documentation	Theoretical quality of documentation	C10
	Quality of documentation practice	C11
	Quality of practical exercises	C12
General	Overall evaluation of the course	C13

ANALYSIS OF RESULTS

In the following we present the results of the evaluations of each participant group. The scores of each group, organized by items, are summarized in Table 5. Each column from G1 to G8 lists the average of the score given by the groups 1 to 8. This table reflects an increase in both the overall rating of the course (from 8.00 to 8.65) and the overall rating of the instructor (from 7.58 to 9.25) throughout the training. Moreover, it is possible to observe how the progress and expectation fulfilment have gained a similar growth rate, increasing by two points assessment.

Table 5. Summary of the evaluation scores.

	G1	G2	G3	G4	G5	G6	G7	G8
C1	7,25	7,50	8,22	8,50	8,08	8,58	8,64	9,00
C2	6,83	6,83	7,67	7,70	8,08	8,33	8,82	8,92
C3	7,67	7,83	8,22	8,80	8,75	8,75	9,18	9,50
C4	7,42	7,67	8,00	8,00	8,33	8,58	8,82	9,17
C5	7,58	8,00	8,33	8,80	8,71	8,92	9,14	9,25
C6	7,42	7,67	7,67	8,00	8,08	8,00	8,73	8,42
C7	6,92	7,17	7,33	8,10	7,88	8,08	8,09	8,50
C8	6,33	5,83	6,00	7,60	6,58	7,25	8,00	8,33
C9	6,42	6,50	7,11	7,40	7,33	7,42	8,18	8,17
C10	6,67	6,83	6,89	7,30	7,67	7,08	7,64	7,58
C11	7,17	7,83	7,00	7,30	8,00	7,83	8,45	8,08
C12	7,08	7,83	6,89	7,90	8,33	7,83	8,64	8,75
C13	7,00	7,33	7,56	8,30	8,20	8,25	8,45	8,67

Overall deviations between the global averages of the course, taking into account each individual feature and the global scores given by participants, have been also observed. This may be due to individual characteristics not taken into account in the evaluation but which are reflected in the overall evaluation. It may also be due to the weight that each participant gives to the individual characteristics that have evaluated the course. For example, the average score given to the characteristics of the instructor in the case of the first group (G1) is 7.29. When participants were instructed to evaluate the instructor, the note was 7.58.

We have performed a further analysis by comparing the mean values and the standard values obtain in two of the characteristics evaluated for the overall evaluation of the course and the overall rating of the instructor. In both cases it can be seen that the detected score increase follows the same pattern. In general, the evaluations obtained by averaging features (C1 to c12, identified as AGV) is lower than the global rating directly obtained (C13, identified as DGV). This can be also noted when closely observing the evaluation of the instructor, shown in the upper graph of Figure 3.

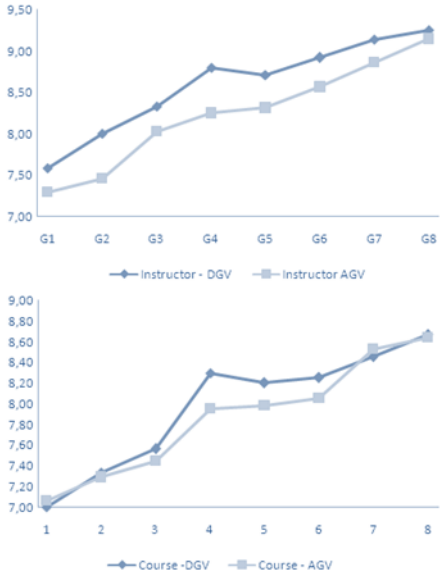

Figure 3. Comparison of overall evaluations for the course and the instructor.

Figure 4 displays four graphs corresponding to the four global evaluations of the course and the instructor separated by phases (as indicated early in the beginning of this article). Each graph shows the average rating per phase. In such graphs we can clearly see the positive trend of the overall evaluation as it increases throughout the successive phases.

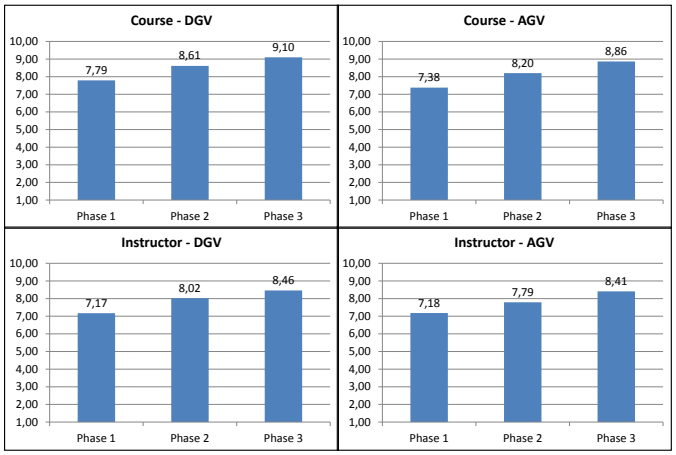

Figure 4. Comparison of averages and standard deviations between phases.

Threats to validation

From the very first moment we have sought to minimize the potential threats within the framework of *in-company* training. We attempted to maintain independence between courses to prevent information leakage among the participants. As a result, no evidence of an in-depth knowledge of the course or the method of work by the late participants of the training course was found. Even though it is has been one of the clearest threats.

The use of the same instructor and the same documentation has attempted to provide homogeneity to the experiment. But it has also incorporated a new threat: the instructor was directly related to the activities of the company, which could lead to improvements in the sessions of the last groups. To mitigate this risk we explicitly sought to isolate the moments where good practice were included. Furthermore, the study also considers as a weakness the fact of being focused on a single company. Regarding that, we expect to overcome this threat and the work accomplished with new evaluations from different companies.

Finally, the results obtained are limited to an *in-company* training in a real company and do not represent a fully controlled experiment. In that sense it is important to take into account that at all times the research on including best practices from executive coaching has been framed in a real training environment. This issue may have affected the flexibility of the research activities performed.

CONCLUSIONS

The results found in the analysis of the evaluations indicate a clear relationship between the inclusion of good practices and the improvement of the evaluations. The changes have been significant, even reaching a difference of more than 2 points. It is also noteworthy that the course contained all the technical contents as contracted with the company and that the use of good coaching practices pursued the goal of improving the learning performance by participants.

One of the points of the analysis we would like to highlight, that has been also shown in previous works (see e.g. (Olivero et al., 1997)), is the large number of positive comments regarding the inclusion of good practices left on the blank section of the evaluation form by the participants. Although this has not been quantified throughout the article, it has been a remarkable issue during the analysis of the evaluations.

We have seen an increase in both the overall rating of the course (from 8.00 to 8.65) and the overall rating of the instructor (from 7.58 to 9.25) throughout the courses. Something that has caught our attention is the improvement in evaluation of the documentation, taking into account that any modification was made between groups. Therefore, we may conclude that the inclusion of good practices enforced the learning performance of the course (one of the risks identified in Table 1). Also, we see that the learning performance and fulfilment of expectations has shown a constant rate of growth throughout the training. Another remarkable result has been the difference between explicit (indicated by the participant) and implicit (obtained from averages) overall rating. The values of the overall characteristics were higher than that obtained as an average of the individual characteristics. This is a warning that affects the characteristics of the evaluation, which need to be revised to reduce this difference.

As future work, we can point out that new evaluations are being conducted currently, including other enterprises and other instructors. This will validate and assure the results obtained more firmly. We are also working on the study of the return on investment and productivity gained after training with good coaching practices.

ACKNOWLEDGEMENTS

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Section 9

The Education of Service Innovators: Bridging the Gaps Between Business and Academia

Co-creation of Values in Designing Service through a Custom of Meta-cognition

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ABSTRACT

"Co-creation of values" is a new common notion of analyzing and producing services. The first objective of the present paper is to provide an underlying theory. Introducing what we call FNS diagram, we have theorized that both a service provider and customers, respectively, create their own values out of situated interactions between both. We argue that the notion of "service" is the whole process in which a provider and the customers create their own values out of communication with each other. This is a paradigm shift from the old "provide and consume" model to "communicate and co-creation".

What cognition is needed, then, in order for "communication and co-creation" to work? We argue that sharing meta-cognition between a provider and customers is a driving force for promotion of communication and co-creation. Meta-cognitive verbalization makes one's problem-finding attitude active, and thus encourages eagerness to communicate and find something significant in others' meta-cognition.

Keywords: Co-creation, Value, Service, Meta-cognition, Verbalization, Communication, Constructive Methodology, Situatedness

INTRODUCTION

"Co-creation of values" is a new common notion of analyzing and producing services (Vargo, 2008). Its main thrust is that service is a whole process that new values are co-created through interactions between a provider and a customer. This makes a contrast against the old sense of service, in which a provider of service designs something that he or she evaluates as good, and provides it to customers as a service so that they enjoy consuming it. This is a paradigm shift from "design, provide and consume" model to "communicate and co-create".

Similar paradigm shifts are beginning to occur in other research fields, too. In cognitive science, especially research fields studying on how people learn, the "provide and consume" model is becoming less popular; the

role of a teacher is not to just provide what he or she wants to teach to students, but rather a coordinator who designs a learning environment that encourages communication between a teacher and students and thereby facilitates students to create their own interpretations of the topic to learn. From the viewpoint of students, learning is not to store what the teacher has said or taught in memory as it is, but to create interpretations that are rooted in their own life. Learning is a process of sense-making. From the viewpoint of a teacher, he or she should keep a watchful eye on what students do and do not understand, and what kind of issues, questions and hypotheses they are cultivating and when, and thereby decide the way of communicating with them and designing the environment. There are no manuals or rulebooks available that teachers can follow. He or she has to make "situated responses" according to the degree and the manner of students' sense-making. The teacher, too, makes trials and errors and learns about how to communicate with students as he or she does so. In this respect, what occurs in a learning situation is "communication and co-creation of senses".

This paper addresses the following issue, "What cognition is needed for sound communication and co-creation of values?" Our hypothesis is that both provider and customer need to do "meta-cognition" to make that happen. Meta-cognition is an act of looking back on and verbalizing what one has thought and/or acted. It has been studied mainly in social and educational psychology, and regarded as an effective method for acquisition of social behaviors and improvement of educational performance (e.g. Hacker et.al, 1998).

The main purpose of this paper is to argue that it is because a provider and customers share each other's meta-cognition that sound communication takes place between them and thereby new values are created out of it. We will show an episode, as an example, in which two persons ate a cake together, shared each other's meta-cognitive verbalization of what each one felt about the taste of the cake, and thereby came to co-create their own values about tastes in general.

SITUATEDNESS IN CREATION OF VALUES

The defect of the "design, provide and consume" model of services is as follows; it has an underlying assumption that an excellent designer of a service would be able to presume situations that the service will be applied to, and design a service that works well. We argue that the form and values of a service is not something that is prefixed before customers' usage, but a product of situated interactions between the provider and the customers. The thing is not that there is a set of predefined values that are generally applicable to any situations. Further, values that were created before are not necessarily regarded as valuable by the customers in the current situation.

In the domain of learning, too, a similar argument has been actively discussed. In the domain of athletic coaching, coaching based on the "provide and consume" model does not work. An athletes' skills are embodied; how he/she feels and perceives from the surroundings including the opponents, pays meta-cognitive attention to parts of the body, and moves the entire body are situated in the particular body of the athlete. Some of them are, of course, general and thus applicable to other athletes. Past literature has not yet clarified whether or not there is a boundary of something generalizable and something situated, and where the boundary is if any. Therefore, an athlete should refrain from a mental attitude to straightforwardly apply what the coach said to his or her body. The coach should be aware of the embodied aspects of skills, although coaches, generally speaking, tend to think that the way of perceiving and moving body parts that constituted the basis of his skills when he was an athlete in old days is general and thus applicable to the current athlete whose coach is him.

In order to formalize our argument that service is a product of situated interactions between the provider and the customers, we use FNS-diagram (Fig.1) developed by us (Nakashima et. al, 2006). FNS-diagram is an abstract formalization of a synthesis cycle. In Fig.1, *future noema* (Kimura, 1988) corresponds to the concept of a goal to be achieved. Generation process (C1) creates some physical entity (object, system, or phenemonon), called *noesis,* in order to aim at achieving the goal. The *noesis* necessarily interacts with the environment (C1.5). What we mean by environment includes people, products, society, its culture and so on in the current time. The interaction is only partially predictable, and therefore may produce some unpredicted consequences. So if the result of the interaction is analyzed (C2) to find out the actual consequences, *current noema*, those are usually different from the original goal. That is, the current noema may differ from the original future noema, containing new values, variables, aspects, viewpoints, or evaluation criteria. The difference may trigger revision of the original goal or generation of a completely new one (future noema

again). This is the C3 process and we call it scripting.

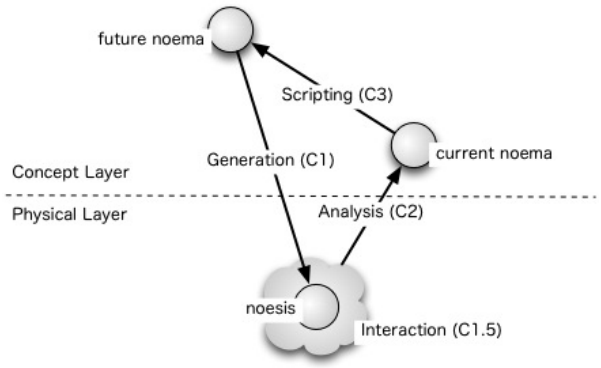

Figure 1. FNS diagram: An abstract formalization of a synthesis loop

Suppose that the loop shown in Fig.1 is a provider's. Service does not end with a one-time provision of a service. A one-time provision merely corresponds to C1. When a service is provided to the real world, customers use it. Customers constitute the cloud shape of interaction (C1.5). Since the service provider does not assume minds of customers, some of them may use the service in a manner that differs from the original intention of the provider. Some social situations may happen to affect customers' use of the service. Those are examples of what we call interaction (C1.5). What we call values in this paper is a product of analysis (C2). Although, in Fig.1, the subject of the analysis (C2) is a provider, it may not be correct to say that the provider has discovered the new value by himself. It is better to say that the new value has been co-created, being affected by interaction C1, of which the significant constituent are customers who have used the provided service.

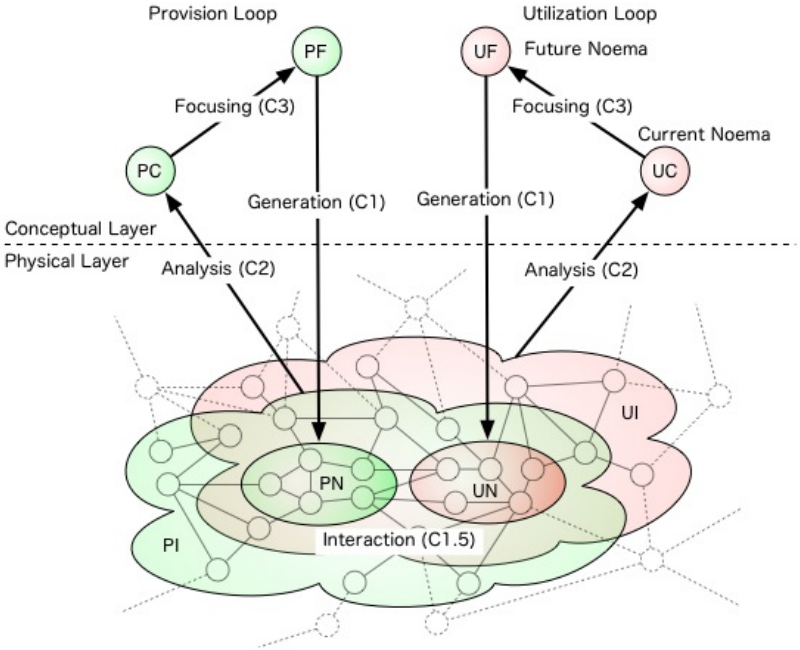

Figure 2. FNS twin loops

In order to formalize the relation between a provider and customers in a more precise manner, we have extended the FNS diagram into a diagram of twin loops, shown in Fig.2. The loop on the left side is a provider's, and the loop on the right side is customers'. The customers' loop is a process of exploration of how to use the services provided. So, UN, *noesis* as a result of customers' generation (C1), represents several ways of usage that have become salient in the society. Customers may use it in many different purposes, which are not necessarily the same as the original intention of the provider (PF). The way one group of users uses it may

become the basis for the way another group uses it. UN includes all of them.

Important is that UN is a part of the interactions (C1.5) for the left provider's loop, i.e. within the cloud for the provider. Out of these interactions, the provider may find new aspects, values and issues (PC), which in turn becomes seeds for generation of new ideas (PF) about service. Also important is that every time a new service is put into the world (PN), it becomes part of the interactions for the customers' loop. Since the range of interactions is determined by the first-person's perspective of a provider or customers, both interaction clouds for the provider and customers overlap but are not the same. From those interactions, the customers may find new values, aspects, and issues in using the provided service (UC), which may trigger generation of new ideas about how to use it in the next cycle (UF). Customers are, in a way, designers who devise how to use a service.

Further significant is that values found by the provider (PC) and values found by customers (UC) are not necessarily the same. The provider finds new values in the context of providing a service as a professional designer, whereas customers find new values in the context of using services to enjoy their lives. Values on both parties could differ. So, when we discuss "co-creation of values", it does not mean that some shared values are created in collaboration of both parties. Each party creates its own values that are rooted in the context and intentions of each, its creation being affected by each other's noesis, generation (C1). This is the most significant remark of this paper, which will be highlighted in the episode of "co-creation of values" to be shown later.

META-COGNITION

We have argued in the earlier sections that interaction between one's own noesis, the result of generation (C1), and other factors in the surroundings is the platform on which a provider and customers find new values in providing service and in using it. This means that fruitful creation of new values is dependent on whether or not one is able to have interactions with so-far unheeded factors in the surroundings. If one does not have open eyes to unheeded factors, being fixated to one's own original intention, the range of interaction cloud (C1.5) becomes small. Then, new values will not be created and the loop will stop. In other words, whether or not a provider and customers are able to communicate well and each party is able to co-create values for oneself depends on open eyes without fixation to one's own intentions.

Then, what cognition is needed for having open eyes? Our hypothesis is that meta-cognition promotes an open attitude. Meta-cognition is an act of looking back on and verbalizing what one has thought and/or acted. Being studied mainly in social and educational psychology, it has been regarded as an effective method for acquisition of social behaviors and improvement of educational performance. What mental attitude does meta-cognition bring about? Referring to past literature related to meta-cognition, we will discuss the answers of this issue.

Verbalization: the Essence of Meta-cognition

The most significant aspect of meta-cognition is verbalization. Merely looking back on and having a second thought in mind without verbalization does not work well. This is similar to the phenomena that externalization such as writing or drawing sketches serves as an effective tool for thinking. The positive effects of externalization on development of thoughts have been actively studied in cognitive science (e.g. Larkin, 1987) and in design cognition (e.g. Schon, 1983; Suwa et.al, 1997). For example, why designers draw sketches was an active research issue in 80 and 90's. Most theorists have agreed that sketches are not just a record of what a designer has in mind as a memory aid. Drawn elements on a paper will necessarily take some physical forms, i.e. sizes and shapes, and make new spatial relations happen among the other existing elements, regardless of whether or not the designer is aware of those. Those physical features and spatial relations are the cause of a new attention and discovery. The designer may be able to find some spatial relations or shapes unexpectedly (Suwa et al., 2000; Schon, 1983) and generate new interpretations of them (Goel, 1997). An unexpected attention to perceptual features and generation of new interpretations enable the designers to create new design issues, i.e. the very driving-force for pushing the design process forward.

Being self-aware of and verbalizing one's own cognition, i.e. thoughts, action and perception, is a kind of externalization. Just as sketches serve as a tool for development of ideas, verbalization makes various aspects and variables more salient, and thus relationships among them are easier to consider. Gibson and Gibson

(1955) discussed that attention to new variables in the surroundings is the essence of learning. Suwa (2008) argued that learning is an act of weaving a network of variables by exploring what variables are to be linked to each other.

Another advantage of verbalization is that selective attention to particular variables as a consequence of verbalization provides a new viewpoint to the surroundings and thus changes a way of perception. A picture of Darmesian whose resolution is quite coarse is hard to recognize, but once asked "where is a dog?", it becomes remarkably easier to recognize a dog in the picture. The only difference between before and after the question is provision of the word, "dog". The word, even though it is just a single word, provides a particular viewpoint to look at the picture, and affects the way of perception. Similarly, meta-cognitive verbalization of the relation between one's own body and the surroundings may change the way of perceiving the surroundings. Verbalization itself is a trigger for new attention to so-far unheeded variables and aspects. Since increased attention to variables and aspects means enlargement of the range of the interaction cloud (C1.5), it may have a positive effect on the creation of new values in the analysis (C2).

Meta-cognition Drives a Problem-Finding Attitude and thereby a FNS Loop

Getzels et. al (1976), conducting a longitudinal study of artists, argued that problem-finding attitude is indispensable in order to be a creative artist. Finding problems, not solving given problems, is the key for creative works. There seem to be many types of problem-finding attitude. Generating an idea of what to do next, making a hypothesis, creating an issue to be addressed, asking a question, finding a problem, and verbalization of that something feels different are all different types. The first three are relatively easier to be connected to next actual moves, whereas the latter three has the nature of analysis of the current situation. The latter three seem to serve as a basis on which ideas are generated, hypotheses are made and issues are created. We conjecture that the first three corresponds to scripting a new goal (C3) and the latter to analysis (C2), although there is no clear-cut boundary between both.

We discussed in the previous section that meta-cognitive verbalization promotes enlargement of interaction (C1.5), which in turn encourages analysis (C2) and then scripting of new goals (C3). This means, in other words, meta-cognitive verbalization drives a problem-finding attitude, e.g. the six types. Once ideas are generated, hypotheses are made or issues are addressed, that may trigger generation (C1). This way, meta-cognitive verbalization may drive a synthesis loop represented by the FNS diagram.

Driving Own FNS Loop Actively Let People Eager to Communicate

Talking back about the relation between provision and usage represented in Fig.2, we discussed that a provider of a service should have a watchful eye on how customers use it, and on the other hand customers should have a watchful eye on provision of a new service. A problem-finding attitude makes people eager to do that. It is because people generate ideas, make hypotheses, create issues, ask questions, find problems and be self-aware of something that feels different that they become interested in each other's meta-cognition, voraciously searching if each other's noesis provides themselves with variables which are so far unheeded but could be relevant to their own meta-cognition. In other words, driving one's own FNS loop through meta-cognitive verbalization encourages people to communicate with others. If they communicate with other, the range of interaction (C1.5) will be enlarged, which in turn drives each other's FNS loop actively. An active drive of FNS loop and enlargement of the range of interactions promotes each other.

AN EPISODE OF CO-CREATION OF VALUES: A CASE OF METACOGNITION ABOUT TASTES

In this section, we will show an episode of co-creation of values that occurred between two persons as they conversed with each other, eating the same cake and sharing each meta-cognitive verbalization about its tastes. Although the episode is not necessarily an example of service, it includes a key notion about how service should be.

Embodied Meta-cognition

Meta-cognition about tastes is verbalization of how one's own body feels, and therefore it is beyond the scope of the conventional meta-cognition in psychology. In the conventional meta-cognition, the target of verbalization has been mostly limited to one's own thoughts verbalized in mind and overt actions observable objectively. Tastes are in the realm of perception, and therefore seem to be tacit; it is expected that tastes are relatively hard to verbalize. That sommeliers are regarded as professional is supportive to this. The conventional sense of meta-cognition has never dealt with verbalization of tastes. Without studies on verbalization of realms that have embodied aspects and thus are tacit, however, embodied knowledge would never be demystified. Extending meta-cognition into embodied realm, Suwa (2008) advocated the notion of *embodied meta-cognition*, in which not just thoughts and overt actions but also perception and movements of body parts are targets of verbalization. Of course, they are embodied and therefore relatively hard to describe verbally. But, as we explained in the previous section, meta-cognitive verbalization is a tool for augmenting attention to so far unheeded variables and furthering thoughts. One does not necessarily have to correctly describe all that happen in one's own body. Correctness of descriptions is not sought after in embodied meta-cognition. Embodied meta-cognition is a tool for enhancing attention to interactions between one's own body and the surroundings, driving a FNS loop involving one's own embodied knowledge, and thereby making it improve.

Experiment of Meta-cognitive Verbalization about Tastes

The aim of this experiment was to examine how a daily custom of meta-cognitive verbalization about tastes changes cognition of tastes for a long period. An undergraduate student and the first author of this paper participated in this experiment, and this examination turned out to the student's graduation thesis (Ikuma, 2005). The duration of the experiment was about one year, lasting from November 2004 through October 2005. The frequency of the experiment was once in two weeks. One day the two participants ate a cake, the same kind for both, and had a conversation, each meta-cognitively verbalizing what one's own body feels in tasting it. The behaviors and facial expressions of the student and the area her face was directed including the table, the dish, and the cake as she was eating it were videotaped. The voice of the first author of this paper was also recorded in the video. Since communication with others enhances one's meta-cognition as we discussed in the previous section, the experimental design in which the first author also meta-cognitively verbalized and conversed with the student was expected to promote the student's FNS loop. Approximately two weeks later, the student watched the videotape of the immediately previous experiment, remembered what she had thought and felt about the tastes of the cake as she ate the cake and verbalized what she thought. The first author of this paper was also there as a partner of conversation, sometimes talking by being inspired by what she said and asking her questions. Then, about two weeks later, the experiment of meta-cognitive verbalization in eating a cake was conducted again. Every time the kind of cake was renewed, according to the hypotheses, issues, goals and questions the students possessed then.

Cakes are one of the student's and the first author's favorites. That is one of the reasons why cakes were selected as the material for the experiment; if the material were something that the participants were not interested in, that would not give incentives to continue the experiment for a long period, which would be fatal for the experiment.

A Custom of Meta-cognition Brings Drastic Change of Cognition

The student disliked oily or fatty food, although oily and fatty materials are often used in cakes. For example, cream is typical. At the beginning of the first experiment in November 2004, she disliked cream. She said, "When I take something oily or fatty, I feel that the inner of the mouth is covered with membrane of oil. That is no good. I have not had fried pork and tempura for the past ten years or so!". Therefore, for the relatively beginning periods of the experiment, we had to select the kind of cakes that do not contain cream.

Interesting was that her cognition about something oily drastically changed in the late 2005. One day toward the end of 2005, the first author was surprised to hear that she had eaten "kakuni", a Japanese recipe of simmering fatty pork loaf in soy sauce based stock, and also to hear about her impression about it. Kakuni is a pronoun of oily food. She said, "Professor, I thought that the fatty part of kakuni must be the key for the whole taste of kakuni. Flavor and sweetness and delicious taste of pork are all sealed in it". Although she had not overcome all of oily food, it seemed true that her cognition about something fatty or oily had changed after the 1-year experiment. The custom of meta-cognitive verbalization requested in the experiment must have had a

positive effect on her cognition about tastes.

An Episode of Co-creation of Values

Here, we will show an episode in which a conversation of the two persons who meta-cognitively verbalized about the tastes of a cake ended with co-creation of values. More precisely speaking, each person found a new value about tastes for each, respectively, with both values relating to each other. The key to the occurrence of co-creation of values was that sharing meta-cognitive verbalization between both caused them to find some variables and aspects in what each other said relevant to one's own purposes. This brought about a rich interaction phase (C1.5) for each of them, and led to co-creation of values.

St1: The sourness of lemon in general is strong, but this tart is not so strong.
Ms1: The mouth is not necessarily filled with sourness, is it?
St2: I guess its sweetness makes sourness coated and hidden nicely.
Ms2: Oh! It is like honey lemon!
St3: Yes, this is similar to the sweetness of honey. Sugar stands out, saying "I am sugar!",
but honey has a soft sweetness.
Ms3: Sugar stands out in sukiyaki![1]
St4: Honey tastes like "Ha~chi~mi~mitsu~~[2]"
Ms4: Honey smells a little, doesn't it?
St5: Ah, I eat hotcake with honey.
Ms5: I do not paste honey on hotcake. Of course, I paste butter. Butter is a kind of oil, but I paste it much! And a kind of jam I paste on hotcake is not strawberry, but a little bit of blackberry with some sourness.
St6: Butter is indispensable, isn't it? I like hotcake with berry jam.
St7: Oil plus sourness! Is it that its combination makes good harmony? That is true to this tart.
Ms6: The combination of oil and sweetness is not very good, is it?
St8: Yes, may become sickly sweet.
Ms7: Oh, lemon sauce used in French cuisine is the combination of butter and lemon. I like it!
St9: Ah! Mayonnaise!
Ms8 & St10:
Ohhh, this is the same combination as mayonnaise, isn't it?

Excerpt 1. An episode of co-creation of values in meta-cognitive verbalization about lemon tart

On that day the two ate lemon tart, the fifth cake since the experiment had begun two months earlier. The first author of this paper tended to hesitate something sour if it has strong sourness. The student disliked something oily or fatty. Lemon tart has a touch of sourness and is shaped and covered with crusty parts like baked cookie, which has a little oily taste. In other words, lemon tart was a food material about which both had issues. The student thought that, although she felt a little too fatty in the tart part, she did not dislike that. The first author of this paper thought that he did not dislike its sourness. Each recognized that the tart had an aspect each tends to dislike, but it was never no good. Both began to question why. Excerpt 1 shows a sequence of conversation in which co-creation of values occurred. 'St' represents the utterances of the student and 'Ms' those of the first author of this paper. The subsequent number represents n-th utterance of the person. At the moment of this conversation, both had already questioned why this tart is never no good.

The beginning of this excerpt is exactly when both began to conjecture why the first author of this paper did not dislike the sourness of this tart and the student did not dislike its oil. St2 is the verbalization of the first

[1] "Sukiyaki" is a popular Japanese cuisine. The way of cooking it is to put sliced beef with vegetables and tofu in a frying pan and stewboil them in soy-sauce plus sugar based stock.

[2] "Hachimitsu" is a Japanese word corresponding to honey. Using pronunciation extending each syllable, she wanted to express that honey has a soft sweetness, in contrast to sugar that has a strong "standing out" taste.

hypothesis. Subsequently, both presented several recipes, products and food materials with an aspect of sweetness or sourness, i.e. honey lemon, sukiyaki, hotcake, jam and butter to be pasted on hotcake. By recognizing what is good and what is no good, both intended to reach the most feasible hypothesis. St7 is the hypothesis adopted as the final answer to the question. Then, in order to prove its feasibility, both searched for something, i.e. lemon sauce and mayonnaise, that the same hypothesis is applicable to.

The first author of this paper came to notice that he does not necessarily dislike sourness. He had thought that he does not like sourness in general, but came to recognize at this moment that he actually had selected something sour in some cases, especially when sourness co-exists with oiliness. When he said that he often pastes blackberry jam on hotcake (Ms5), he began to question if he really does not like something sour. This is the very example of a change of values about one's own favorites. Similarly, the student came to recognize that she usually uses butter on hotcake, although butter is a kind of fat. Noticing the fact that she loves mayonnaise made her persuaded that reorganization of her original presumption about favorites is needed. This is the example of creation of values, too. Now it is easy to guess that reorganization of this sort would happen to her several times in the subsequent experiments, and accumulation of those would lead her to talk about the fatty part of kakuni one year later.

Finding some variables and aspects in what the conversation partner said relevant to one's own purposes is the key action. Without the conversation partner, similar cases of creation of values might not have been possible. Since what the partner is going to say is basically unpredictable, the boundary between what is relevant and irrelevant is recognized on the fly in the conversation. That recognition determines the range of interactions (C1.5) from which to find values in analysis (C2). It is in this respect that values of each person were "co"-created, and further significantly the values created by both are not necessarily the same.

DISCUSSION

The episode discussed in the previous section, although it is evidence suggesting that sharing each other's meta-cognitive verbalization promotes co-creation of values about each other's tastes, is not necessarily an example of service. But, we want to stress that this evidence includes a key notion about how service should be. That is, first, both a service provider and customers should meta-cognitively verbalize about what the service provides to the lives of people, and share and converse about it with each other. That communication, then, encourages each to find some variables, aspects and viewpoints in the partner's verbalization relevant to one's own exploration, and to weave them with so far attended ones by oneself and thereby to reorganize one's own values.

Let's think of a Japanese sake restaurant as an example. Suppose that a customer's recognition of sake taste is only along the axis of sweetness-bitterness. Many customers still believe without a doubt that this is the only and correct way of classifying sakes, although the tastes of Japanese sakes nowadays have a variety of facets and aspects. The owner of the restaurant knows better and recognizes that Japanese sakes have various facets and aspects of tastes. Here, a form of service that the authors find ideal is not to directly tell the owner's recognition to the customer, saying "this is the way of enjoying sake". Important is that, first, the owner should make a series of opportunities for long months or years for conversing with each customer about what each meta-cognitively feels and thinks about sake, food and other relevant issues, and thereby help the customer find his /her own values of tasting sakes. The owner should always have a watchful eye on each customer in conversation sessions. Does he/she want to enjoy the sweetness of rice, the raw material of Japanese sakes? Does he/she want to feel the flowery aroma of rice malt, which emits an enzyme necessary for fermentation of rice? It is said that there are various ways of marriage between sake and food. One kind of sake that forms a perfect marriage with a vegetable, e.g. cabbage, tomato, and etc., could be fatal when it is eaten with grilled chicken, and vice versa.

Further, the owner should think that "helping customer find values" may be a consequence. A mental attitude required is that the owner himself or herself is a learner, too. He/she should be eager to find some variables, aspects and viewpoints in a customer's meta-cognitive verbalization relevant and thereby reorganize his or her own values. Awareness of "help" may be even unnecessary. If one of the conversation pair has a mental attitude of helping, the other may not be encouraged to be an eager learner.

We expect that service providers who recognizes the significance of "communication and co-creation of values" in service will increase.

CONCLUSIONS

Based on what we call FNS diagram, we have theorized that values on both parties, a service provider and customers, are created in a situated manner out of interactions between both. This means that values are co-created. Customers, too, are designers to create ideas about how to use services. A service provider, too, is a learner to have a watchful eye on how customers use services and re-script a new service. A service is the whole process in which a provider and the customers create their own values out of communication with each other.

Further, we have argued that, in order for communication to work well, meta-cognition is needed on both parties. The essence of meta-cognition is verbalization. Meta-cognitive verbalization makes one's problem-finding attitude active, and thus encourages one to be eager to find something significant in others' meta-cognition. Its eagerness enlarges the range of interactions (C1.5) in one's FNS loop, which in turn promotes problem-finding attitudes in the FNS loop. Out of these processes co-creation of values is easier to occur.

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Designing Service System Prototype Workshops

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ABSTRACT

The design focus is shifting from industrial projects to service systems due to the service economy. The research on designing a service system becomes more important. The difficulty of designing a new service system is how to share values among many stakeholders involved. The scope of design becomes wider, more complex and including more interactions among various stakeholders. Because of these shifts, the new research on service system design is emerging. In this paper, a service system design framework is proposed, which is based on two viewpoints, such as systems with value sharing condition and scopes of system layers. Using the framework, a service system prototype workshop is designed and executed. The paper shares the evaluation result and findings.

Keywords: Service Innovation, Service Design, Prototyping, Management, Engineering and Design (SSMED)

INTRODUCTION

The society has been fast advancing toward a service-based economy. This phenomenon, common to both developed and developing countries, results from the growth of the service sector's share of the economy, spurred by rapid growth in service industries consequent to increased social sophistication and diversification. The growth of services encouraged the researchers to study the fundamental business changes from product-based systems to service economies (IfM and IBM, 2007, Chesbrough and Spohrer, 2006). Besides the follow-up sales of product-based services, the business strategies of the most of companies had to shift their focus to services as a key differentiator in their new business models (Sawatani, et al., 2007, van der Aa and Elfring, 2002). Such a shift does affect the design focus.

The design focus is shifting from industrial projects to service systems due to the service economy. The research on designing a service system becomes more important. The difficulty of designing a new service system is how to share values among many stakeholders involved. The scope of design becomes wider, more complex and including more interactions among various stakeholders. Because of these shifts, the new research on service system design is emerging. In this paper, a service system design framework is proposed, which is based on two viewpoints, such as systems with value sharing condition and scopes of system layers. Using the framework, a service system prototype workshop is designed and executed. The paper shares the evaluation result and findings.

SHIFT OF THE DESIGN FOCUS

Industrial products

Literatures on design appeared since 1950 in the most industrialized countries. The followings show some definitions of design (Jones, 1992).

- Fining the right physical components of a physical structure (Alexander, 1963)
- Decision making, in the face of uncertainty (Archer, 1965)
- The conditioning factor for those parts of the product which come into contact with people (Farr, 1966)
- The performing of a very complicated act of faith (Jones, 1966)
- A creative activity – it involves bringing into being something new and useful that has not existed previously (Reswick, 1965)

The design was described using various different words, such as decision making, conditioning factor, creative activity, etc... The commonality among these definitions is to initiate change in man-made things (Jones, 1992). Industrial design initiated by William Morris is growing influenced by the economic and societal change, such as Bauhaus and Postmodern design. IDEO and d.school at Stanford are expanding the target of design, not only industrial products, but service systems.

Service products

The early research on service design discusses service products (Shostack, 1984, Bitner, 1992, Marger, 2004) by distinguishing between product and service. Service design starts focusing on user experience and interaction (Holmlid, 2007), such as human-computer interaction and participatory design. Recently the systemic perspective in service design including engineering viewpoints is emerging.

Service systems

Discussions on a service system are growing in SSMED community. Service is value co-creation interaction that is beneficial changes that result from communication, planning, or other purposeful interactions between distinct entities (Spohrer and Maglio, 2010). The entity can be viewed as a service system entity. A service system is dynamic configurations of resources that include one or more persons, and evolve complex structures and interaction patterns (Spohrer and Maglio, 2010). Designing service systems including various industrial and service products needs additional knowledge.

Looking at the history of design since 1950, focus areas are shifting from products to service systems. The design focus is shifting from industrial, tangible products to service products focusing on interaction design, and service systems. At the same time, the scope of a service system is expanding from one particular organization e.g. a closed system to an open system that covers multiple stakeholders.

FRAMEWORK FOR SERVICE SYSTEM DESIGN

The design of a service system requires various viewpoints. Jackson (Jackson, 2003) categorized systems approach from complexity of systems and value sharing condition among participants in the problem contexts. First looks at the complexity of systems. The complexity of systems by Jackson (Jackson, 2003) is as the following: a system is simple if it is static, closed and has a few subsystems, or is complex if it is dynamic, open and has many subsystems. Service systems could be categorized as a simple system or a complex system. The class 1 to 3 (Ueda, et al., 2009) introduces the shared value concept to an open system. Class 1 is a closed system. Class 2 is an open system, but the

purposes of the system are fixed, and Class 3 is an open system without concrete purposes by synthesis approaches (Ueda, et al., 2009).

Value sharing conditions among participants (Jackson, 2003) are discussed as (1) Unitary which shares similar values, beliefs and interests, (2) Pluralist which does not share the same values and beliefs, however, accommodations and compromises can be found, (3) Coercive which has few interests in common and conflicting values and beliefs, and decisions are taken on the basis of who has most power. From the solution point of views, interactions in a service system are typed as value proposition based and governance based (Spohrer, et al., 2011).

On the other hand, service system design incudes multi-level interactions, such as people interactions, as well as organizations and society level. S3FIRE program (Sawatani, et al., 2013) introduced three layers, micro-meso-macro as the following:

- The first layer, Micro, expresses a one to one relationship, mainly person-to-person interactions. From business point of views, it shows operational relationship.
- The second layer, Meso, is for an n-to-n relationship, mainly organizational interactions, which shows strategy and collaborative organizational policy.
- The third layer, Macro, is for the social system and policymaking.

Jones (Jones, 1992) describes the level of design as components, products, systems, and communities. Service systems include community level as well as systems level, such as relationships between products and between systems. Many unsolved design issues occur at the systems level and the above. These levels are beyond the scope of traditional designing (Jones, 1992). It includes the political and social aspects of user behavior.

Viewpoints such as system complexities, value sharing conditions and scopes of a service system help to identify technical and social difficulties designing a service system. Table 1 shows the summary of the discussions.

Table 1: Service system viewpoints: Complexities, Interactions, and Scopes

System complexities

Systems	Simple	Complex		Jackson (System of Systems Methodologies (SOSM)) (Jackson, 2003)
Difficulties in synthesis	Class 1	Class 2	Class 3	Ueda, et al. (Ueda, et al., 2009)

Value sharing conditions

Interactions	Value proposition based		Governance based	Spohrer, et al. (Spohrer, et al., 2011)
Value sharing condition	Unitary	Pluralist	Coercive	Jackson (System of Systems Methodologies (SOSM)) (Jackson, 2003)

Scopes

System layer	Micro: People	Meso: Organization	Macro: Social systems	S3FIRE (Sawatani, et al., 2013)
Layer of design	Components, Products (Traditional designing)	Systems	Community (Political and social aspects)	Jones (Jones, 1992)

Industrial products are developed in a factory and are sold to customers (consumers or companies). On the other hand, service products vary from an almost closed system like a maintenance support a printer, to an open system with multiple stakeholders like an on-line auction service at an e commerce site. Service systems are not limited to the area of these products, but include a regional community system that is the intersection of class 2 or 3 and the

meso scope, and a national society system at the macro scope level. As the result, service system design needs to expand research areas from products as the following.

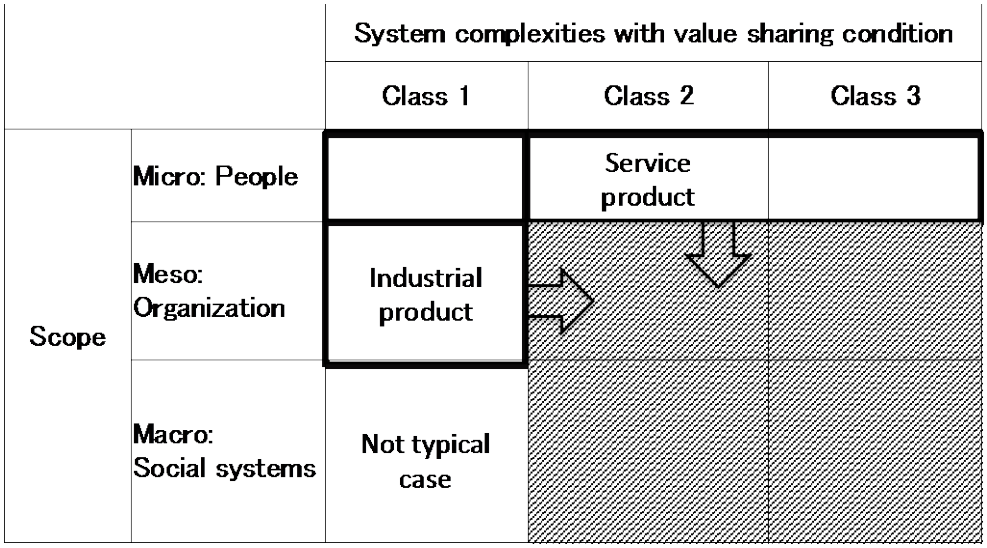

Figure 1. Expanded research areas by service system design

SERVICE SYSTEM PROTOTYPE WORKSHOP

The service system prototype workshop is designed to focus on the intersection of the micro-meso scope and class 2 value sharing condition. The target of attendees of the workshop includes students, teachers, and professionals from companies. The six project teams are formed for the prototyping from Dec., 2013 to March, 2014.

Design process

At the project level, the following steps are designed.

1. Problem identification and definition
2. Idea generation
3. Hypothesis inspection based prototyping
4. Prototype testing and feedback

Step1: problem indication and definition is trying to capture the interested area from objective and intuition like perspective. Idea generation, step 2, is executed by the innovation workshops using various ideation methods. This workshop puts stress on concept, product and experience testing by prototyping. So that step 3 and 4 are important, which include plans for the prototyping, the execution and the feedback to the original prototype.

Meta-Design process

At the program level, the following are examined extending an input-process-output model (West and Aderson, 1996) from service system viewpoints.

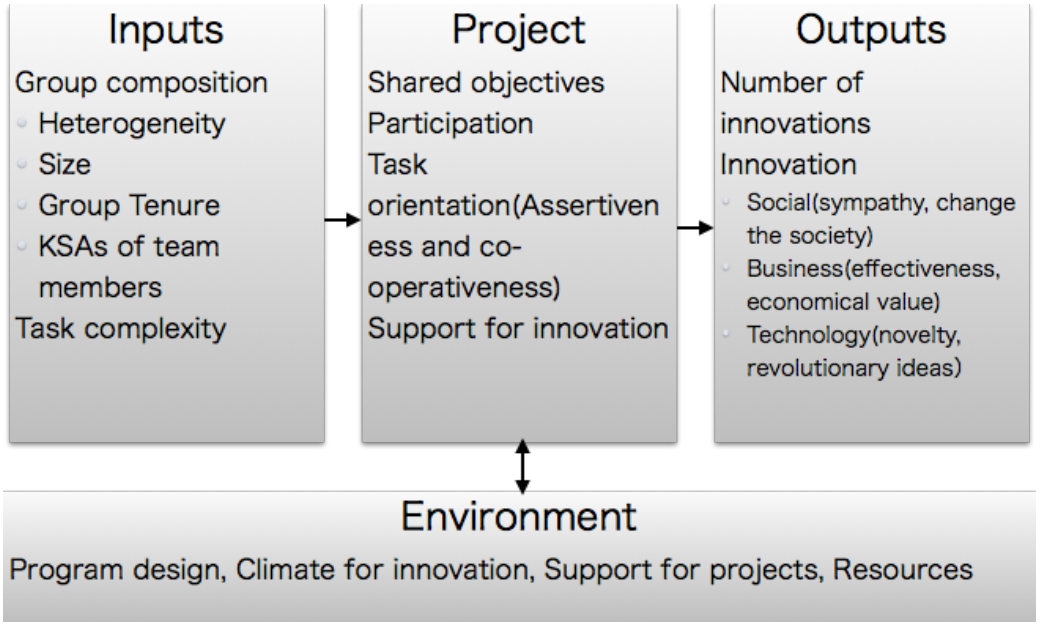

Figure 2. Evaluation of service system prototype workshop

The inputs of the workshop are team group composition and task complexity. The progress of projects is majored by surveys at each event, such as the kick off, idea generation workshops, the middle team presentation, and the final team presentation. The outputs are tested by the judges from social, business and technical point of views.

RESULT AND DISCUSSIONS

Result

Table 2 shows the early evaluation result of the service system prototype workshop.

Table 2: Evaluation result of service system prototype workshop

| | | |

Team C and team B shared project objectives with team highly, which is ranked the second and the third at the final team presentation. The joint ownership of the objectives might be important to start the innovative idea generation. When a purpose is not shared enough, arguments may not be carried out effectively. As a result, an idea may become commonplace. For team D case, even though a purpose is not shared enough, if a team is more homogeneous and keeps the same quality, then deep arguments are possible to generate a sharp idea.

Discussions

From the early research on the service system prototype workshop, it becomes important how to create the idea generation environment, which is the meta-design process such as the team formation, the value sharing process and innovation evaluation. These areas need to be studied in the future. Adding to the meta-design process study, prototype methods need to be explored.

From the interviews of attendees at the service system prototype workshop, prototyping of the service system was challenging. The most of the service systems, which teams created, were not a products, but social systems. The areas of prototyping are expanding from products to concepts and experience. The operationalization from the model (concept or experience) to the reality is difficult. The methods supporting the concept and the experience prototype areas need to be researched more.

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A Dynamic Model based on Customer Learning Speed

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ABSTRACT

The heterogeneity of customers is dependent not only variety of customers but also the time change. How do we treat the variety of customers based on time is issue for the service research. We construct a model for representing the customer learning speed interpreted by customer expectation based on novelty. The results are to show the customer learning rate in relation to the novelty of each service sector (Restaurant, Hotel and Mobile-phone users), and effects of the customer learning assistant promotion by numerical simulation. We can manage the dynamic aspects of customers' variety adding the static aspects of them.

Keywords: Customer Learning Speed, Customer Expectation, Hotelling Model

INTRODUCTION

The servicizing economy is prevalent all over the world. We are required not only to provide services but also to treat in accordance with the variety of customers. We are focusing on the customer learning speed based on the customer expectation, typically based on novelty. We construct a microeconomic model for representing the customer learning speed and show the parameter based on an empirical research.

Background

Servicizing is wide spread in economy all over the world. From competition, manufacturing businesses are required to treating the services. Within the current situation, service dominant logic is remarkable (Vargo and Lusch, 2004).

We face to the variety of customers in the servicizing economy. The criteria of service evaluation are not uniquely fixed. The characteristics of the criteria depended on the culture, religion, gender and so on.

It is difficult to treat the variety in relation to the change of time. On the other hands, the static aspects are scrutinized by a lot of researches. The reason is difficult to make closed models for the dynamic aspects of customers.

However, we cannot understand the mechanism by adding the statistical aspects. We interpret the behavior by using any dynamic models. Therefore, we need to make the theory for the criteria of the service evaluation.

Research Question and Purpose

How to connect the variety of customers based on the time and a modeling. We need to represent the change of the criteria of service evaluation. In addition, it is important that where we focus as the dynamic factors.

To develop this approach, we can manage businesses considering the dynamic aspects of customers. For example, from perspective of ergodicity, the understanding to static aspects for customers deepens with the long-term analysis of them. Thus, companies can treat two varieties of customers, varieties depended the static and dynamic aspects.

Approach

In this paper, we construct the connection of customer learning speed and customer expectation based on our previous works (Masuda and Hara, 2011, 2012). First one, we constructed a model for representing the customer dynamic aspects by focusing on the novelty and familiarity within customer expectation. Second one, we proposed a model for representing the customer heterogeneity by using the customer learning rate.

After that, we fit the parameter by questionnaire data (Masuda and Hara, 2011). We collected the customer satisfaction and expectation data from users of the restaurant, hotel and mobile-phone users in Japan, 2009. Typically, we focus on the gap of expectation, that is, if customers have no knowledge for the services, the gap is the biggest one.

As the results, the customers learning rates are the following; Restaurant: 68%(t=1), 66%(t=2), 92%(t=3); Hotel: 70.8%(t=1), 50%(t=2), 50%(t=3); Mobile-phone users: 93.6%(t=1), 100%(t=2), 97.1%(t=3). In the case of restaurant and hotel, t=1 is receiving the service first time, t=2 is receiving the service from second to forth, t=3 is receiving the service more than five times. In the mobile-phone case, t=1 is ensemble of purchase point of customer, t=2 is ensemble of duration from purchase time to 1 year, t=3 is ensemble of duration more than 1 year. In addition, we see the behavior of these parameters by numerical simulation (Masuda and Hara, 2012).

From this approach, we can manage the variety of customers dependent the dynamic aspects based on time. Typically, it is important to understand the customer statements of customer learning. The difference of the customer learning rate lead the decision making how to choice the strategies.

The following section, we explain the detail. Section 2 is the related works. Section 3 is to make the connection with customer learning speed and the change of the customer expectation. Section 4 is to find parameter based on questionnaire data from a survey research. Section 5 is implication from our work. Section 6 is conclusion.

RELATED WORKS

Our work is positioned in the integrated area of microeconomics and service marketing. How to evaluate the dynamic aspect is a big problem for the researched in relation to service. We need to have a dynamic model for representing the aspects. Here, we aim to apply the microeconomic model to the service research.

We show the existing economic model for representing the dynamic aspects. The Hotelling model is the basic model for customer choice in microeconomics (Hotelling, 1929). Fudenberg extended the hotelling model for customer poaching (Fudenberg and Tirole, 2000). There is an extended work to "behavior-based personalization"(Zhang, 2011).

Next, we show the approached from service marketing. Customer satisfaction research was started by Oliver (Oliver, 1997). Disconfirmation model is the basic approach in the customer satisfaction. Another basic service evaluation model is the SERVQUAL model by Parasuraman (Parasuraman, Zeithmal and Berry, 1998). Regarding the dynamic aspects of the expectation and satisfaction researches for customer, Bolton analyzed customer of mobile-phone by a dynamic model by showing first experienced satisfaction is related after the evaluation by the customer (Bolton, 1998).

CONNECTING THE CUSTOMER LEARNING SPEED AND CUSTOMER EXPECTATION

We represent the customer learning speed based on the customer expectation. We set the start rate is 0%, there are no person understanding their preference for the services, and the end rate is 100%, there are all person understanding their preferences. We interpret the rate by the gap of expectation and modified expectation receiving after the services.

Concept of Customer Learning Speed

How to represent the heterogeneity of customers is the issue for the service researches. There are a lot of directions representing the heterogeneity of customers. And the directions are not uniquely fixed each person within a long-term period.

We constructed a model focusing on the novelty and familiarity expectation perspective (Masuda, 2011). We interpreted novelty and familiarity by using the gap of expectation and modified expectation. And we showed the change of the novelty and familiarity by each frequency of receiving the services.

On the other hand, we constructed a model for representing the dynamic aspects using by customer learning perspective (Masuda, 2012). We represented the heterogeneity of customers by using two type classifications; one is unknown customers for their preferences, other is known customers. And we showed the change of the weight of two types against all customers for representing the dynamic aspects.

Specification to combine the Customer Learning and Novelty Expectation

Our approach is how to connect the customer learning speed and the novelty expectation perspective. We connect customer novelty expectation rate and customer learning rate (see Figure 1). For modeling, we hypothesis from 0 to 1 of customer learning rate is equal to from 1 to 0 of customer novelty rate.

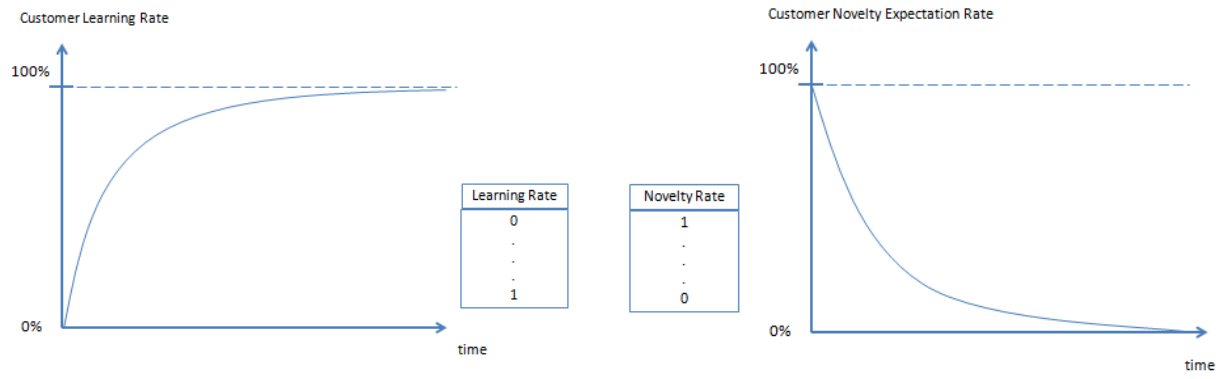

Figure 1: Overview of customer learning speed and novelty expectation perspectives

Here, we hypothesize that the progress of customer learning/novelty expectation rate is a linear equation, that is,

$$r = r_v \cdot t + r_0 \quad (1)$$

Parameter r is a weight of customers understanding their preferences against the overall customers. Variable t is representing of discrete time (natural number). Parameter r_v is the velocity of customer learning. Parameter r_0 is initial condition for the weight of customers understanding their preferences.

Naturally, we believe that the change of customer learning/novelty rate is non-linear one. Here, we constructed the simplest form. In the future, we need to develop and validate the one.

Make a Dynamic Model for representing the Customer Learning Speed

We constructed the duopoly model for customer choice. Here, we use the same logic (see Masuda, 2012 for the detailed).

There are two firms, A and B. first-period is same as Hotelling model (see Hotelling, 1924). Second-period, firm B carry out a well-known service assistant strategy with additional cost C. Firm A is same action in the first period. Each firm knows strategies of each form. A well-known service assistant promotion strategy is meant that firm B's customer provide service b but competitor's customers provide special service b'. Customers have a learning rate of their preferences. Here, it is y in [0, 1]. Learning of customer preferences happen equally in the distribution.

In the case of customer learning rate y = 1 (perfect learning), a well-known service assistant strategy is the most effective,

$$\pi_{A_{y=1}}^{(2)} = \mathrm{P} \int_0^{x_a} 1 \, dx = P x_a \tag{2}$$

$$\pi_{B_{y=1}}^{(2)} = \mathrm{P} \int_{x_a}^{1} 1 \, dx - C = P(1 - x_a) - C \tag{3}$$

In the case of customer learning rate y = 0 (imperfect learning), a well-known service assistant strategy is ineffective perfectly,

$$\pi_{A_{y=0}}^{(2)} = \mathrm{P} \int_0^{1/2} 1 \, dx = 1/2P \tag{4}$$

$$\pi_{B_{y=0}}^{(2)} = \mathrm{P} \int_{1/2}^{1} 1 \, dx - C = 1/2P - C \tag{5}$$

Regarding the total profits, we equate total profit with discount factor delta,

$$\pi_A = \pi_A^{(1)} + \delta\left(y\pi_{A_{y=1}}^{(2)} + (1-y)\pi_{A_{y=0}}^{(2)}\right) \tag{6}$$

$$= \frac{1}{2} P + \delta\left(\frac{yP(b'+a)}{2} + \frac{(1-y)}{2} P\right) \tag{7}$$

$$\pi_B = \frac{1}{2} P + \delta\left(y\left(P\left(1 - \frac{b'+a}{2}\right) - C\right)\right) + (1-y)\left(\frac{P}{2} - C\right)\Big) \tag{8}$$

In this case, y is static over time. For extending the n period, we hypothesize learning of customer preference progress by same rule. For example, in second period, y and (1-y), in third period, y+(1-y)y and 1 - (y+(1-y)y) and so on.

AN EMPERICAL RESEARCH FOR PROPOSED MODEL

In this section, we got the customer learning rate from questionnaire data. We represent the microeconomic model based on the customer expectation. Finally we show the output from the formula for numerical simulation.

We got the novelty expectation rate from questionnaire (see Table 1). Point of our questionnaire is to ask 'a number of times of receiving the service', 'expectation before receiving(5-scales)', 'gap of expectation after receiving(3-scales)', 'customer satisfaction after receiving(5-scales)'. We got the data in 2009 December. Mobile phone and restaurant research is to construct web questionnaire. Japanese hotel, Ryokan, research is to distribute sheets of the questionnaire. In the Table 1, n is a number of people and t is label of subset of questionnaire data. In the mobile-phone case, t=1 is ensemble of purchase point of customer, t=2 is ensemble of duration from purchase time to 1 year, t=3 is ensemble of duration more than 1 year. In the case of restaurant and hotel, t=1 is receiving the service first time, t=2 is receiving the service from second to forth, t=3 is receiving the service more than five times.

Table 1: Questionnaire Survey: Customer Expectation and Satisfaction (2009)

Mobile-phone

t	n	EV		MEV		Gap	CS	
		mean	variance	mean	variance	mean	mean	variance
1	48	2.723	0.961	2.787	1.254	0.064	2.745	0.956
2	14	2.667	1.135	2.667	1.491	0	2.467	1.31
3	34	2.657	0.954	2.686	1.282	0.029	2.657	0.984

Restaurant

t	n	EV		MEV		Gap	CS	
		mean	variance	mean	variance	mean	mean	variance
1	16	2.531	0.865	2.844	1.149	0.313	2.75	1
2	6	2.833	0.687	3.167	0.898	0.334	3.333	0.471
3	28	2.536	0.906	2.607	1.113	0.071	3.036	0.823

Japanese Hotel (Ryokan)

t	n	EV		MEV		Gap	CS	
		mean	variance	mean	variance	mean	mean	variance
1	41	3.293	0.943	3.585	0.987	0.292	3.463	0.858
2	10	3.3	0.781	3.8	1.166	0.5	3.5	0.5
3	4	3.5	0.5	4	0.707	0.5	4	0

We got the customer learning rate from this questionnaire (see Table 2).

Table 2: Customer Learning Speed from Questionnaire Survey

Mobile-phone

t	n	Gap mean	Novelty rate	Learning rate	Customer Learning Speed (mean)
1	48	0.064	6%	94%	96.9%
2	14	0	0%	100%	
3	34	0.029	3%	97%	

Restaurant

t	n	Gap mean	Novelty rate	Learning rate	Customer Learning Speed (mean)
1	16	0.313	31%	69%	76.1%
2	6	0.334	33%	67%	
3	28	0.071	7%	93%	

Japanese Hotel

t	n	Gap mean	Novelty rate	Learning rate	Customer Learning Speed (mean)
1	41	0.292	29%	71%	56.9%
2	10	0.5	50%	50%	
3	4	0.5	50%	50%	

We input the parameters to the proposed extended hotelling model (see Figure 2). This is show the effect of the promotion for the well-known service. That is the effect increases by the completed learning customers.

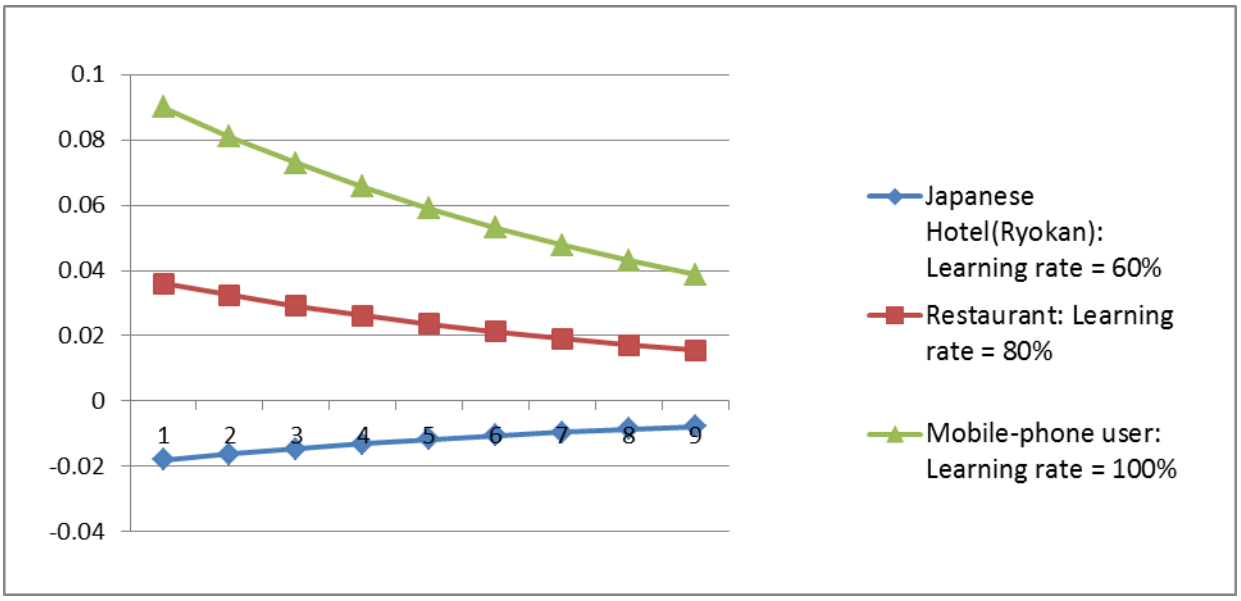

Figure 2: Well-known service assistant promotion strategy

IMPLICATION

This is one approach for treating the variety of customers from dynamic aspects. We can combine a microeconomic model and service marketing by using customer choice model like the hotelling model. In business side, this approach is useful how to treat the variety of customers for their differentiation.

CONCLUSION

We showed the customer learning speed. From questionnaire survey, the specific customer learning rates are; Restaurant: 68\%(t=1), 66\%(t=2), 92\%(t=3); Hotel: 70.8\%(t=1), 50\%(t=2), 50\%(t=3); Mobile-phone users: 93.6\%(t=1), 100\%(t=2), 97.1\%(t=3), t is representing the time period. And we showed the effect of well-known service assistant promotion by using customer choice model extended the Hotelling model that is one of microeconomic models.

There are theoretical and practical limitations. The novelty/familiarity perspective is one of them for the criteria of service evaluation. We believe that it is insufficient to treat the perspective only. Another issue is how to collect the data. We believe that it is important for understanding and applying the customer variety that to develop meta-perspectives, e.g., meta-questionnaire, meta-business process modeling and so on.

The direction of further research is two ways. First way is to develop other qualitative factors like novelty/familiarity perspective and discuss the customer learning speed. Another way is to develop the method how to collect the data like meta-modeling approaches.

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Section 10

Context-Related Service: Lessons in Humanisms

Cooperative Body-Worn Sensor Network for Efficient Healthcare and Activity Monitoring Applications

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ABSTRACT

Body Sensor Networks are an interesting emerging application to improve healthcare and the quality of life monitoring. In this work, we compare the performances of multi-hop cooperative and single-hop networks with real-world sensor networks based on Zigbee technology. The network reliability, the data flow rate, the packet delivery ratio and the energy consumption are included as performances criteria. It is shown experimentally that the cooperative approach can provide a network more robust to link losses at the expenses of a lower bit rate and higher energy consumption. Specifically, for a packet delivery ratio >0.9, the cooperative scheme can provide the network with a link gain up to 14 dB traded off with an energy demand up to 30.7% higher and a data flow rate about 20% lower than a single-hop system. This work is a first exercise step in assessing reliability and life time trade-off with real-world platforms for body area sensor networks.

Keywords: Body-worn Sensors, Cooperative Topology, Energy Efficiency, Healthcare Monitoring Systems

INTRODUCTION

Research on sensor network has been carried out using small, low-power digital radios based on an IEEE 802.15 standard (IEEE, 2003), a high-level communication protocols suitable for WBANs (Otto, 2003, Jovanov, 2005). The most straightforward approach to deploy a WBAN is considering single-hop (SH) communications between sensors and the sink. However, the body impact on the signal can result in severe path losses, even larger than 50dB (Yazdandoost, 2009). Due to these high losses, direct communication between the sensors and the sink will not always be convenient (or even possible), especially when extended sensor lifetime is targeted deploying ultra-low range transceivers (Strömmer, 2007).

In a relay MH network, each sensor is dedicated to transmit or relay information packets, while in cooperative MH network each sensor can performs both operations. An example of MH WBAN benefits is introduced in (Latre, 2007), where spatial diversity gain is analyzed for a two-relay assisted transmission link, while a tree cross-layer

protocols such CICADA (Braem, 2006) and WASP scheme (Su-Ho, 2010) aimed to achieve WBANs reliability and low delay, although no considerable attention is focused on balancing the power consumption between the interconnected sensors (Djenouri, 2009). Several researchers also attempted to design energy-aware MH protocols, considering also different metrics such as delay and reliability as Quality of Service requirements (Felemban, 2006, Razzaque, 2008). Although these studies shows that MH communications are suitable to overcome link blockage in sensor WBANs, the MH energy efficiency compared to the SH schemes is still an open issues and depends on several system parameters, including chipset implementation, sensors distance, and network topologies. A recent network design proposed in (Heinzelman, 2000), shown a significant increase in battery life for relay MH scenarios considering only the transmit power.

The main objective of this paper is to compare experimentally the performances of MH cooperative and SH schemes for a WBAN. The power margins, the data flow rate, the sensor packet delivery ratio (PDR) and the average energy consumption are selected as a main performance criterion. The sensors generate and transmit data at regular intervals with a data flow rate suitable for ECG constant monitoring system.

CONSIDERATIONS AND SETTING OF THE BODY-WORN SENSOR NETWORK

A prototype synchronous sensor network at 2.4 GHz is set-up, where each sensor consists of a Sentilla Perk mote (Sentilla, 2008), standard compliant with the IEEE 802.15.4/Zigbee protocol. A total number of 4 sensors (with index i = 1, 2, 3 and 4) were placed on human volunteer (each attached on head, left leg, left wrist, and back) in sitting postural as shown in Fig. 1, while a sensor acting as sink is placed in the waist area. This is a representative scenario for patients who are resting for a major part of the day. The sensor 4 is placed on the volunteer's back diametrically opposite sensor 3. The sensors are placed such that batteries are closest to skin, with the antennas being further away. With respect to the sink, two sensors are in quasi-LOS (e.g. 1 and 2) while two others are in NLOS (e.g. 3 and 4). Experiments were run in office indoor scenario.

The sink collects raw data, and sends statistics to an off-body server using a wireless link. The network operations can ideally be cyclically repeated and they can be divided in 3 main phases: (1) setting-up of the routing tree topology, (2) time-slot transmission synchronization, and (3) data transmission. A time-synchronous architecture approach was selected as best suited to maximize the data delivery ratio. The first two phases can be ranked as start-up phases, the latter as steady-state phase. The sensors send routing messages in phase 1, dummy messages in phase 2 for synchronization purposes, and actual data messages during phase 3. The network performs cycles of the 3 phases with periodicity TN to adapt its topology to the body movements and postural and environment changes.

Topology Update

The Minimum Cost Forwarding (MCF) network routing protocol (Fan, 2001) has been implemented on the top of the standard connection functionality provided by the Sentilla motes kit. The routing algorithm adopted seeks to achieve minimum cost from each sensor toward the sink, where costs are proportional to the RSSI. In SH case, each sensor transmits by default to the sink so no routing data is required, while in MH protocol case, each sensor retains the next hop target sensor address to build the tree topology. From previous published works (Holland, 2006, Barsocchi, 2009), the RSSI seems to provide a good estimation of packet loss rates; e.g. RSSI of −90 dBm or larger always corresponds to a PDR of 95% or more. The RSSI register value RSSIVAL can be referred to the power PRF at the RF pins by using the following equations:

$$PRF = RSSIVAL + RSSIOFFSET \quad (1)$$

where the RSSIOFFSET is approximately –45 (e.g. if reading a value of –20 from the RSSIVAL register, the PRF is approximately –65 dBm). The RSSIVAL can directly be related to the path loss LP and to the transmit power PTX according

$$RSSIVAL = PTX - LP - RSSIOFFSET \quad (2)$$

As transmit and receive antenna gain cannot be explicitly estimated because of the relative orientation and body

impact, they are considered as embedded in the LP term. The PRF values are not numerically suitable as link costs for the routing algorithm. In fact, the sum of any MH links combination will not be lower than the SH links, even for MH power-wise convenient routes.

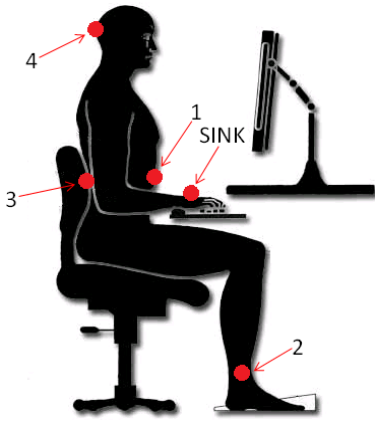

Fig. 1. Displacement map of 4 sensors and a sink network on volunteer body.

Synchronisation Phase

The transmit time slots are synchronised in Phase 2 using beacons with a unique sensor address periodically sent by the sink. In this phase, each sensor is constantly in receiving mode, listening for sink beacons and other sensor massages. If a beacon is received, the sensor set up a wake-up timer and send a packet to the next hop target sensor (or to the sink in case of SH scheme). If a sensor receives a message, it simply relays to the next hop. Thus, the sink and the sensors involved in relaying can synchronize their wake-up timers for receiving the messages from neighbourhood sensors. As the sink knows the total number of sensors (but not the network topology nor the latency a priori), it does not send a new beacon until a packet is received from the target sensor. As the massage delay depends of number of hops, R is expected to lower in MH scheme. After phase 2, the sink and the sensor have set a wake-up time, and no beacons are required anymore.

Transmission Phase

At the end of phase 2, the communication between sensors is time-slotted according the wake up times to avoid idle listening and save energy. Each sensor regularly transmits data packets of 75 bytes of payload. In case of MH protocol, a sensor relays messages from neighbourhood sensors immediately after reception, with no data buffering. The sensor operation type (e.g. transmit or transmit and relay) depends on the network topology and it can dynamically change every cycle TN. Considering a sensor in transmit operation type as shown in Fig. 2, the communication tasks are divided into 3 time slots: in TP, the sensor generate data to transmit, in TTX the sensor transmit the data packets, while in TS the sensor is in sleeping mode. TTX is fixed and empirically estimated to be ~108ms. This value includes value data serialization, a method of transforming Java objects into a byte stream (binary form), so they can be sent and received over the radio. Thus, the actual time required to transmit data itself is <100 ms. The sensor sleeping time is TS and it varies according the synchronisations, while the active time is defined as TA=TTX+TP, where TP is ~72ms.

DATA PROCESSING AND ANALYSIS

This section presents the results of the real-world tests. Considering a static posture of the patient, we assume a constant time average for RSSI is assumed per each link. Each body link has been preliminary characterized in terms of measured average RSSI; data are stored in the devices memory and associated to each link before the experiments. As the links costs are now fixed, a single network cycle TN is enough for each test. This approach has the benefits of comparing the SH and MH energy consumptions for the same network topology, enabling a separate study of the packet losses due to the synchronization drifts from those due to the PRF dropping below the sensitivity threshold, and the repeatability of the results.

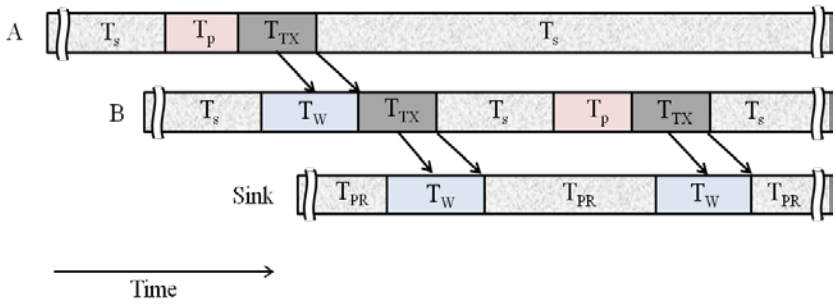

Fig. 2. Packet data communication tasks for a (A) transmit sensor, (B) relay sensor and Sink sensors operation modes (blocks are not in scale)

Network topologies and body links characterization

A preliminary characterization of the network topology in terms of link cost and time variability is performed. Per each link (e.g. γ_{13}), a data packet was sent every 1 second at 0 dBm of transmit power, for an observation time of 2 minutes. Each measurement was repeated 3 times and data were merged in a single history vector for each link. Per each packet, a RSSI measurement based on the Zigbee standard was stored and the path losses statistics are derived these values. While taking measurements, the volunteer was allowed to perform changes in the posture, as naturally happens in such scenario.

In case of MH scheme, the routing protocol sets the sensor 1, 2 and 4 to communicate directly to the sink, as these links have a lower link cost if compared with any other MH link combination. The sensor 3 transmits to the sensor 4 and the latter acts as relay. In fact, considering the RSSI, the γ_{S3} link cost (where S stands for sink) is higher than the sum of γ_{13} and γ_{4S} link costs (e.g. (-16)+(-9)<-30). This can potentially results in transmit a power margin for the sensor 3 of 14 dB if compared to the SH case. The P_{RF} values are not numerically suitable as link costs for the routing algorithm. In fact, the sum of any MH links combination will not be lower than the SH links, even for MH power-wise convenient routes. As discussed before, only the 4 links relative to the sink are of interest for both SH and MH, while γ_{34} is of interest for MH only. The L_S time histories of these links are shown in Fig. 3, while Table 1 shows the statistical parameters. The standard variation σ spans from 5 dB to 8.1 dB, while the power range is up to 66 dB.

Network packet delivery ratio (PRR) and data flow rate performances

From Table 1, the sensor 3 has M_0 of 20 and 34 dB for the SH and MH case, respectively. Moreover, σ is 8.1 and 5.0 dB for the γ_{S3} and γ_{34} cases, respectively. The probability of exceeding M_0 (or link blockage probability) is about $7 \cdot 10^{-3}$ for the SH and about $5 \cdot 10^{-12}$ for the MH case. Thus, a γ_{S3} blockage is significantly more likely than a γ_{34} link blockage. Figure 4 shows the SH PRR (primary y-axis on the right) and r (secondary y-axis on the left) for γ_{S3} with and without link blockage. The results are compared with the MH PRR and r with no link blockage on the γ_{34} link. The cases for T_w = 93.75 and 250 ms are considered. The PRR is > 0.9 for both SH and MH schemes with no links blockage. In case of MH network, it is shown the capability of sensor 4 to receive and route to the sink at least the data from the sensor 3 with a PRR comparable (e.g. $PRR > 0.9$) to the SH case with no blockage. In case of γ_{S3} link blockage, the SH PRR degrades of about 23% compared to the MH with no link blockage for both T_w cases, while the SH r reduction is 21% and 25% for the T_w case of 93.75 ms and 250 ms, respectively. This means that the MH topology can be used to overcome SH link blockages theoretically without PRR degradation, as the MH lower r compared to SH scheme is merely due to the synchronization basic approach discussed beforehand and it will be deepened later in this section. As mentioned in Section II, the PRR (and consequently r) depends directly on the waiting time (T_W) value. For this reason, both the PRR and r are preliminary studied against the T_W to maximize the data r while keeping at minimum the packet losses.

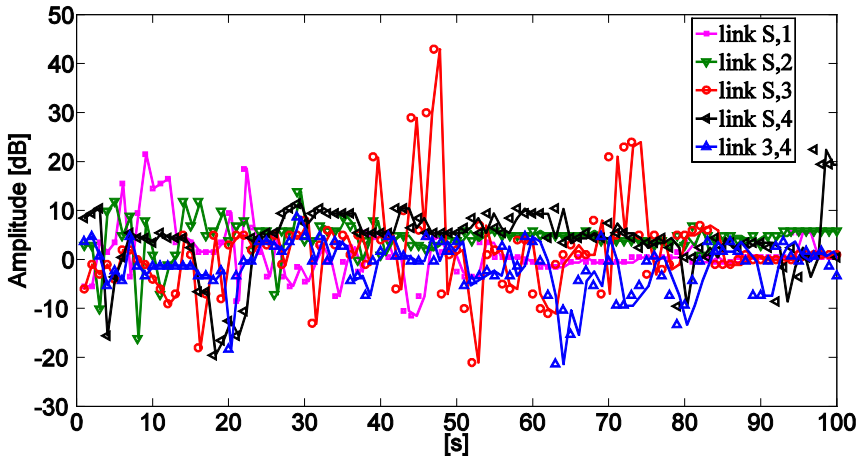

Fig. 3. Sample LS history during the first 100 measurement seconds with sampling rate of 1 second.

Table 1. Average path loss, available margins and statistical parameters of LS per each link of interest

Link	L_{AVG} [dB]	M_0[dB]	L_S [dB]			
			σ	Range	Min.	Max.
γ_{S1}	-44	24	7.2	53	-31.4	21.52
γ_{S2}	-62	42	6.7	43	-25.11	17.89
γ_{S3}	-75	20	8.1	66	-23.02	42.98
γ_{S4}	-54	34	7.4	44	-21.57	22.43
γ_{34}	-61	41	5.0	32	-21.33	10.67

As path loss L_S can change significantly in time even for sitting postural because of body movements, it is important to compare M against the energy consumption. The relationship between the transmit power and the sensor current consumption is not linear. The energy consumption can be estimated as a function of data packets transmitted, based on the exact circuitry being used. As a 1.8V chipset voltage is used and the defined bit rate is 250 Kbps (Fan, 2001), $\tilde{E}_{rx}$ is 135.4 nJ/bit, while $\tilde{E}_{tx}$ at $P_T = 0\ dBm$ is 125.28 nJ/bit. The microcontroller energy costs are not considered. From (Fan, 2001), the current consumption in idle and sleep modes are significantly smaller (>500μA) compared to the maximum transmit and receive currents (17.7 and 18.8mA, respectively) and they are not considered neither.

The energy consumptions estimation only represents the energy per bit dissipated in the transceiver. As the extra energy dissipated during overhead processing (data generation, data serializations, etc.) and the media access control (MAC) related (such as the waiting time T_W) are not considered, this approach provides more general results as the energy is approximate using only the network topology, the transmitted power, the chipset implementation, the bitrates and the target reliability.

CONCLUSIONS

In this paper the potential benefits and limitations of cooperative networks as a means of augment the reliability in body-wearable sensor are studied. These trade-offs have been quantified for a sensor network prototyping a real-world platform for continuous ECG healthcare monitoring. For a packet delivery ratio >0.9, the MH scheme can provide the network with a margin gain up to 14 dB traded off with an energy demand up to 30.7% higher and an average sensors r 20% lower than a SH scheme. The network lifetime of the MH scheme ranges from the 27% to

45% of the SH lifetime in cases of 0 dB and 20 dB margins, respectively. This work is a first exercise step in assessing reliability and life time trade-off with real-world platforms for body area sensor networks. Follow-up studies will address wireless ECG emulators with higher number of sensors (e.g. up to 10 for a typical 12-leads ECG system) employing ultra-low power chipsets in different specific health monitoring environments, such as critical care in hospitals, aged care or athlete monitoring.

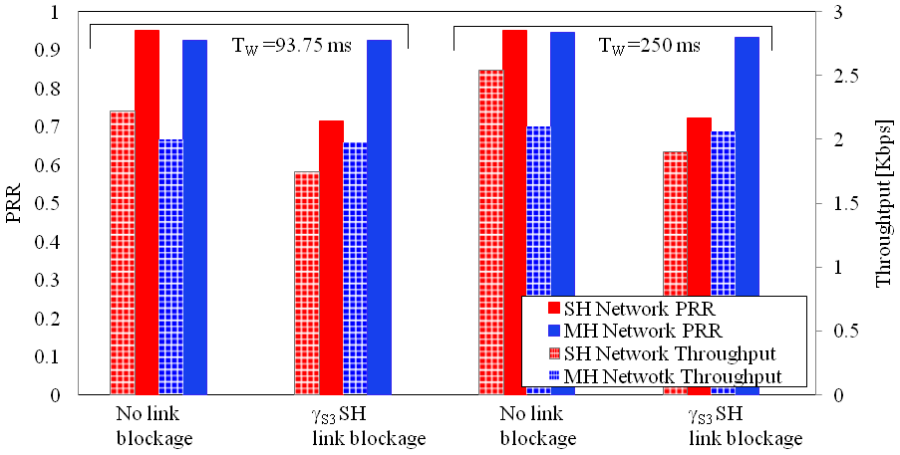

Fig. 4. Total Packet Delivery and throughput r for the SH and MH cases.

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Detection of Satisfaction for the Services by Body Motion Wave Revealing Unconscious Responses Reflecting Activities of Autonomic Nervous System

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ABSTRACT

For suppliers it is significant theme to know how much their service satisfied customers. Questionnaire survey, for example, is often adopted, however, the reply from customers obtained by such a way is not always accurate to express honest mental activity. This paper describes a detecting method of a more accurate reply by entrusting mental and physical activities for the services to unconscious responses reflecting activities of autonomic nervous system during sleep. This was performed on the idea that there is some relationship between satisfaction and conditions of both mental and physical activities. As a result of some experiments using services for healing, the unconscious responses reflecting the above nervous system such as respiration and pulse rate shifts beyond several hours at night showed satisfaction instead of conscious responses reflecting mental activities.

Keywords: Autonomic Nervous System, Unconscious Response, Body Motion Wave (BMW), Dynamic Air Pressure sensor, Satisfaction, Service

INTRODUCTION

It is well known that the music or aroma heals us mentally and physically. This healing makes us relaxed or comfortable state, in another word, it makes us induce satisfaction. Satisfaction is induced also by exiting matters due to such as favorite sports or success in an examination, for example. While in daily life we accept various services such as articles, information, friend and circumstances, etc. The suppliers of them usually want to know how much the service satisfied customers. Though questionnaire survey is often adopted, the reply is usually distorted by some reasons, so that it is not always accurate to express honest mental activity.

The theme for the suppliers is how to know honest replies for the services. Therefore, the question here is do we know the degree of satisfaction turning out the honest reply. If we know it, we would make better services by considering the honest reply. In this respect, we have studied entrusting the reply of satisfaction for services to unconscious responses reflecting activities of autonomic nervous system (Okawai et al., 2011; 2012). In the series of

these studies, we have an assumption that such unconscious responses reflecting activities of autonomic nervous system mean the degree of satisfaction, because the music or aroma to heal mentally and physically is already approved by some other way throughout the world as adopted in aromatherapy. At the present study, the phenomena of relaxation detected by our measurement system were further investigated to know fluctuation of instantaneous pulse rate.

METHOD FOR TAKING DATA OF UNCONSCIOUS RESPONSES

Instrumentation

In the state of relaxed during sleep, it is understood that both respiration and pulse are controlled by autonomic nervous system and the rates of those are become less (Hori,2008;Kaniusas,2012) and that the vital activities such as respiration and pulse appeal unconscious responses free from reason, et al.(Okawai et al., 2012;2013). Then, and our measurement system to detect the vital activities during natural sleep was described in Fig.1. A pressure sensor, named "dynamic air pressure sensor" (M.I.Lab) was adopted in order to fabricate a non-restraint, non-attachment measurement system. In principle, it was set on a bed to detect dynamic air pressure arises between the sensor and a subject's body at lying. The pressure variation detected with the sensor was converted to electric signals, "body motion wave" as mentioned later, sampled at the rate 400 Hz, 16 bit and stored in a personal computer. The signal was processed with Chart v4.2.2 (AD Instrument) and programmable software VEE Pro ver6.0 (Agilent Technologies). The reproducibility of this system was confirmed (Okawai et al., 2011; 2012).

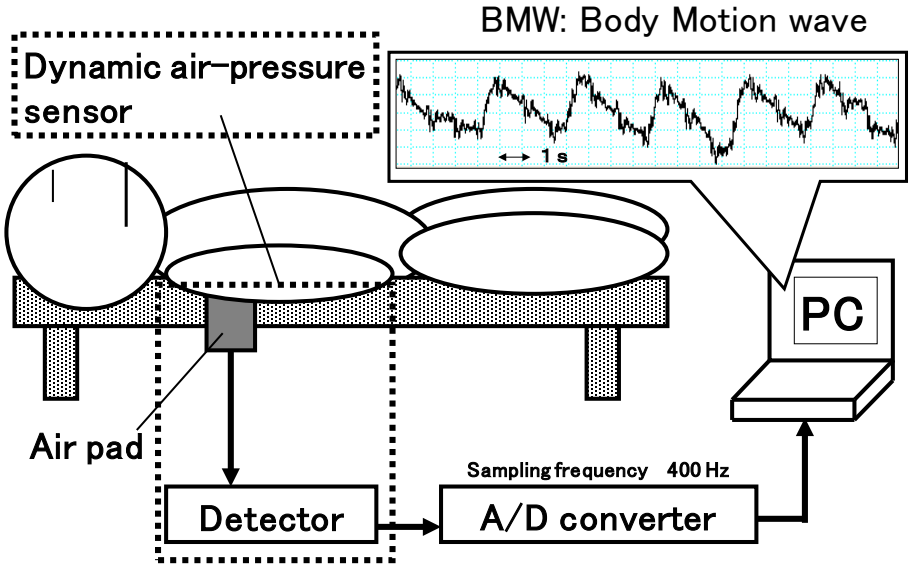

Figure 1. Measurement system for body motion wave (BMW) having components of respiration-origin BMW (R-BMW) and pulse-origin BMW (P-BMW)

Body motion waves detected

As reported by Okawai et al. (Okawai et al., 2011-2013), in subject's body during sleep some continuous motions are generated resulting in respiration and pulse, so that thus motions can be detected as pressure waves named "body motion wave (BMW)", "respiration-origin BMW(R-BMW)" and "pulse-origin BMW (P-BMW)". In addition during sleep, some frequent extra motions are generated resulting in unconscious actions et al., these can be detected as pressure waves also. For these extra waves, approximately two types of waves appear. The one was named Tremble-origin BMW (T-BMW) having a small magnitude and short duration of wave due to a slight action of a portion of a body. The other was named Action-origin BMW (A-BMW) having a large magnitude and wide duration of wave. Accuracy of the present method for detecting rates of respiration and pulse was already confirmed by comparing with the data taken from a thermistor and an electrocardiogram (Kuno et al.2004).

Basic concept for a human system and its reply to input such as service

In general idea, a system has a mechanism to produce an output modulated by its characteristics for an input. This idea was applied to following human system (Okawai et al, 2011:2012). A human is an elaborate system. The services are input to the system both intentionally or unintentionally. Then, the system is influenced and makes a response, viz., an output. Such phenomena were shown in Fig.2 suggesting a mechanism of resulting a conscious response and an unconscious response for an input of a service to the human system.

Here, article, information, energy and labor were listed for example for input. The output of speech or action, for example, is a conscious response, on the other hand, the variation in physical condition is an unconscious response. At first, the flow to conscious response is as follows. A biological signal, produced as sensing stimuli, i.e. service by, for example, sense of sight at channel 1 (circled 1), flows into two channels. The one, channel 2, processes it as mental activity, and the other, channels 3, does it as physical activity. Then, these mental and physical activities interact through channel 4. Mental activity, such as satisfaction or emotion, probably makes physical activity better. Also good physical activity will make mental activity better.

Thus, the mental activity will reply to the service by satisfying for a conscious response through channels 5 and 6. However, there would be possible to reply not satisfying, because a signal of mental activity was sometimes distorted by reason or consideration et al, as shown in the bracket between channels 5 and 6. This output is a conscious response also. Thus, the reply from here is not always accurate because of above distort.

On the contrary, there are two lines in the physical activity as a physical condition to express an unconscious response. The one is direct channel 3 and the other is channel 4 via a mental activity. The signals from such two pass ways are combined and then sent by channel 7 for output. This unconscious response might be an honest answer because it was not distorted by above reason.

Physical condition generating unconscious response as shown in Fig.2 (a) was determined by a factor c. A new sensitive surroundings or service is input under health maintained, the output will mainly occurs as delta c=delta s. When delta c varied with no sensitive matter, the fraction of health condition, delta h , must have changed.

Daily life is roughly classified into two situations of in awake and in sleep as shown in Fig. 2(b). In the former, mental activities produced in cerebrum will generate a conscious response. On the contrary, in the latter, because of unconscious state, autonomic nervous system activity is superior so that physical activities will generate an unconscious response. This is why the answer is put into unconscious response.

Then, service input can be classified into three types as shown also in Fig. 2(b). Articles and food are examples of type I having channels 2 and 3. Information is an example input of type II not having channel 3. Unconscious responses would be accumulated in the body and, therefore, would appear during sleep. During sleep we are in unconscious state, therefore, the output through several hours is free from reason, consideration, et al. Some bedding materials, input to human system without awareness during sleep, are examples of type III which having neither channels 2 nor 4.

Experiment

Consecutive four days were set to perform one set of experiment. In the first and second days for normal days as usual, physical reproducibility for a subject was checked, and then, in third and fourth days for receiving service days, i.e., stimulated days, he/she was checked in the same way. At the present study, (a) healing music and (b) aroma were adopted for the service of healing, relaxing or improving circumstances.

For healing music, subjects who did not hear healing music in daily living were selected. The subject hear any music chosen by himself/herself for approximately 30 min (minutes) to 1 h (hour) in the time of 2 h to 0.5 h before going to bed. For aroma, subjects who do not use aroma in daily living were selected also. The subject spent time with any aroma he or she chose for 1-2 h before going bed. The aroma was available for approximately 3h after going bed.

A subject accepted a stimuli at awake. Subjects, 22 -30 normal males and females, 4 to 20 for each stimulus participated.

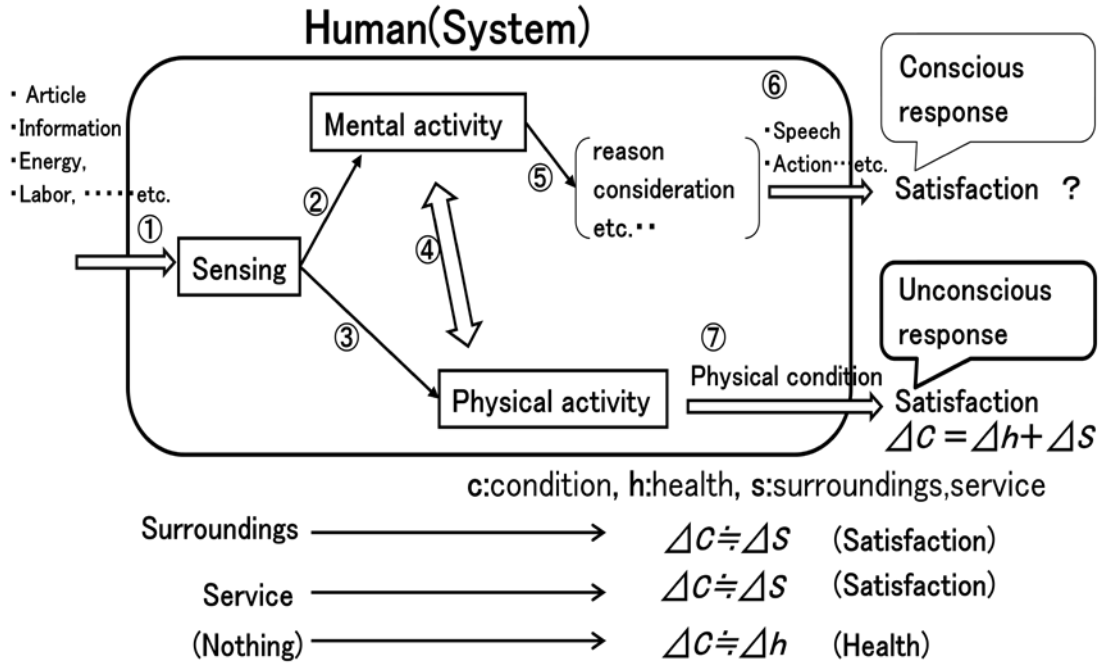

Figure 2(a). Hypothetic model revealing flow of a service for a human system from sensing to response (Okawai et al., 2012)

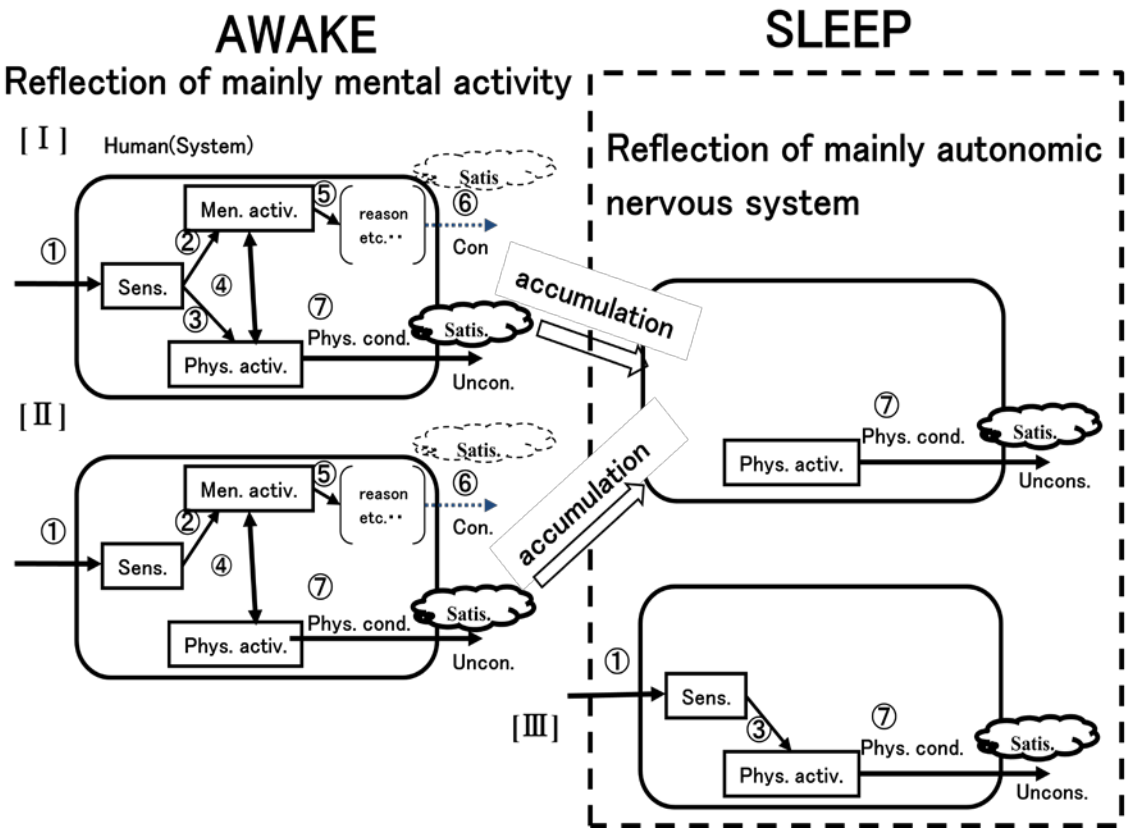

Figure 2(b). Hypothetic model revealing three types of flow of service: I, II, and III

RESULT AND DISCUSION

In Fig. 3, example transitions for a subject of pulse rate in the upper and of respiration rate in the lower through one night were shown. Left two are for the normal, i.e., no particular stimulus for the first and second nights, and then right two are for healing music stimulus for the third and fourth nights. As shown by arrow in the left trace for pulse showed a clear decrease pattern, while that of respiration also showed rather decrease pattern but not clear or flat pattern. On the contrary, the transit patterns for music stimulus showed flat pattern. The reason why the shape changed is decrease of above two rates especially in three hours from the beginning of sleep as shown by downward wide arrows in the right trace. Such distinct decreasing patterns were seen in 3 of 4 subjects. As for aroma stimulus, as shown in Fig.4, pulse rate decreased especially in one hour, while respiration rate did not decrease in 3 of 3 subjects.

It has been understood fundamentally that pulse rate and respiration rate decrease by relaxation (Hori,2008; Kaniusas,2012). This means actions of parasympathetic nerves become superior to that of sympathetic nerves in principle. However, from the result, it is clear that the stimulus did produce some variation in autonomic nervous systems with a difference between controls of pulse rate and respiration rate. It was also found that the effect of music and aroma appeared at the early time portion especially in three hours. This seems to show that such healing stimulus made a subject sleep easily because of low rate in the early period. By the way, music was input to human system by type II, while aroma was done by type I as shown in Fig. 2, so that, the difference in input way maybe made a little different effect.

At the present study, in order to further investigate what the decrease in the rate of pulse or respiration due to healing stimulus, i.e., services, we detected instantaneous pulse rate for example. Two portions of five minute in the neighborhood of 90 minute and 230 minute, i.e., earlier than and later than three hours from the beginning of lying on a bed, respectively, were selected and then instantaneous pulse rate were investigated as shown in Figs.5 and 6. In figures, fluctuation appeared with large magnitude of approximately 25 for the left, normal day, however, it became less, approximately seven, for the right, music stimulus day, though the fluctuation for later three hours showed almost same value of six between for “normal” and “music”.

For also aroma as shown in Fig.6, the fluctuation appeared with large magnitude of approximately 15 before three hours for the normal day, however, it did with less magnitude of approximately 10 for the stimulus day. On the contrary, fluctuation did not varied by aroma after three hours. Here, a time period value of three hours was determined temporary at present study.

Therefore it can be considered that healing stimulus made human decrease in the rate of pulse and/or respiration. This decrease produced, or was produced by, relaxation. The relaxation means comfortable state in mental and physiological factors. Then autonomic nervous system permitted such a human systems to control the rates of pulse and respiration to relax. A large scale of fluctuation in pulse rate for “normal” maybe means relatively rather uncomfortable state because of the usual state. The word “relatively rather uncomfortable” here means that the healthy young students who usually sleep well participated for the subject at the present study and then they slept better than usual at the day of healing stimulus just in case.

It can also be confirmed that the information of satisfaction for response to a service in awake was accumulated in autonomic nervous system and then appealed unconsciously during sleep at night as shown in Fig2 (b) at least by music.

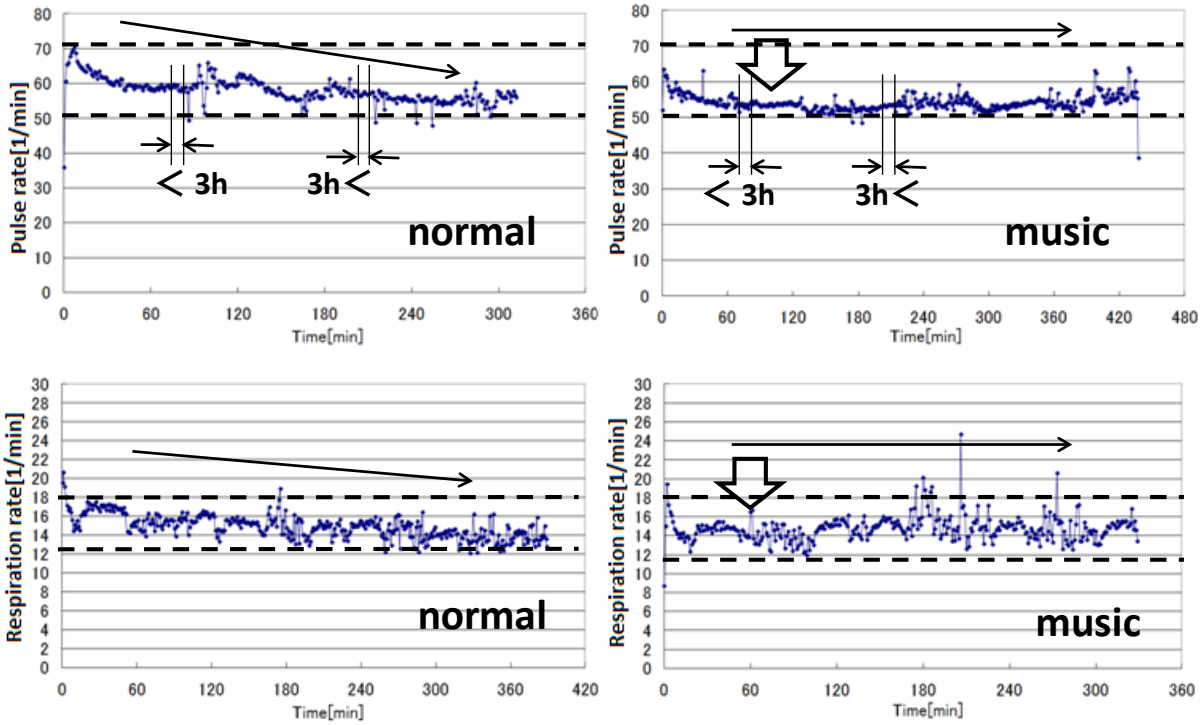

Figure 3. Rates of pulse, upper, and respiration, lower, during sleep through a night. The left shows for "normal" with no particular service (stimulus) and the right shows for "music" with service (music stimulus).

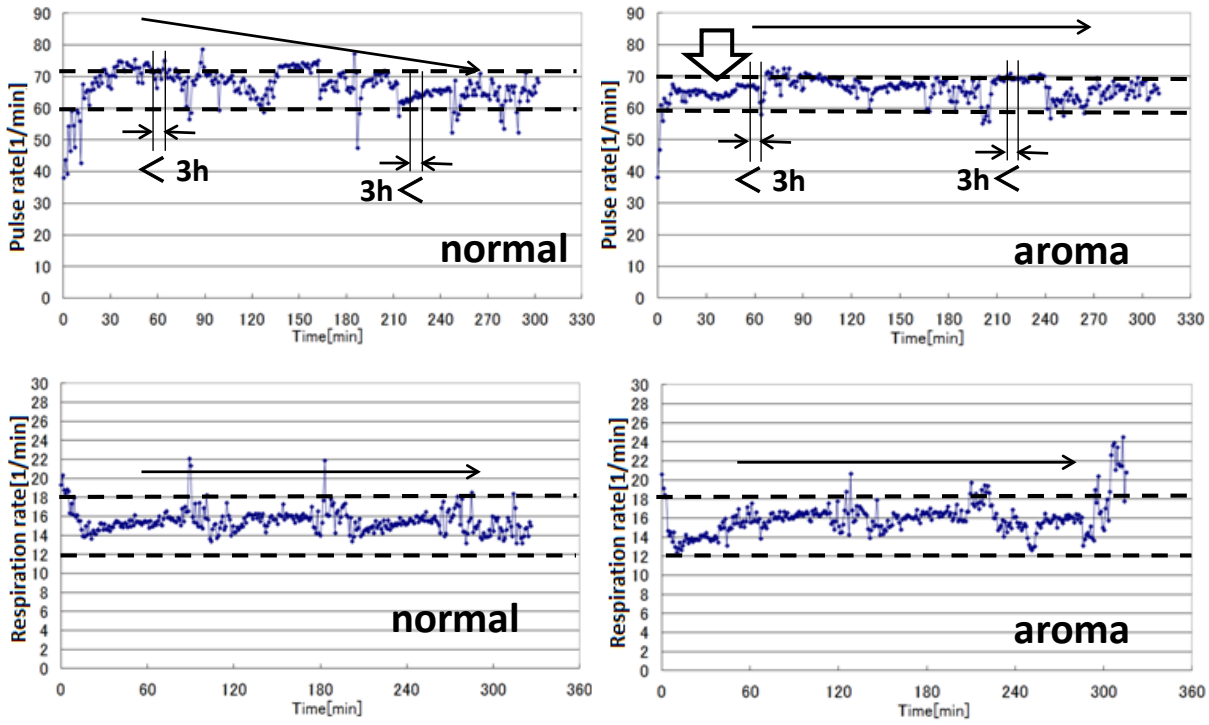

Figure 4. Rates of pulse, upper, and respiration, lower, during sleep through a night. The left shows for "normal" with no particular service (stimulus) and the right shows for "aroma" with service (aroma stimulus).

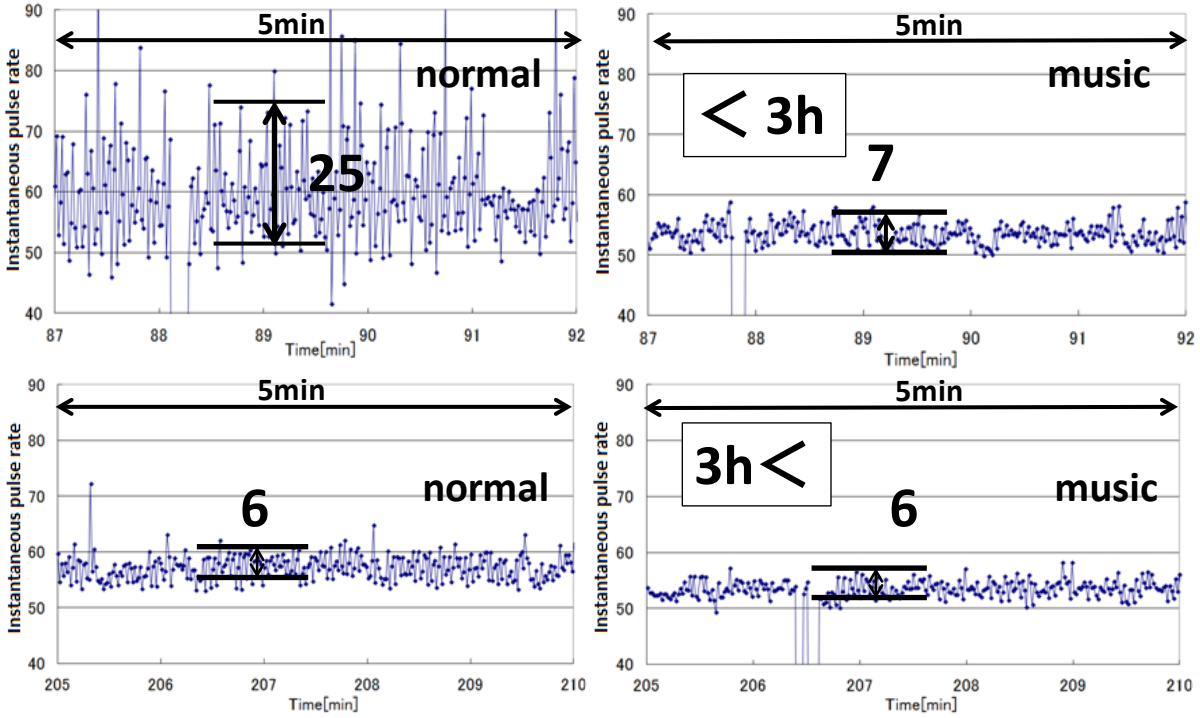

Figure 5. Variation in the instantaneous pulse rate due to music stimulus. The trace is for in 5 min of the time portions determined by arrows facing each other in Fig.4: upper for earlier and lower for later than 3 hours from the beginning of lying

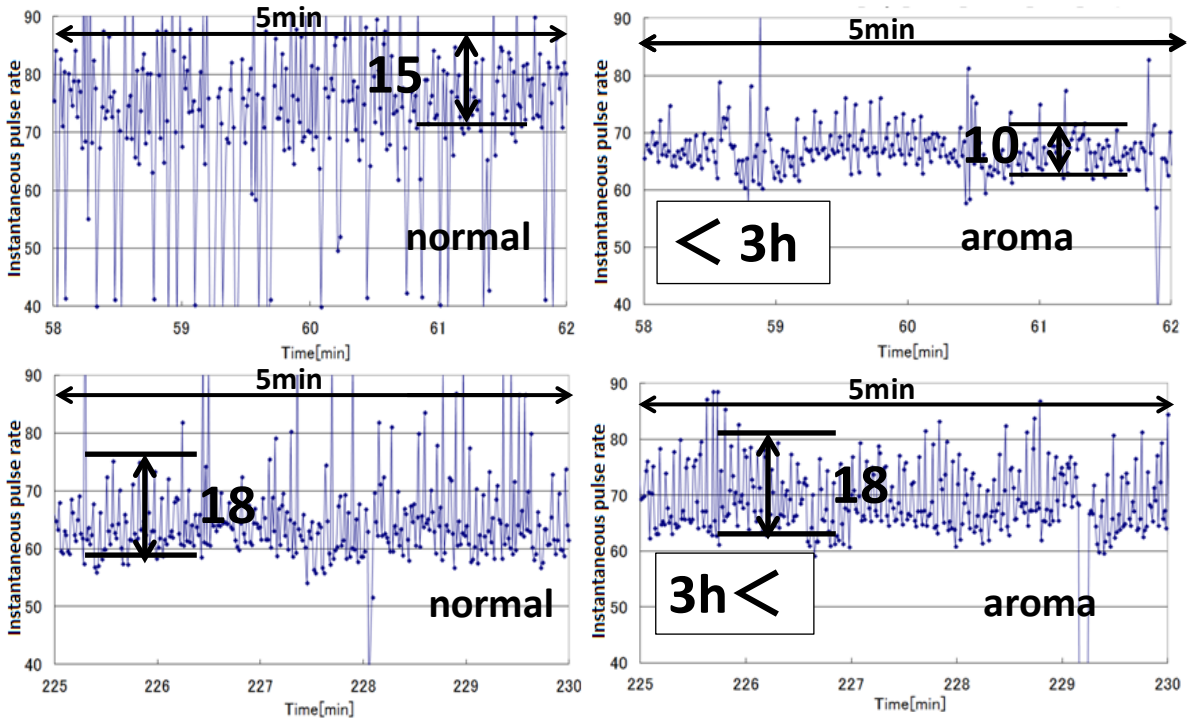

Figure 6. Variation in the instantaneous pulse rate due to aroma stimulus. The trace is for in 5 min of the time portions determined by arrows facing each other in Fig.4: upper for earlier and lower for later than 3 hours from the beginning of lying

CONCLUSIONS

Autonomic nervous system answered satisfaction to services in awake by unconscious responses of varying rates of pulse and respiration during sleep. The responses were, in concrete terms, decrease in above two rates and decrease in the magnitude of fluctuation. It was also confirmed that the information of satisfaction for response to a service in awake was accumulated in autonomic nervous system and then appealed unconsciously during sleep at night.

ACKNOWLEDGMENT

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Estimating Skills of Waiting Staff of a Restaurant based on Behavior Sensing and POS Data Analysis: A Case Study in a Japanese Cuisine Restaurant

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ABSTRACT

An approach to estimate skills of waiting staff of a restaurant by using the human-behavior sensing and POS (point-of-sales) data is proposed. Understanding skills of employees is important in every industry but it is difficult because there are no standard to evaluate their skills. In this paper, we describe experiment results of the support of a *QC (quality control) circle* of a restaurant. We observed behavior of waiting staff and visualized them to members of the QC circle. Members found that there was a difference on their workload by watching trajectories of waiting staff. For improving their process, they decided the main theme of the QC as "*keep positions*". They decided actions to achieve the theme that consist of following: (1) stay longer in the dining area, (2) reduce the movement, and (3) keep their positions. We evaluated these actions using several metrics based on the behavior-sensing and POS data analysis and confirmed that actions (2) and (3) were achieved. Based on these results, we argue skills of waiting staff.

Keywords: Human-behavior analysis, POS data analysis, skill estimation, QC circle, service process improvement

INTRODUCTION

Today there are many services in our society. We can go to trip by using public transportation such as bus and train, we can have meals in restaurants, and so on. In every services, an important aspect is the quality of services; We consider that the quality of services is derived from the systems of services and skills of employees. In this paper, we focus on the latter aspect.

The aim of this study is to assist activities of employees who want to improve their services. These activities are called the *QC (quality control) circle* (Nonaka, 1983). The QC circle is a voluntary group of employees whose mission is to identify and resolve issues in their work. Although the QC circle originated in manufacturing, methodology and tools can be used in the service industry. In the QC circle, there is discussion between members based on data. There are basic tools used in the QC circle such as *cause-and-effect diagram*, *check sheet, control chart, histograms, Pareto chart*, *scatter diagram, and stratification diagram* (Tague, 2005).

Although there is an established way to have the QC circle, one of major difficulties to improve service processes is the collection of data. To collect data in service fields is not easy because it takes much time and effort for employees. Traditional methods such as the *Motion-and-time study* (Pigage & Tucker, 1954) and the *work sampling* (Ray, 2003) have limitations to collect data because they are based on human observation. Because these approaches are based on human observation, it is hard to collect data continuously. Furthermore they can't apply to service fields where ordinary customers are buying or receiving services.

For assisting the QC circle, Ueoka et al. (Ueoka, Shimmura, Tenmoku, Okuman, & Kurata, 2012) proposed a method to assist QC circle by using the human-behavior sensing and visualization tool. This approach is named as *CSQCC (computer supported quality control circle)*. In CSQCC, one can observe behaviors of employees by using wearable sensors and s/he can browse her trajectory by combining business data such as POS (point-of-sales) data. Ueoka had an experiment of the CSQCC in a Japanese cuisine restaurant and confirmed its effectiveness.

In this paper, we describe an experiment which was held at a Japanese cuisine restaurant to assist the QC circle. We assisted members of the QC circle by using the human-behavior sensing and visualization tool. Members found their behavior and POS data in their normal operation and found an issue that the workload of waiting staff was different among them. For resolving this issue, they implemented actions to improve their process. We evaluated their performance by using several metrics and confirmed improvement of their process. Based on these results, we argue an approach to estimate skills of waiting staff.

This paper is organized as follows. In the next section, we describe the related work. Then we describe an overview of the human-behavior sensing and visualization tool. We describe an overview of the experiment, and results of the experiment. In the discussion section, we discuss results of experiment and argue an approach to estimate skills of waiting staff. In the conclusion, we summarize arguments of this study.

RELATED WORK

There are related work on measurement on workers' behavior. In the field of Industrial Engineering (IE), there are established methods to observe behavior of employees such as the motion-and-time study and the work sampling. These methods have limitations to observe the work continuously for long term. In this paper, we use the human-behavior sensing tool to collect behavior data of employees automatically and visualize them to assist employees to find issues in their work.

Choudhury and Pentland proposed a sensor system called *sociometer* that collects human interaction data (Choudhury & Pentland, 2003). With the sociometer, interaction data such as who was accompanied, how long s/he talked, and how often s/he moved are recorded. Kim et al. analyzed shoppers' behaviors by using the sociometer and found correlations between actions of customers and interests for items (Kim, Chu, Brdiczka, & Begole, 2009).

Olguín and Pentland proposed an approach to observe behavior of employees by using the sociometer to improve their productivity. They reported trials of the sociometer to evaluate productivity in banks and hospitals (Olguín & Pentland, 2009; Olguín & Pentland, 2010). Ara et al. proposed an approach to analyze behavior data of humans by linking with other data called *performance indicators* such as financial profit, amount of communication, employee satisfaction (ES), and customer satisfaction (CS) (Ara et al., 2008). They created a feedback system that supports employees to find their communication states, and improve them by visualizing interactions among managers and employees (Ara et al., 2012).

Ueoka et al. proposed the concept of CSQCC and its prototype system. They reported experiment results of CSQCC in a restaurant (Ueoka et al., 2012). Fukuhara et al. reported another results of CSQCC in the same restaurant (Fukuhara et al., 2013). As effects of CSQCC, they reported that (1) the increase of the staying time of waiting staff in dining area, (2) the increase of additional orders in the dinner time, and (3) the few difference on the walk distance per customer which indicates the workload of waiting staff. This study also focuses on the assist of the QC circle of the restaurant. This study focuses on the evaluation of actions that are made by the QC circle.

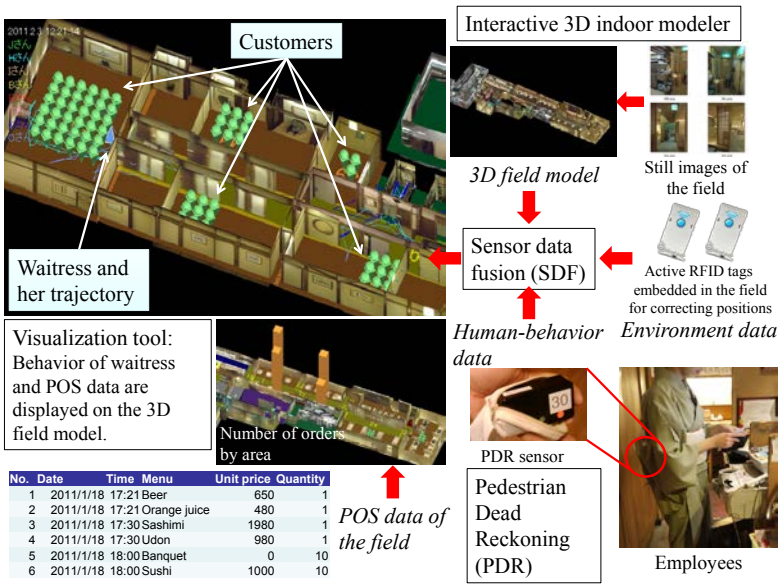

Figure 1. Overview of the human-behavior sensing and visualization tool.

HUMAN-BEHAVIOR SENSING AND VISUALIZATION TOOL

Figure 1 shows an overview of the human-behavior sensing and visualization tool. The tool consists of following subsystems (Ueoka et al., 2012; Fukuhara et al., 2013).

1. Interactive 3D indoor modeller
2. Pedestrian dead-reckoning (PDR)
3. Sensor data fusion (SDF)
4. Data visualization tool

Interactive 3D indoor modeller allows users to create a 3D model of a service field from still images. Figure 1 shows the 3D model of a Japanese restaurant. One can easily create a 3D model from images which are taken by digital cameras (Ishikawa, Okuma, & Kurata, 2009).

PDR estimates the location, direction, and velocity of a person (Kourogi et al., 2010). We developed a PDR sensor that captures behavior of a person (see Figure 1). The sensor contains several sensors such as barometer, magnetometer, accelerometer, gyroscope, thermometer, and an RFID reader. PDR estimates the position, direction, and velocity of a person based on the data obtained by the PDR sensor. The error rate is 4.3% and this can be improved to 2.0% by using the *action recognition method* (Kourogi et al., 2010).

SDF also estimates the location and direction of a person by integrating several data such PDR data, 3D model of the field, active RFID data which are embedded in an environment to correct positions, and so on (Ishikawa, Kourogi, & Kurata, 2011a). The average error of estimation is 2.2 meters by using SDF (Ishikawa, Kourogi, & Kurata, 2011b).

The data visualization tool (visualization tool) visualizes the behavior and business data of the field. One can easily look at trajectories of employees and statistics such as the number of orders by area in this tool. Figure 2 shows an example of trajectories of waiting staff of a restaurant. Arrows indicate staffs and lines indicate their walk paths (trajectories). Customers are also shown as dots. The sharp edge of an arrow indicates the direction of a staff.

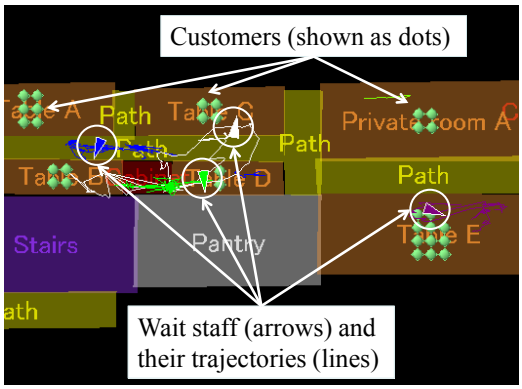

Figure 2. Visualization of the movement of waiting staff estimated by the PDR and the SDF methods.

Table 1: Terms of the experiment.

Terms	*Period*
Normal observation	Jan 16 to Jan 24, 2012
QC circle meeting	Jan 31 and Feb 2, 2012
First term (before)	Feb 6 to Feb 8, 2012
Second term (after)	Feb 10 to Feb 12, 2012

EXPERIMENT

We had an experiment of the CSQCC in a Japanese cuisine restaurant. We describe an overview of the experiment and metrics to evaluate performance of their service process.

Overview

We collaborated with the QC circle of a Japanese cuisine restaurant to assist them to find issues and resolve them by using the human-behavior sensing and visualization tool. Table 1 shows the terms of the experiment. We first observed the normal process of waiting staff to find issues. Then we showed behavior and POS data which was obtained in the normal observation term in the QC circle meeting. In the meeting, members discussed the data and decided actions to improve their processes. The actions are listed in Table 2. After having the meeting, we observed behavior of waiting staff for a week. The week is divided into two terms. In the first term, waiting staff behave normally, i.e., improvement actions were not executed. In the second term, improvement actions were executed. We evaluated actions by using several metrics which are described in the next subsection.

Figure 3 shows the trajectories of two waiting staff which are discussed in the QC circle meeting. These trajectories are made by a novice and a senior staff. At the meeting, members noticed the difference of trajectories by looking at the visualization tool. They found that the novice staff kept her position and served customers in that position, while the senior walked around the floor and served customers in the entire floor. Although the senior staff has an enough skill to serve customers across her position, she could not serve customers in her position carefully. In this restaurant, there is a shift schedule of waiting staff that describes positions to be kept. Waiting staff have to keep their positions, but this rule is not achieved. In Appendix, we describe the positions of the restaurant (see Figure A.1) and the shift schedule (see Table A.1).

From this discussion, members decided the main theme of their process improvement as "*keep positions*". The aim of this theme is to decrease the workload of waiting staff which were too different among staff.

Figure 3. Trajectories of the novice and the senior staff.

Table 2: Actions to improve processes and its metrics.

No.	Actions	Description	Metrics to evaluate performance
1	Stay longer in the dining area	Waiting staff should stay longer in the dining area to serve their customers.	Stay time in the dining area per hour (see Figure 5) Stay time in territory areas per hour (see Figure 6)
2	Reduce the movement	Waiting staff should reduce their movement to other areas.	Walk distance per customer (see Figure 7)
3	Keep your positions	Waiting staff should keep their positions. They should not undertake jobs of other areas and should do their jobs in their positions.	Recall and precision of order taking (see Figure 8 and Figure 9)

Table 2 shows the list of actions to improve their process. The actions consist of following: (1) stay longer in the dining area, (2) reduce the movement, and (3) keep their positions. We evaluated each action by using the metrics listed in Table 2.

Metrics to evaluate performance

We used the following metrics to evaluate actions which were decided by the members of the QC circle:

1. Stay ratio of waiting staff in the dining area
2. Stay ratio in territory areas
3. Walk distance per customer
4. Precision and recall of order taking and F_1 measure

On the metrics 1 to 3, we analyzed the behavior data of waiting staff. We used the stay ratio in the dining area and the stay ratio in the territory areas for evaluating the action 1. These values are obtained by the human-behavior

sensing tool. For the action 2, we used the walk distance per customer. We normalized the walk distance[1] because there is a significant correlation between the walk distance and the number of customers in the B1 floor (r=.27, p<.001).

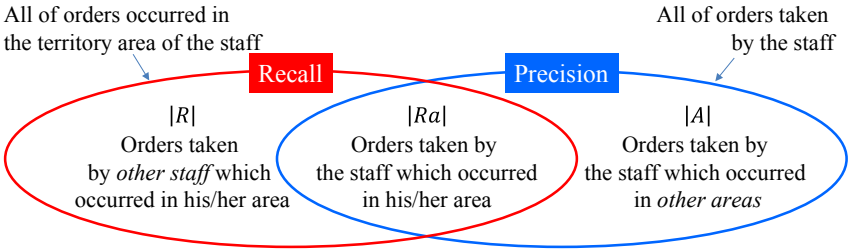

Figure 4. Overview of the recall and precision

On the metric 4, we analyzed POS data of the restaurant. The recall and precision metrics are widely used in the fields of the pattern recognition and information retrieval (Baeza-Yates & Ribeiro-Neto, 1999). These metrics are effective to understand whether a waiting staff kept her positions, i.e., if she was a good staff, she could take many orders in her position that means the recall and the precision increase. In addition to the recall and the precision, we used the F_1 value (Manning, Raghavan, & Schütze, 2008).

Formula of recall, precision, and F_1 metrics are following:

$$Recall = \frac{|Ra|}{|R|}$$

$$Precision = \frac{|Ra|}{|A|}$$

$$F_1 = \frac{2\ Precision\ Recall}{Precisoin + Recall}$$

Figure 4 shows an overview of the recall and the precision metrics. $|Ra|$ is the number of orders accepted by waiting staff who is responsible to that area. $|R|$ is the total number of orders in the area. $|A|$ is the number of orders accepted by the waiting staff.

The meaning of the recall and the precision are following: The recall indicates how many orders a waiting staff *should* keep because the definition is the ratio of accepted orders out of all of orders in her position. Ideally the recall will be high if the waiting staff keeps her position keenly. The precision means how devoted a waiting staff serves her customers because its definition is the ratio of the number of accepted orders out of the total number of accepted orders by the staff. We will discuss these meanings again in the discussion section.

RESULTS

Table 3 shows the summary of metrics to evaluate each action between two terms. The table compares means, SDs, and Mann-Whitney's U and its probability between two terms. We found a significant difference in the walk distance per customer which corresponds to the action 2. We describe results of each action in the following.

Evaluation for the action 1: "Stay longer in the dining area"

We examined the stay time in the dining area and the stay time in territory areas (positions) for evaluating the action 1. Figure 5 compares the average of the stay time of waiting staff in dining areas. Means and SDs (in parenthesis)

[1] We normalized the walk distance by the number of customers stayed in the B1 floor of the restaurant.

for each term are 37.4 (14.2) and 36.4 (15.0). There was no significant difference between two terms.

Figure 6 shows the average of the stay time in territory areas of two terms. Means and SDs are 12.0 (7.5) and 11.4 (8.2) respectively. We also found no significant difference between two terms.

Table 3: Summary of metrics variables between two terms (through a day).

	Before		After			
Variable	*n*	*M (SD)*	*n*	*M (SD)*	*U*	*P*
Stay time in the dining area per hour (minutes/hour)	99	37.4 (14.2)	94	36.4 (15.0)	4574	.84
Stay time in territory area per hour (minutes/hour)	98	12.0 (7.5)	94	11.4 (8.2)	4400.5	.59
Walk distance per customer (meters / hour /customer)	64	103.7 (60.2)	89	61.6 (31.9)	1631	<.001
Precision	53	.61 (.37)	51	.74 (.27)	1244	.49
Recall	49	.66 (.24)	51	.60 (.21)	1032	.13
F	49	.58 (.25)	49	.67 (.18)	1003	.16

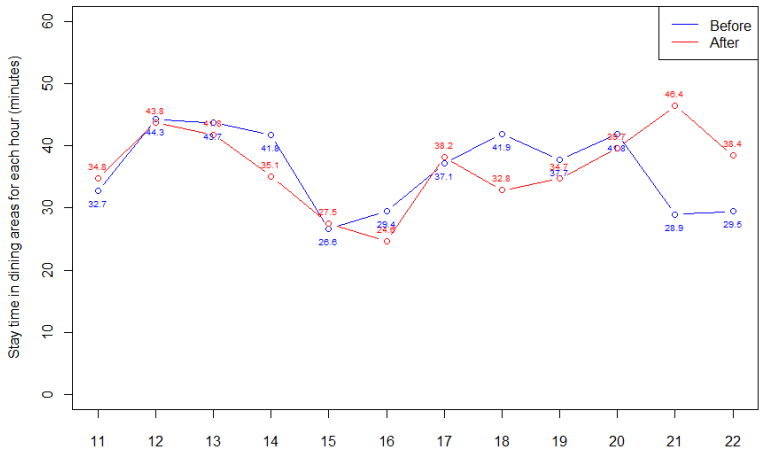

Figure 5. Stay time of waiting staff in dining areas (minutes / hour).

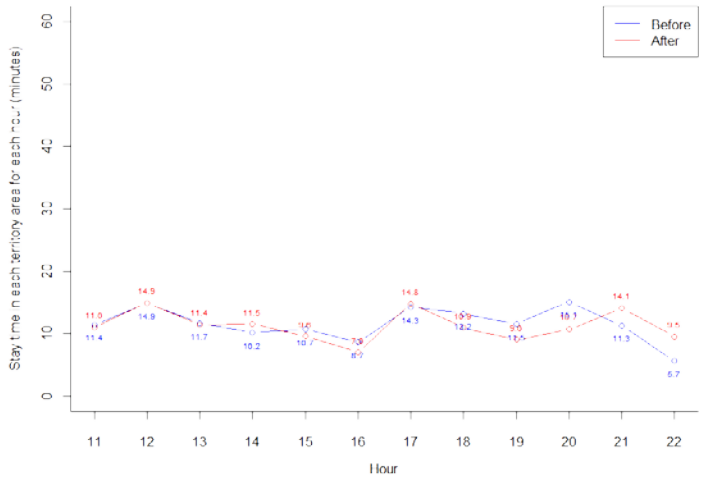

Figure 6. Stay time of waiting staff in territory areas (minutes / hour).

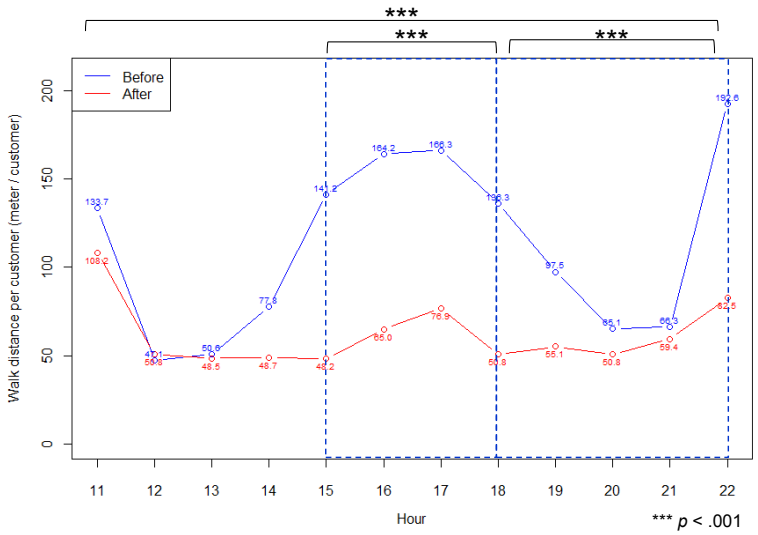

Figure 7. Walk distance of waiting staff per customer (meters / hour / person).

Evaluation for the action 2: "Reduce the movement"

For evaluating the action 2, we evaluated the walk distance per customer. Figure 7 shows the walk distance per customer for each hour. We found several significant differences in the following time categories: through whole day (11 a.m. to 11 p.m.) (U=1631, n_1=64, n_2=90, p < .001, two-tailed), in the tea time (3 p.m. to 6 p.m.) (U=41, n_1=15, n_2=23, p < .001, two-tailed), and in the dinner time (6 p.m. to 11 p.m.) (U=118, n_1=23, n_2=27, p < .001, two-tailed). Means and SDs for each term are 103.7 (60.6) and 61.6 (32.1) through the whole day. We found that the waiting staff reduced their movement in the second term.

Evaluation for the action 3: "Keep your position"

Figure 8 and Figure 9 show the precision and the recall of order taking of waiting staff for each term. In Figure 8, waiting staff are scattered over the plane. Meanwhile in Figure 9, waiting staff are plotted at the upper-right area where both of the recall and the precision are high. Although there was no significant differences, we found that there is a tendency of the movement of positions in the recall and precision plot.

Means and SDs on the recall for each term are .66 (.24) and .60 (.21). For the precision, means and SDs for each term are .61 (.37) and .74 (.27). We can see the increase of the precision. On the F_1 value, means and SDs for each term are .58 (.25) and .67 (.18). Although the F_1 value increased, there was no significant difference.

DISCUSSION

From experiment results, we found that the QC circle members succeeded to improve their processes by achieving some of actions.

For the action 1, we consider that this action was not achieved because there were no significant differences on the stay time in dining areas (see Figure 5) and the stay time in territory areas (see Figure 6).

For the action 2, we found a significant difference on the walk distance per customer between two terms (see Figure 7). The mean of this metric was decreased from 103.7 to 61.6 which was a significant difference (U=1631, p<.001). This indicates that waiting staff achieved this action.

For the action 3, we confirmed the change of positions in the recall and the precision plot between two terms (see Figure 8 and Figure 9). Although we could not find significant differences on the recall and the precision between two terms, this result suggests that waiting staff kept their positions in the second term. We can guess that waiting staff did their work with less effort by keeping each position in the second term.

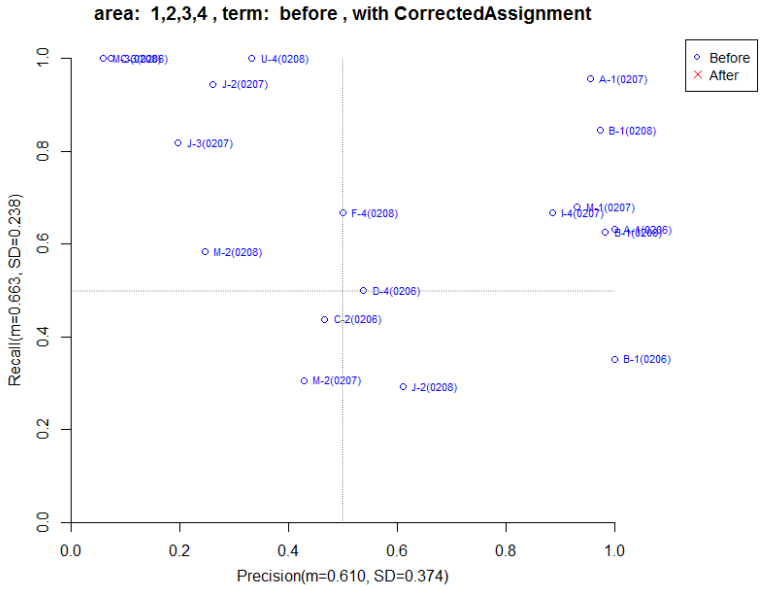

Figure 8. Precision and recall in the first term.

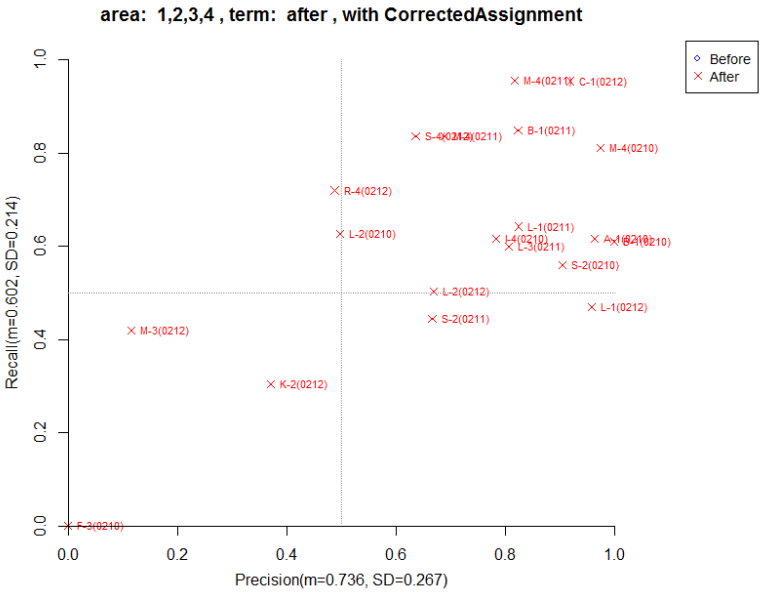

Figure 9. Precision and recall in the second term.

Based on the recall and precision plot, we consider that we can estimate the skills of waiting staff by using the recall and the precision values. Figure 10 shows the idea of the skill estimation by using the recall and the precision plot. We consider following four classes of skill: (I) Novice, (II) Beginner, (III) Proficient, (IV) Expert.

The class names are based on the classification of skill acquisition stages proposed by Dreyfus (S. E. Dreyfus and Dreyfus, 1980). They proposed the following stages on the skill acquisition: (1) Novice, (2) Competence, (3) Proficiency, (4) Expertise, and (5) Mastery. Among these stages, we adopted four stages.

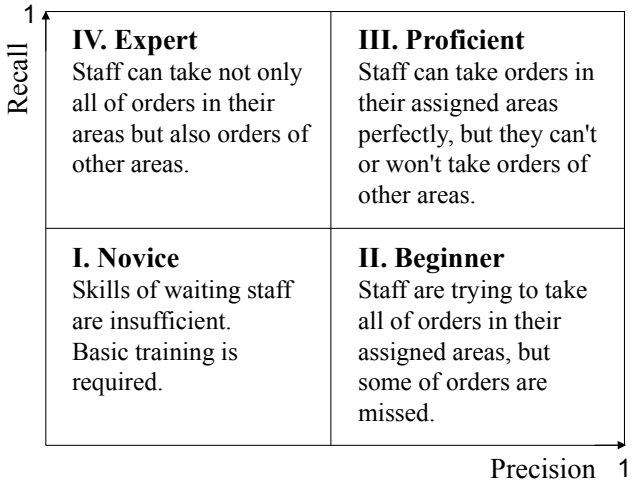

Figure 10. Relation between skill level and the recall and the precision plot.

The novice class has a property that both of the recall and the precision is low. This means that the staff failed to take orders in her area (i.e., recall decreases) and takes orders in other areas (i.e., precision decreases). For waiting staff in this class, basic training is required to keep her position.

The beginner class has a property that the recall is low and the precision is high. This means that the waiting staff is trying to take orders in her area (i.e., precision approaches 1.0) but failed to take some of them (i.e., recall

decreases). For waiting staff of this class, appropriate support by senior staff would be needed.

The proficient class has a property that both of the recall and the precision is high. This means that the waiting staff can take all of orders in her area perfectly (i.e., recall approaches to 1.0), but she does not take orders in other areas (i.e., precision approaches to 1.0). For keeping each territory, waiting staff who belong to this class is better. From the viewpoint of skills of waiting staff, this might not be better because the development of her skill is stopped because she does not care about any orders in other areas. If she takes orders in other areas, her skill might be developed towards the class IV.

Finally the expert class has a property that the recall is high and the precision is low. This means that the waiting staff can take all of orders in her territory area (i.e., recall approaches to 1.0) and she can take orders in other areas (i.e., precision decreases). Waiting staff of this class can be said an expert because they can take all of orders in her assigned area and orders in other areas additionally. In this experiment, waiting staff of this class appeared in the first term but disappeared in the second term (see Figure 8 and Figure 9). For averaging the workloads of waiting staff, this strategy is better.

We consider that skills of waiting staff can be developed from class I to class IV. Although this is a hypothesis, we will verify this hypothesis in the future work.

CONCLUSIONS

We described experiment results of CSQCC in a Japanese cuisine restaurant. We had an experiment in the restaurant to assist its QC circle by using the human-behavior sensing and visualization tool. From this experiment, we found that our suite supported the members to identify issues in their work and decided actions to resolve them. They suggested the main theme of the QC as "*keep positions*" and decided several actions to achieve the theme. Experiment results revealed that the walk distance per customer decreased in the second term which correcpods to the achievement of the action 2, and the recall and the precision plot changed which corresponds to the achievement of the action 3. From these results, we conclude that members achieved their theme. Finally we proposed an approach to estimate skills of waiting staff by using the recall and the precision plot. Our future work is to verify whether skills of waiting staff develop from class I to class IV.

ACKNOWLEDGMENT

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APPENDIX

Area assignment and shift schedule of the restaurant

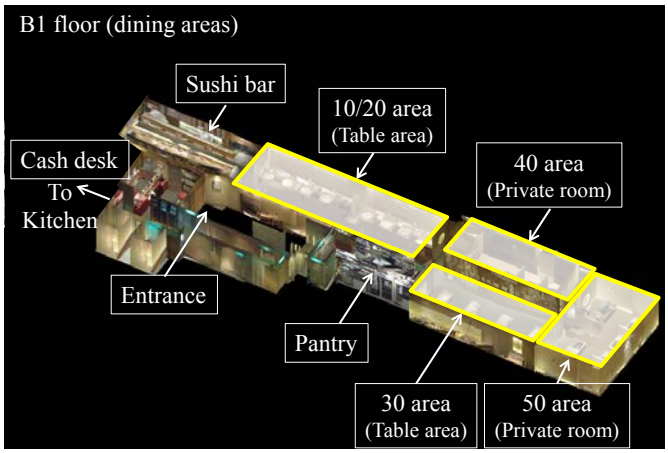

Figure A.1. An overview of the restaurant (B1 floor). There is a sushi bar, two table areas, and two private rooms. There are four positions (territory areas) to keep: 10/20 areas, 30 areas, 40 areas, and 50 areas. One staff is allocated to one of these areas (see Table A.1).

Table A.1: Shift table of the restaurant in the experiment term (February 6 to 12, 2012).

	Before								After					
	Feb 6 (Mon)		Feb 7 (Tue)		Feb 8 (Wed)		Feb 9 (Thu)		Feb 10 (Fri)		Feb 11 (Sat)		Feb 12 (Sun)	
Area	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
10/20	A	B	A	M	B	B	A	K	A	B	B	L	L	C
30	C	F	M	J	M	J	N		S	L		S	K	L
40	C			J	M		O			F	L		M	
50	D		I		F	U	I	F	I	M	M	M	S	R

Note. The schedule is manually corrected so that adequate staff is allocated to each cell based on the original schedule and the POS data. Letters "A" to "U" in the table indicate IDs of waiting staff. "Day" indicates the shift which begins at 11 a.m. until 5 p.m. "Night" indicates the shift begins at 5 p.m. until 11 p.m.

Figure A.1 shows the overview of the B1 floor of the restaurant. The B1 floor has one sushi bar, two table areas (10/20 and 30 area), and two private rooms (40 and 50 areas). We call these areas *dining areas*. For waiting staff, there are positions (*territory areas*) to take charge of. Figure A.1 also shows territory areas. One staff is allocated to each territory area. Table A.1 shows the shift schedule of the restaurant indicating who keeps which position.

Proposal of Quality Study for Nursing-Care Service

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ABSTRACT

Quantitative measurement of service process and service quality are necessary to evaluate the service productivity. We have measured employee behaviors at nursing-care facilities using the time and motion study, and visualized their nursing-care service processes. However, we have not assessed the service quality. Therefore, this paper describes development of a service quality model and a measurement system for it in nursing-care services. We examined a nursing-care facility and assessed employee consciousness related to service quality using interviews and questionnaire surveys to develop service quality model. We then proposed a quality study for methods of measuring service quality, along with prototype software developed for the quality study.

Keywords: Service engineering, Nursing-care service, Service process, Quality, Measurement

INTRODUCTION

Nursing-care services are provided in Japan as facility care services, home care services, and day services. The facility care services are provided at nursing homes where elderly people live. Home care services are provided at individual homes of elderly people. Day services are provided at nursing facilities that elderly people visit. At nursing care facilities, employees such as care workers, nurses, and care managers provide nursing-care services according to care plans designed to meet residents' physical and mental conditions and needs. In addition, they have heavy physical and mental workloads because of limited human resources. Hence, they must improve service productivity to fulfill residents' satisfaction and reduce the workload.

The service productivity is defined as the ratio of input resources to provide service and the additional value provided to the customer. It is expected to be increased by the improvement of operational efficiency and additional value or by creation of new business (Research Group on Innovation and Production of Service Industry, 2007). We considered that the additional value included factors to increase customer satisfaction such as quality, safety, and security of nursing-care service, and that the resources were employment and management cost. Improvement of service quality while maintaining costs is one means to improve the service productivity in nursing-care services.

However, traditional evaluation of service quality has not been based on engineering methods but on the inspiration of managers or employees involved in nursing-care services because service quality includes many subjective factors. The authors inferred that a measurement system of service quality would be useful to improve the service productivity. Therefore, this study was undertaken to develop a service quality measurement system. As described in

this paper, we propose a service quality model and a service quality measurement method.

PREVIOUS WORK

The authors previously defined service processes as a flow of humans, objects, information, tools, time, and money in the service field, and also defined nursing-care service processes. The nursing-care service process indicated when, where, who, what, and to whom the employees acted. We developed a task classification for nursing-care services and a description of nursing-care service processes using a state transition model to visualize the nursing-care service process and to support the improvement of service productivity. Figure 1 presents the task classification structure for nursing-care services. We measured employees' behaviors at nursing-care facilities using a time and motion study, and visualized their nursing-care service process. We confirmed that visualization was effective for quantitative feedback, and evaluated the nursing-care service process (Miwa et al., 2012) (Miwa et al., 2013). Additionally, we are continuing development of a communication enhancement system to support the improvement and design of a nursing-care service process (Watanabe et al., 2013).

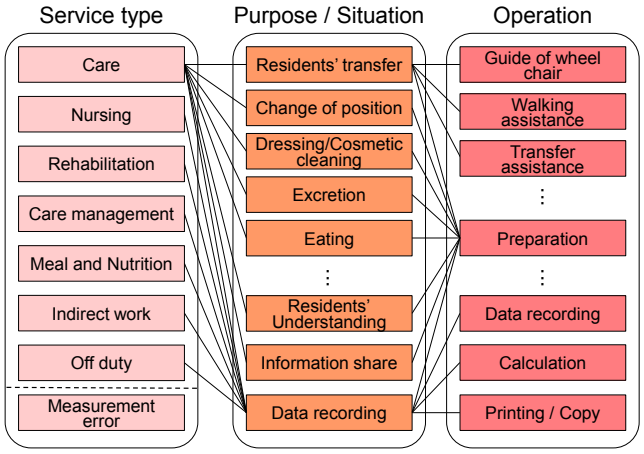

Figure 1. Three-layer structure of task classification for nursing-care service.

SERVICE QUALITY MODEL

Service Quality

In the field of manufacturing, productivity is defined as the ratio of production value and production cost calculated using the number of employees and their working hours. The production value would not vary if the amount of production remained constant. Accordingly, reduced working hours would be effective to increase productivity.

However, in the field of services, the concept of productivity is extended, and service productivity is defined as the ratio of additional value provided to a customer and input resources to provide services. Nursing-care services provide many services such as walking assistance, meal assistance, excretion assistance, health management, medicine management, and rehabilitation. The additional value of the nursing-care service is created by provision of appropriate service by service providers such as care workers and nurses to service receivers such as elderly people and facility residents. In addition, uniform services do not satisfy service receivers because their physical and mental condition are individualized. Optimization to their condition is necessary to increase their satisfaction. Therefore, we defined service quality as adequacy of service provided to the service receivers, and inferred that service quality is proportional to the additional value created in the service.

Moreover, the additional value varies according to the employees' skill and assistance procedures even if the provided service is the same in the nursing-care service. The service productivity does not increase when the additional value is decreased by reduction of the resources. In the worst case, service productivity decreases and becomes trapped in a negative loop because of emergent difficulties related low service quality.

Therefore, modeling and measurement of service quality and input resources are necessary to evaluate service productivity of nursing-care services. As described in the previous section, we measured nursing-care service processes with the time and motion study. This work contributed to the evaluation of input resources. However, we have not measured how employees provided their services and developed the service quality model.

Modeling of Service Quality

We examined a health institute on long-term care for the aged "Wakouen", located in Nanao, Japan. We interviewed two care workers to survey differences of service quality among employees. They responded that large differences prevailed in terms of meal assistance and excretion assistance among employees. Especially, the meal assistance had the features shown below.

* Meals are pleasurable for elderly people.
* Employees have longer contact with elderly people during meal assistance than during other services.
* Employees must check more points when providing meal assistance than during other services.
* Employees have higher awareness of meal assistance more than of other services.
* Elderly people face a risk of death or injury in case of aspiration.

Providing high-quality meal assistance service increases satisfaction of elderly people. Moreover, meal assistance constitutes an important nursing-care service. Therefore, we chose to develop a service quality model for meal assistance from among many service that employees performed.

Quality of Meal assistance

We interviewed a care worker, a nurse, and a managerial dietician, all of whom were key persons related to meal assistance. Based on their responses, we developed a meal assistance service quality model. Results for meal assistance showed 28 important points related to service quality from the care worker, 14 points related to the nurse, and 30 points related to the managerial dietician. We extracted 11 categories and 43 service quality factors composing meal assistance service quality, as shown in Table 1.

Subsequently, we surveyed employee attitudes using a questionnaire. Employees chose items practicing daily meal assistance from the service quality factor of meal assistance. 66 employees giving meal assistance to the facility residents answered the questionnaire as shown in Table 2. Figure 2 shows response rate of each service quality factor of meal assistance. We inverted the response rates of factors 7, 8, and 26 which were negative questions. The average quantity of responses for an employee was 32.4 (SD: 6.35), the average quantity of responses for a service quality factor was 49.7 (SD: 11.9). The average response rate was 75.3% (SD: 18.0%).

Consideration

We assessed the relation between the service duration and the average response rate. Then, the average response rate showed a linear increase with the service duration, as shown in Figure 3. Longer-term employees were able to practice more service quality factors in daily work. The correlation coefficient between service duration and the average response rate was 0.92. The regression model is shown as equation (1). Its coefficient of determination R^2 was 0.844.

$$y = 0.978x + 68.0 \quad (1)$$

x: service duration year
y: average response rate %

However, not all factors were proportional to service duration. Results showed that short-term employees got a high response rate of some service quality factors. We calculated the mean and standard deviation (SD) of the response rate. Service quality factors with high mean value had low SD. Those with low mean value had high SD, as shown in Figure 4. We classified them into two groups using discriminant analysis. Group 1, including 28 factors, had a high mean value and low SD. Group 2, including 15 factors, had a low mean value and high SD.

Table 1: Service quality factors of meal assistance

ID	Category	Service quality factor in meal assistance
1	Before meal	Do vocal exercises before meals.
2		Communicate with the resident before meals.
3		Devise ways of meal serving to increase the resident's motivation to take meals.
4		Check to confirm that a resident has finished to take medicines before meals.
5	Choke	Count resident's choking during meals and record the number.
6		Mind that the resident does not choke during meals.
7	Eating speed	Boost eating speed to finish the meal assistance on time when you are busy.
8		Hold the next food served on a spoon in front of the resident's mouth to maintain eating speed.
9		Reduce eating speed when residents are sick.
10	Posture	Check the wheel chair and bed angle before meals.
11		Adjust the wheel chair and bed angle according to resident's health condition.
12		Adjust the wheel chair and bed angle to avoid bending the resident's jaw backward during meals.
13	Meal condition	Check to confirm that morsel of food are suitable for the resident.
14		Check to confirm that meal conditions are suitable for the resident.
15		Check to confirm that meal conditions are suitable for the resident's health condition.
16	Assistance way	Do not continue meal assistance when residents cannon eat because of sickness.
17		Follow doctor or nurse instructions related to resident posture and morsel of food.
18		Change the eating order according to residents' preferences.
19		Do not look away, but hold eye contact with the resident during meal assistance.
20		Check the resident's facial expressions during meal assistance.
21		Do not mix pureed foods on a dish.
22		Give the next food portion after confirming that no residue remains in the resident's mouth.
23		Try an original mode of meal assistance according to residents.
24		Communicate with the resident to create a pleasant atmosphere during meal assistance.
25		Provide meal assistance service in the same way to the same resident, even if employees are not the same.
26		Try to give food to the greatest extent possible to get proper nutrition even if a resident feels bad.
27	Resident's condition	Evaluate the resident's health condition from their facial color, eyes, vital signs, stomach pains, and appetite.
28		Memorize the resident's likes and dislikes.
29		Check the resident's motivation for meals.
30		Provide a comfortable environment for meals.
31		Check the resident's fatigue during meal assistance.
32		Detect residents' attitudes about meals from their facial expressions and comments.
33		Try to give residents a good experience during meal assistance.
34	Information share	Hand-over what you notice when a resident's condition shows something unusual.
35		Give advice to other employees when you notice that their meal assistance practices are dangerous.
36		Provide meal assistance service after completely understanding all of the resident's information such as the doctor's instructions and handing-over.
37		Inform doctors or nurses when you notice that morsel of food, food condition, content of meals, or eating speed are unsuitable for a resident.
38		Confirm the resident's information at the nurse station when you forget the information.
39		Inform the resident's condition to nurses for their diagnosis when you notice that the resident's swallowing speed is slower than usual.
40		Inform the resident's condition to nurses for their diagnosis when you notice residents choke more than usual.
41		Confirm resident's information at the nurse station when you wonder about the mode of meal assistance.
42	Oral care	Do oral care after meals.
43	Family needs	Provide meal assistance service in a manner most consistent with family wishes.

Table 2: Survey conditions related service quality factors of meal assistance

Service duration	Job category							
	Care worker	Nurse	Care manager	Physical therapist	Occupa-tional therapist	Manage-rial dietician	Unknown	Sum
< 1 year	4	1	2	1	0	0	0	8
1 - 3 years	12	2	0	0	2	1	1	18
3 - 5 years	4	2	0	2	0	0	0	8
5 - 7 years	7	1	0	0	1	0	0	9
7 - 10 years	4	3	0	0	0	1	0	8
10 - 15 years	3	2	0	0	1	0	0	6
15 - 20 years	2	1	0	0	0	0	0	3
20 years <	4	2	0	0	0	0	0	6
Sum	40	14	2	3	4	2	1	66

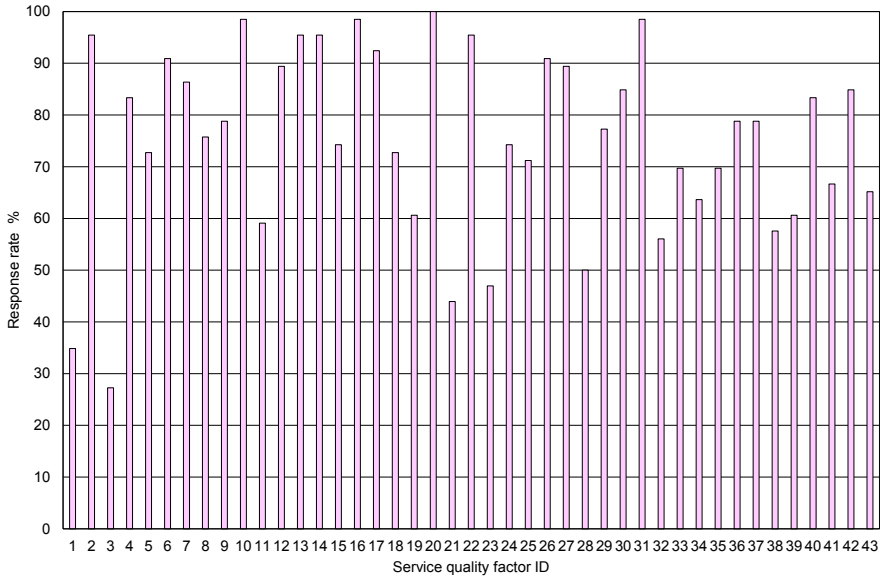

Figure 2. Survey results of response rate about service quality factors of meal assistance.

Figure 5 shows the relation between average response rates of each group and service duration. Group 2 increased the average response rate according to service duration more than Group 1. We assumed that all employees could practice the service quality factors in Group 1 irrespective of the service duration and that the factors should be provided to residents as usual services. We named it “Fundamental Quality (FQ)”. However, we considered that employees experientially acquired service quality factors in Group 2, and that the resident’s satisfaction was increased by providing the factors in Group 2. We named it “Experimental Quality (EQ)”.

As explained above, results showed that the service quality in meal assistance consisted of 43 service quality factors classified into two groups: FQ and EQ.

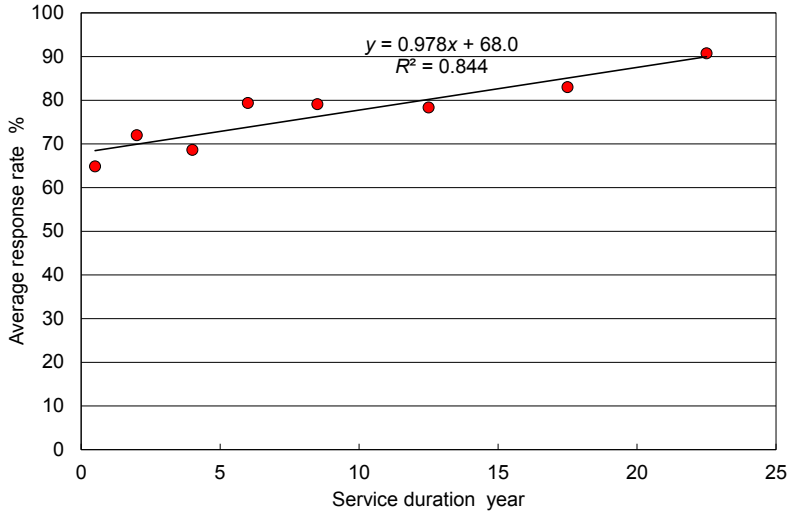

Figure 3. Relation between service duration and average response rate.

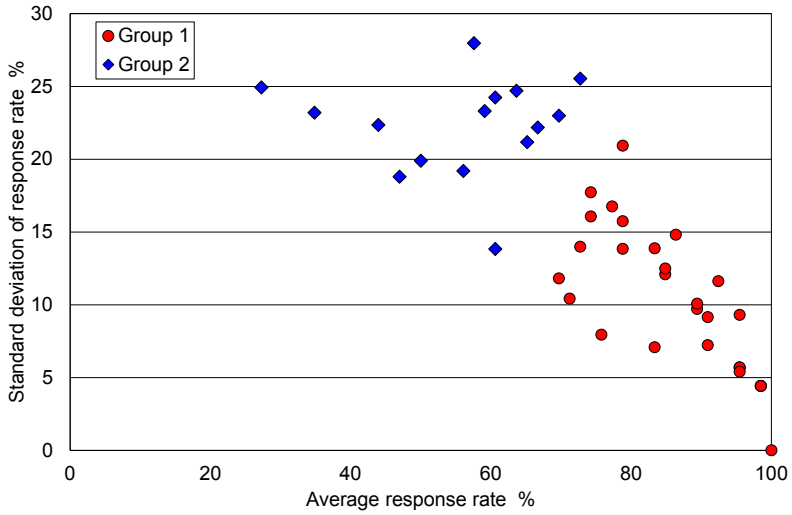

Figure 4. Average and standard deviation of response rate.

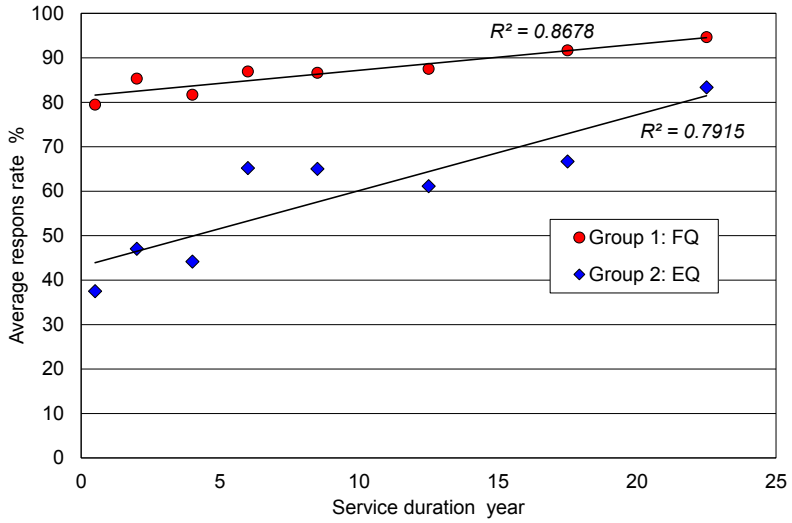

Figure 5. Average response rate of fundamental and experimental quality.

QUALITY STUDY

Proposal of Quality Study

To measure nursing-care service quality, we proposed a "quality study" by extension of the time and motion study used for our measurement of nursing-care service process.

The time and motion study is defined as "the observation and analysis of movements in a task with emphasis on the amount of time required to perform the task." A continuous measurement method or work sampling method is generally used for the time and motion study. The subjects' behaviors are assessed through observation by a third person or by self-reporting of the subjects (Pigage et al., 1954). Similarly, the quality study assessed the subjects' service quality through observation by a third person or by self-reporting of the subjects.

In addition, service quality should be classified to standardize and compare the service quality similar to task classification for nursing-care services. We regarded service quality factors as applicable for the classification of service quality. For example, when we would like to measure the service quality of meal assistance, we can use the service quality factors of meal assistance proposed in the previous section. And, we observe and evaluate the employees' FQ and EQ.

In the future, we expect to conduct continuous measurement for use in a quality study and for applications to employee training, as well as service process evaluation, by comparison of service quality among employees.

Development of proto type software

We considered not only that quality study but also time and motion study should be conducted and that overlapping visualization of their results was effective for deep evaluation of the service productivity. Nevertheless, it is difficult to record both quality study and time and motion study simultaneously in notebooks because employee behaviors in nursing-care service change quickly.

Therefore, we developed prototype software to support both quality study and time and motion study. Figure 6 presents a screen image. The prototype software runs on iOS (iPod touch, iPhone, and iPad, Apple Computer Inc., USA) and was released from the AppStore (Apple Computer Inc., USA). We were able to input free description as comments and service type, select service quality, location, and behavior from predefined lists. The "Start and Stop" button recorded the employee state and time. We were also able to measure two conditions or two employees in parallel using individual clocks implemented inside the software.

We will conduct the quality study and the time and motion study using the prototype software in the service field. Then, we will evaluate its efficiency and usability.

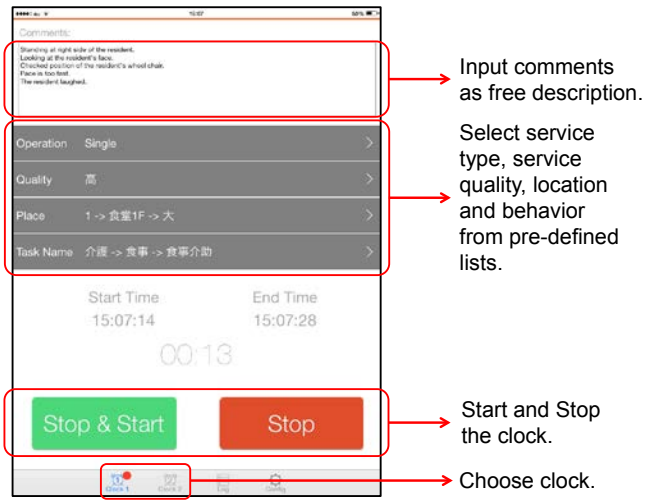

Figure 6. Prototype software to support quality study.

CONCLUSIONS

As described herein, we surveyed employees' attitudes related to service quality using interviews and questionnaires administered to employees at a health institute on long-term care for the aged: "Wakouen". We proposed a service quality model for meal assistance consisting of 43 service quality factors classified into two groups: Fundamental Quality (FQ) and Experimental Quality (EQ). FQ was acquired irrespective of the service duration; EQ was acquired from experiments. Additionally, we proposed the quality study as a method of measuring service quality, and proposed development of prototype software to conduct quality study and time and motion study simultaneously.

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Big Data, Analytics, and the Human in the Middle

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ABSTRACT

Big data and the analysis of that data is being marketed as the next big opportunity for "innovation, competition, and productivity" according to McKinsey and Company. The primary focus of the Big Data opportunity has been on the value of Big Data to businesses that can is achieved through augmenting businesses and government's ability to better understand their customers and the product and services "needs" of those customers. This understanding provides the opportunity to springboard the development of new products and to deliver focused advertising to specific groups of consumers and businesses. The analysis of Big Data is seen as the mechanism that is the catalyst in the development of new, robust customer behavioral models and the discovery of as yet hidden behavioral trends. This paper, however, will focus on the issues related to the human factor in this new data frontier specifically providing a review of the psychological and legal challenges created as a function of the consolidation and analysis of what have historically been disparate data sets. Data storage, data processing, data security, and privacy will be discussed in the context of their impact on corporate and government policy making and the present and future impacts on the human who is both the marketing focus and owner and creator of the resources vital to Big Data. Finally the role that service science can play in shaping the services that are and will be created by Big Data.

Keywords: Big Data, User Experience, Service Science, Security, Privacy

INTRODUCTION

The term Big Data is used to describe the collection of large and potentially complex data sets containing both structured and unstructured data into commonly accessible data sets. It has been described to have the potential to be as important to business and society as internet is today. Big data represents the technology that can support the aggregation of a data that was traditionally stored in siloes, organized around specific applications (business transactions) or tasks (content search) and typically stored in relational data bases or file systems located within the companies data center. Access to these traditional data sets was optimized around specific transactional uses such as business transactions (tasks). Big data has to potential to aggregate a large number of these transactional or task oriented data sets into a single ubiquitous access point where behavioral and statistical analysis techniques can be applied uncover new behavioral patterns and market segments. With the advent of cloud technologies, specifically cloud storage, it has become cost effective for companies, governments, and other organizations to store large volumes of unstructured and semi-structured data "the cloud", typically in off-premise and often times off-country, data centers. The extension of the storage of this data outside of the tradition corporate IT sphere of control and has introduced a number of significant security and privacy issues for consumers (humans), companies, governments, and service providers (Wood, 2014).

The change Big Data could introduce can be explored using traditional banking systems as an example. A bank typically stores customer's transaction information in a relational data base in their data center. The bank uses this information to maintain customer identification data and track financial transactions. This information can be used to provide its customers with transaction history and to ensure compliance with governmental banking regulations. This data was proprietary to both the customer and to the bank and therefore not accessible outside the specific use that it was intended and banks did not have access to a customer's data or activities in other financial institutions. Using the available information a bank is able to assess a customer's current accounts and determine if there other products the bank has that it could offer. The bank is limited in their ability to develop a complete picture of a customer's current financial positions or banking activities through other financial institutions. The application of Big Data provides the potential for financial institutions to begin to share customer information in a cost effective way. Current laws, as well as technologies, prevent institutions from these activities without customer consent, however, these laws as well as technologies are changing. The complexities and as yet unanswered questions in the areas of privacy and data ownership leave open the opportunity for the sharing of information to become a reality. Consider how many internet users do not consider the privacy and terms of use statements that they click through when signing up for services. Without careful scrutiny on the part of the user or strict government laws and policies to limit such data aggregation there is the potential for people to unwittingly giving consent to activities and they would never consent to if they understood the ramifications. Enabling business to understand the motivation of a person's actions, financial or other, through analysis of aggregated behavior puts that person at a disadvantage if the person enters into a relationship with an unscrupulous company. Clearly there is a need to protect against this behavior through education, law, and governmental policies.

The marketing of Big Data to large companies and the potential for financial windfall and competitive advantage is demonstrated in an excerpt from an invitation to a corporate breakfast briefing sent out by a Big Data consulting firm:

> "Big Data sources are compelling organizations to create their competitive advantage by uncovering new ways to engage with customers, new revenue streams and go to market channels. Explosion of new data sources is enabling organizations to deliver personalized insights to customers that were not previously available."

The corporate marketing of Big Data and the analysis is growing in intensity and has been touted as the next big opportunity for "innovation, competition, and productivity" in business according to McKinsey and Company (Manyika, 2011). The initial focus on Big Data has been primarily in two areas: 1) Efficiency and 2) Security. Efficiency in the Big Data context is manifested through enabling businesses and governments to become more effective in acquiring, retaining, and servicing customers. The issue of security encompasses concerns with data protection, organizational and personal privacy, and data sovereignty. The primary perspective of the ongoing work has been that of the corporation, associations, and government focusing on legal and ethical issues as they pertain to them. This paper will explore Big Data from the perspective of the human in terms of the issues that impact them and how service design and service science can shape the future of how users and service providers navigate the complexities of Big Data.

THE BIG-AGGREGATED DATA DIFFERENCE

One of the core tenants of Big Data is the aggregation of data from various large data sources consisting of both structured and unstructured data into a single repository that can be used to identify trends and patterns in behavior, behavioral models, and data visualizations. This potential value of data aggregation is not new to science; Charles Minard (1869) designed charts that demonstrated the value in the mid 1800's that are still discussed and admired today. Minard's graph of the decreasing size of Napoleons army during its march to Moscow and back (Figure 1) is a canonical example of his work. In his graph Minard overlaid the size of Napoleon's army on a map of the route and included a temperature table to provide a visualization of the interrelatedness of the different measures. To construct this visualization Minard had to manually access this data from a number of different unstructured data sources and combine them into a single graphical representation.

The aggregation and consolidation of different data sets continues to the creating interesting and enlightening data visualizations. Von Worley's (2009) depiction of the distance to nearest McDonalds in the contiguous United States demonstrates the ease of which large data sets can be obtained and visualized. Von Worley obtained physical

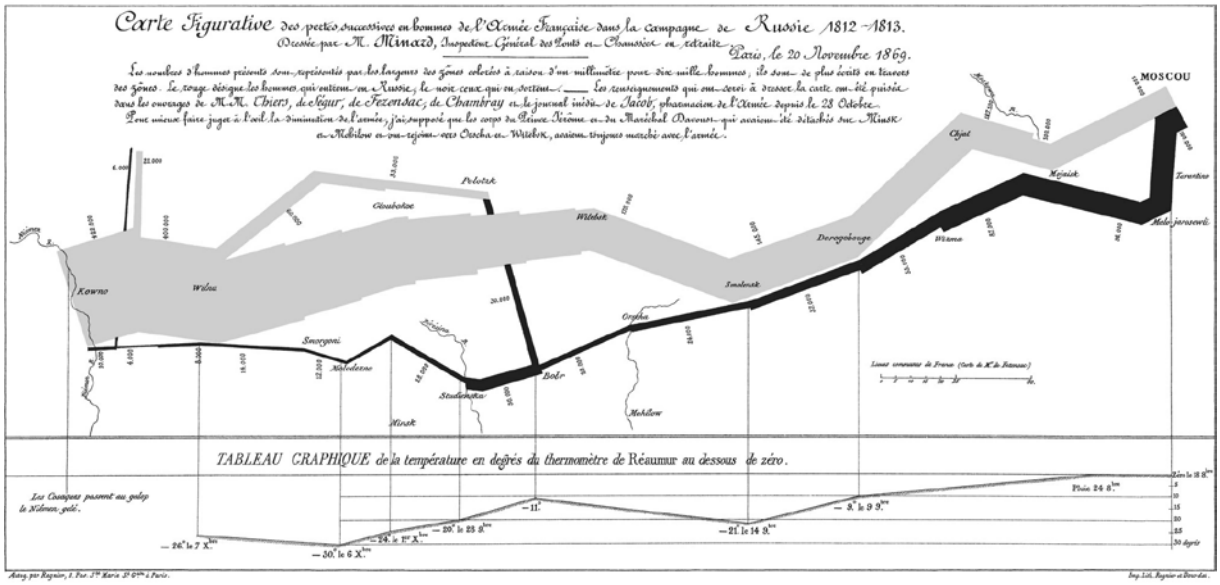

Figure 1. Charles Minard's 1869 chart showing the number of men in Napoleon's 1812 Russian campaign army, their movements, as well as the temperature they encountered on the return path. (1869).

location data from AggData, a data service provider that specializes in collecting data from various public resources and consolidating it into a single data set (AggData lists ~2,500 location data sets on their website for businesses ranging from banks to hospitals to movie theaters). In his graph Von Worley augmented the location data with the distance that a reasonable person might drive to dine at a McDonales. This visualization may give comfort to those addicted to McDonald's fast food, an insight into America's problem with obesity, and serves as a demonstration of the ease in which large data sets are available and the techniques that can be applied to the data to demonstrate a theme.

The availability and breadth of Big Data sets will enable the application of new or non-traditional analysis methods. One sure method, Mosaic Theory which holds that individually innocuous pieces of information, when combined with other such pieces of information can result in a composite - a mosaic – producing a clearer concept that when the information is viewed separately. Used for some time in the intelligence, legal, and investment fields, this approach is being applied to address public policy issues. Mathew Connelly of Columbia University is directing a project to identify the inherent bias in declassified information from the United States government. The project called "The Declassification Engine" employs data mining techniques to evaluate public records of publicly release, form secret government consolidated from multiple sources into a single document repository. The approach attempts to identify what the government is trying to keep secret from the public by evaluating redacted content in these documents (Garfield, 2013). The application of Mosaic Theory to the document attempts not to identify trends in government policy not simply from the information present in the data set but also from what has been removed from it with the goal of identifying what the government is attempting to be kept secret.

Technology-enabled humans produce a significant amount of data in a day, week, or year. On average it is estimated that a young adult age 18-24 sends 67 text messages a day or over 2,000 per month. In 2013 it was estimated that over 100 billion emails are sent and received each day worldwide (Radicati, 2013). Facebook, Twitter, browser histories and search engine questions, television viewing behaviors, bank and trading transactions, medical histories, voter and vehicle registrations, driving histories, etc. all add to the data that is available for capture and storage in large data repositories. Understanding the issues with what data can be stored, by whom, with what permissions, with what security, and for how long are critical to not only the development of laws and policies to provide governance but also in protecting and educating the people producing the data.

Figure 2: The Contiguous United States Visualized by distance to the nearest McDonald's

THE HUMAN ELEMENT IN BIG DATA

There are a number of factors that combine to form a human's view of Big Data and define the role human play in the Big Data universe. Privacy and Security are common topics are the focus of most Big Data laws, policies, and standards being developed. There are however other topics, with a human focus, that need to be considered in the Big Data discussion such as the monetary value and ownership of the data. This section contains information on Big Data issues as they relate to the human side of Big Data.

Privacy

Personal privacy is a first principal in addressing Big Data people-focused issues. The loss of personally identifiable information (see PII section below) through a breach in security has been sensationalized in the media which has raised awareness in the public that other Big Data issues do not have. Breaches of corporate data have resulted in significant monetary, brand, and consumer confidence losses. Traditional and social medial has stress the importance of properly protecting personal information and government and standards organizations are diligently establishing and updating policies of securing personal information. Governments are increasing the enforcement of privacy laws through the creation and funding of departments focused privacy protection. Standards and government policy makes must continue to refine and update their policies as Big Data analytics evolves. The identification of what is considered private personal data is core to developing the laws and policies required to govern it.

PII: Personally Identifiable Information

The guidance provided by the U.S. National Institute of Standards and Technology (NIST), the United States agency that works with private industry to develop and apply technology, measurements, and standards, definition of privacy is purposefully vague and open to interpretation. The intent of their guidance is to establish boundary conditions within which decisions on what constitutes private information can be discussed. NIST used the term Personally Identifiable Information to identify this category of personal data. NIST identifies Personally Identifiable Information (PII) as "(1) any information that can be used to distinguish or trace an individual's identity, such as name, social security number, date and place of birth, mother's maiden name, or biometric records; and (2) any other information that is linked or linkable to an individual, such as medical, educational, financial, and employment information." (McCallister, 2010). NIST provides an extensive set of examples such as names, personal identification numbers (social security numbers, passport numbers, etc.), contact information, and also less obvious onse such as a person's place of birth, religion, weight, activities, etc. The less obvious "linked or linkable"

information are included to avoid using these characteristics to decrease the probability of using this type of information in aggregate to identify an individual.

In a research project investigating the relationship between a person's ability to manage their own anonymity effectively, Professor Sweeney of the Harvard College demonstrated the need to extend privacy protection to less obvious personal information. Sweeney and her team used data that was publically available in the Personal Genome Project (PGB) records and was able to "re-identify" 84-97% of the profiles in the PGB data base to names and contact information by linking the participants publically available profile information to public records data bases such as voter lists (Sweeney, 2013). Participants in the PGB study were able to withhold personal information from their record in order to maintain their public anonymity. Participants were cautioned that the PGP could not guarantee the confidentiality of any of the information uploaded by the participants and it was the responsibility of participant to maintain their anonymity. The researchers found that participants regularly uploaded information containing personally identifiable information including their names and addresses demonstrating that even though participants were advised of the risks associated with using the PGB data base to store their information they were unable to properly do so on their own. Sweeney has proposed additional methods to enable participants to more effectively determine their vulnerability through the use of programs that determine the re-identification exposure when postal code, data of birth, and gender are made public. The program utilizes the three demographics and searches through lists readily accessible in public records and demonstrates this exposure to participants.

Anonymity

Anonymity, the act of remaining publically unknown, and control over it is an important aspect of a person's life particularly when it comes to navigating the internet. Anonymity is becoming increasing more difficult to maintain as more internet sites are requiring PII information from users in order to utilize a provided server or to obtain "registered" user access to services they provide. When presented with the decision to provide this information people must weigh the risk to benefits of this information. Site sponsors are producing extensive Terms of Use and Privacy policies that users must accept during registration. Design to address the potential users concerns about anonymity protection and security it is uncertain how this content corresponds to those concerns. Issues of trust, site ownership, data security, and concerns over how the provided information will be used as well as the lack of oversight and penalty if it is inappropriately used are common. Article 17 of the new European Union General Data Protection Regulation includes a provision that will give people the "right of erasure" (renamed from the previous term 'right to be forgotten') that has been proposed to address some of these concerns. Under the article people are granted the right to request the "erasure" of personal data relating to them, including links to, copies and any replications of private data provided to a third party. Ensure people have the ability to erase their personal information is a significant first step, the next logical issue is assisting them in tracking the businesses they have provided it to in support of them removing it when they deem appropriate.

The core expectation of erasure is to assist in people in maintain the degree of anonymity the wish to maintain. The identification of what is personally identifiable information to support this removal is challenging as was demonstrated in the Personal Genome Project (Sweeney, 2013). The removable of PII data increases in complexity when data is aggregated from multiple data sources. During the data consolidation process the source of the information along with the governance of its use specified during its collection is likely to be lost. The loss of "context" decreases the ability for entities using the information in the aggregated data store to abide by its original intended use. Technologies have been proposed to address the "loss of context" issue are under consideration; however, the potential impact of their application on system performance is significant and the problem becoming more pronounced as a function of the number of data sources being aggregated (Oliver, 2014).

Removal of personal data from data stores becomes further complicated due to standard data retention, backup, and archive practices (Burn-Murdoch, 2013). Burn-Murdoch noted that at any one time there can be eight or more copies of collected data in different data stores across different locations. The technology challenge is how to locate and anonymize this data when the owner initiates the request and how to demonstrate compliance with government regulations. Current data archive technology introduces additional complexity since backed up data could be stored on tape in a secure, offsite location and therefore not directly accessible.

Security

Securing Big Data, specifically PII, is a leading concern and focus for security experts responsible for protecting a company's reputation and customer's data as well as governments protecting their citizens and their sovereignty. Prior to the advent of Big Data, security standards and policies focused on securing information from breaches or

leakage stored within a company data centers. The exposure of a security breach have been well documented and sensationalized in the media, the recent Target data breach affected tens of millions of customers and will have a significant impact on Target's profits in the near term and likely in the longer term. Security research is increasing in areas such as intrusion detection in high speed networks, anomaly detection, and cryptography in response to the increasing number of cyber-attacks. Experts do not anticipate a increase, in the number of security breaches and attempts and Big Data storage will increasing become the targets of such attacks in part due to the large amount of data stored.

Organizations such as NIST in the US, the European Union, the Cloud Security Alliance, etc. have ongoing efforts to identify, prioritize, and address Big Data security issues. These organizations along with others in the private and public sectors are focusing on accessing the risk and approaches to securing Big Data collection, processing, and analysis. These efforts will in turn result in a multitude of laws, policies, standards, and recommendations. The impact on people attempting to understand the understand security issues and how to assess risk have yet to be studied. In a compilation of research on the psychology of security Schneier identifies a number of factors that interact when a person assess risk (Schneier, 2008). Schneier identifies perception as playing a significant role in human security decision making. Factors such as media coverage, familiarity, the recency effect, complexity of the risk, and the ability to make trade-offs in risk avoidance together impact how a person assess their exposure to risk and how they will respond. Combining all of these factors together at a single decision point during which a person must decide whether to share their personal information or not presents a difficult design problem for a company attempting to properly educate a person prior to engaging them in a service relationship.

Data Sovereignty

Data sovereignty laws attempt to protect the data of governments and their citizens from unlawful or illegal use. Typically these laws govern the transfer of data outside of a country's border in order to ensure the data is handled in accordance with the security and privacy laws of the host country. In addition there are laws that govern the availability and access to information stored within systems in a country (e.g., U.S. Patriot Act). These types of regulations place restrictions on the movement of certain types of data across borders, making it seemingly more difficult for a business to adopt cloud applications with datacenters located outside their home country.

Data sovereignty issues have largely been government and in-country focused. These laws are intended to protect citizens, business, and governments of that country and do not extend to citizens when they travel to other countries with conflicting or less stringent privacy and security laws. The violation of a person's home country privacy while in a different country has yet to be contested in the court systems. Can a violated citizen seek judicial judgments in their home country for the transgressions that occurred while not in their home country?

Data Collection

Securing data at the point of collection is a difficult problem to solve. Devices such as cell phones, kiosks, POS terminals, laptops, tablets, and smart watches expose people to one set of possible risk while images from security cameras, Facebook posts, tweets, etc. preset a different type of exposure. Data can be collected clandestinely, without user's knowledge or consent through a compromised sensor or network device. The value and utility of even the most mundane information is not well companies will err on the side of collecting it all since storage is cheap and it is a lot easier to throw away captured data than it is trying to capture it after an event has happened. How can we inform and advise people on securing their personally information when faced with this multitude of breach points? Would an informed person destroy their smartphone, lock themselves in their houses, and turn off their WI-FI. Establishing a balance between an informed user and the risk-rewards of utilizing service is an area where further research is needed.

Data Retention

Data retention, the period that collected data should be stored, and determining when it can or should be deleted is another complex Big Data issues. Data retention is intricately inter-linked to privacy, security, ownership, and use policies. When a consumer gives a company permission to capture and use data is there or should there be a shared agreement of the period during which that data can be analyzed and put to use. From a Big Data perspective the goal would be to never delete the data since it would be more important to have the data available to use then to have deleted it and not have it available when it might be valuable. A person on the other hand would seemingly want to have more control over how the data was used and when; along with the ability to delete it when they feel it is no longer of value to them.

Data Usage

When a person shares their personal data there is usually an expectation of how it will be used by the person or entity they are sharing it with based on the context it is provided. When a user provides their email address or name and phone number in order to register to win a free iPad, that user expects to receive some email advertisement or phone solicitation from the drawing sponsor trying to sell them something. This is an expected or assumed use by the person which could be verified by reading the fine print on the registration website. The extent to which collected information can be used for other "purposes" and the question of whether a person must give specific consent for each type of use are issues that have not yet been addressed by policy makers. The loss of usage context, like the loss of security context during data aggregation must be addressed as standards and policies evolve.

Data Ownership

"Who owns the data?" is a question whose answer impacts how the other Big Data issues are addressed. This question has gone largely unaddressed outside of personally identifiable information laws, policies, and standards. Clearly a person owns their own PII and can lend it out to businesses and governments for use. In such a situation the information is shared for a specific use with an expectation that it can and will only be used for a prescribed purpose. There is an underlying expectation that the information will either being deleted or anonymized when that purpose is served. People are most familiar with demographic and statistical data when it is aggregated with other data and presented in charges and statistics describing large groups of people. The value of a single data point in a aggregated set of data is relatively small and insignificant and is lost without the context of the other data in the set. The value of non-PII data that is continuously being collected and captured tied to a particular person is not as obvious. As more and more companies amass large data sets of business and people habits and activities, the fuel needed to run the Big Data analytics engines, which other companies will pay them for, there is clearly value to an individual's data and the right to use it. How much would a pharmaceutical company being willing to pay a person who maintains and extensive electronic medical history, including exercise regimen, and eating habits and has taken that companies prescription drug for a decade or two? Who has ownership rights to the data? Ownership of medical history is straightforward having been consistently identified as personal information. Ownership of exercise and eating habits becomes complicated if a person uses and equipment suppliers website or a free for use application to track and store that information. The ability for a person to sell the non-medical information will depend on the usage agreement they accepted when signing up to use the provided service. Creating standard agreements for these situations would enhance Big Data's access to this information and address privacy concerns for the people agreeing to them.

Data Aggregation – Big Data Security Risk

As noted above aggregating data from different data sets has the problem of losing security context. A user who provides data in one context, say to apply for a home equity loan, may not have wanted to allow that data to be consolidated with data they provided when they registered for a sweepstakes drawing to support a marketing campaign for houses for sale in Aruba.

Compliance and Assurance

Addressing Big Data security policies and standards results in another Big Data problem - oversight and regulatory compliance requires administering and reporting on data security activities. Capturing and storing information whenever protected data is access produces new opportunities for Big Data analysis. Glick (2013) postulated that in order for a business to demonstrate compliance with the laws that will eventually be enacted to support privacy and security in the Big Data space each data element that is governed by these laws will need to be tracked. Businesses will need to demonstrate that PII data is secure and has not been accessed illegally, that the data has been anonymized per owner request, and that it has been properly and completely deleted when required. This produces significant overhead to companies managing Big Data and on the companies developing Big Data tools. Glick posited that technology to address the compliance assurance problem should not be expected any time soon and when developed will not be able to address existing data stores seamlessly.

SERVICES SCIENCE AND BIG DATA

Service science, service innovation, and service design disciples have the opportunity to shape and influence how Big Data addresses these issues through establishing interface between service businesses and the people that use

them. The identification and definition of service centered interactions between users and business which data collection, usage, ownership, privacy, and security in the context of service delivery and co-creation of value (Vargo, 2008) would provide a context in which solutions can be developed. Determining the impact of Big Data on the "service-for-service exchange" and service value creation where the value equilibrium between service provider and service consumer may be disrupted by the change in service relationship. Understanding the roles and motivations of the participants in the service relationship and the development of value-in-context models is critical to addressing Big Data application to services.

Human in the Middle

There are a number of organizations that are participating in establish the direction of Big Data. Figure 3 represents these organizations and how the human is in the middle of the Big Data model of the future. Typically the human is viewed as a data source, a target for products and services, or an entity that needs to be protected. The data source is capturing how the human operates in the world which includes both the physical and the virtual.

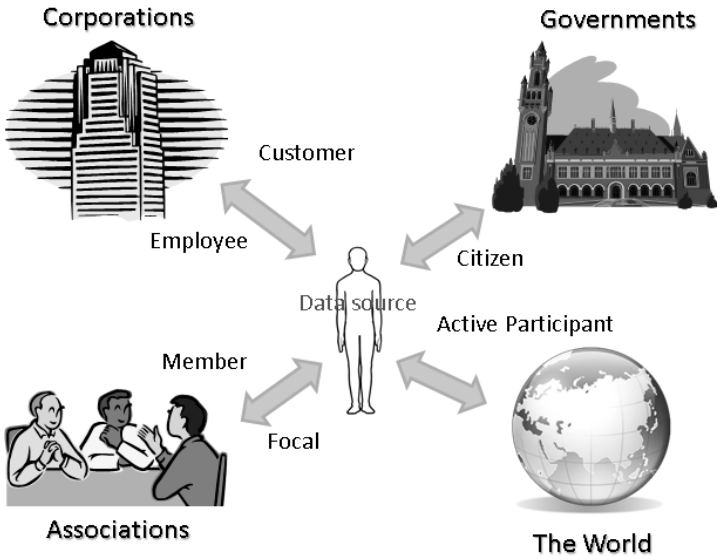

Figure 3: Human in the Middle

Government involvement in the Big Data journey is motivated by the need ensure the protection of their citizens and to protect and defend the country. Laws and policies have been and will continue to be developed that address project of citizen privacy and data sovereignty. One of key provisions of the US PATRIOT Act (USA Congress, 2001) the right to perform "searches of business records" has resulted in difficulties to many global businesses who have data center storage within the United States since this provision allows for the US government to ignore or violate the privacy of citizens of other nations. Governments are also considered one of the biggest potential sources of data that can be used to seed Big Data projects since they potential hold data sources for information for all of the citizens of a country (e.g., Welfare, Taxation, Healthcare, etc.). Since governments have been selling this data for decades it also makes sense that they want to protect this revenue source. Lastly, governments have the opportunity to put the data they already have to the benefit of their citizenry through the proactive delivery of services based on analysis of the data they already have available to them.

Corporations play multiple roles in Big Data. While can be sources of data, like humans, they will most likely be the biggest consumers of it as well. In addition, corporations need to protect themselves and their employees from unauthorized or illegal use of their data. Consequently corporation's involvement in Big Data policy and standards spans across all areas of Big Data and often times they are at odds with themselves.

Associations are similar to corporations in as a group they are involved in the creation of Big Data policies and standards and are also consumers of them, however typically the same association is not involved in both. Standards bodies focus on developing standards that address security and privacy issues while the collections of like-minded people (e.g., Cancer Society, National Audubon Society, etc.) seek to use those standards and policies to protect their members.

Humans are the basic elements of all of these organizations and are consequently differentially affected through the roles play in each.

BIG DATA IN HUMAN TERMS

In order for service systems to properly adapt to the introduction of Big Data and Big Data analytics as an extension to co-creation of value system the following human impacting issues need to be addressed:

Privacy – people engaging in services requiring the sharing of personal information will need to clearly understand what information is being collected and how it will be safeguarded. The service must provide the ability to opt-in to the use of this data for purposes other than those agreed to when the service relationship was initiated. In addition, the ability to anonymize and delete personal data once it is no longer required for the service must be provided.

Service providers will need to identify all conditions under which a person's privacy could be violated such as compliance with laws that permit access to private information in support of criminal investigations and national security concerns.

Security – service descriptions should identify the security measures that a service provider utilizes to protect collected data including the security policies and standards that are employed and the mechanisms used to ensure compliance. In addition the description should include the identification of risks to the user and what remedies that will be employed should a data security breach occur.

Ownership – an explanation of data ownership and right-to-use policies should be included in the service descriptions along with the identification of the length of time that data will be used, what will happen to the data at the end of this time period and at the end of the service relationship (e.g., deleted, anonymized).

Data Collection – identification of the information that will be collected during the use of the services and how it will be stored must be provided to the service user. This should include how the information will be collected and how the data will be used. The ability to opt-out of certain information from being collected should also be provided.

Notification - services should identify the method the user will be notified should a data security breach occur including breaches where their data was and was not affected. In addition, the method for communicating changes to the service privacy, security, and data usage policies should be identified.

Data Integration – a description of how collected data for the service will or may be aggregated into other data sets and how the user's data will be anonymized when aggregated should be included within the service description. In addition users must be given the opportunity to opt out of the having their data aggregated.

CONCLUSIONS

The purpose of this paper was to identify issues within Big Data and Big Data analytics that impact the people who own, produce, and are targets of this new wave of innovation. An exploration of the impact on big data was briefly explored and as well as areas of the research that should be undertaken to both adopt Big Data capabilities within service science. Service design and innovation have an opportunity to help shape the standards and policies being developed by governments and standards body by identifying and championing the human perspective in these efforts. There is a need for an initiative in service design and service innovation to address Big Data issues, particularly those dealing with best practices that will enable the transition from small data to Big Data.

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A Case Study: Designing the Service Experience for Big Data Discovery

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ABSTRACT

The purpose of this paper is to present early-stage results from three investigations we have undertaken to support the goal of collaborative innovation to scale discovery. This work is being conducted at IBM Research - Almaden in the recently announced Accelerated Discovery Laboratory. The motivation for this work was the need to experiment and investigate ideas of how to accelerate discovery in a real-world setting (at the very same time that we were learning what it means to "discover"). The underlying tenets borrow ideas from Service Science to build a framework for discovery in which the Participant's service experience takes place across and within technical, social, and spatial systems. In the big picture view, our goal is to be able to capture project teams' journeys through this framework and provide navigational assistance. We present results of the investigations to start identifying the resource and co-creative patterns of Participants – examining what it means to "discover" and perform work in a living lab, factors that impact information sharing by heterogeneous teams, and mapping of the service experience to establish a shared mental model.

Keywords: Service Science, discovery, cloud, value co-creation, participatory design, collaboration, framework, information sharing

INTRODUCTION

Big Data is all the rage – abundantly generated from social, enterprise, and scientific sources and presenting an invitation to explore, combine, and analyze at a scale previously unachievable. This invitation, and all that it entails, enables the discovery of patterns in the data faster than people and computation have been able to do up to now. With the emphasis on using and analyzing big data to assist in accelerating the pace of discovery, innovation, and invention we will need to re-examine the enablement of the human effort and how to support it in this new context.

The purpose of this paper is to present early-stage results from three investigations we have undertaken to support the goal of collaborative innovation in order to scale discovery. This work is being conducted at IBM Research - Almaden in the recently announced Accelerated Discovery Laboratory (henceforth "Lab")[1]. The vision of the Lab is to provide a computationally rich set of data and analytical technologies along with a physical and social environment, for research collaboration with business clients to accelerate discovery through data analytics. However, increasing the speed of discovery is not as simple as running a set of data through a specialized algorithm. Instead, it is a complex mix of human and technology interactions for a range of activities from exploration and hypothesis generation through implementation and running of enabling technologies to address a discovery challenge. Examples of discovery challenges include the application of machine learning and natural language processing algorithms to aid in the discovery of new drugs to treat and cure diseases such as cancer, Alzheimer's,

[1] http://www-03.ibm.com/press/us/en/pressrelease/42169.wss

and Amyotrophic Lateral Sclerosis (ALS; a.k.a., Lou Gehrig's Disease)[2]; and the development of a water cost index that standardizes the measure of true water costs by identifying direct and hidden costs to estimate missing cost variables using advanced analytics[3].

In this paper, we will be reporting on three early-phase activities to investigate and characterize the Lab's service experience. Findings from these investigations will be used to inform the design of human, technology, and space interaction to fulfill the vision of collaborative innovation for discovery. We begin with a background of the Lab itself, to describe its purpose and provide a picture of its technological, service, and social structure. Then, we progress through the three investigations, exploring the facets of building and working in a living lab (Pentland, 2014) and what it means to "discover", bringing together heterogeneous teams through information sharing, and mapping the service experience within the context of big data and discovery. We close the paper with a discussion of our early findings, plans, and ideas for future work, and conclusions.

BACKGROUND

The Lab is a service environment designed to facilitate research projects that deal with the most difficult and complex big data analytics issues faced by business, government, and universities. It is specifically targeted at enabling discovery through the use of data and analytics, and at enabling the subject matter experts who use the environment to focus directly on their investigation instead of the underlying hardware systems, software systems, and data curation.[4]

Discovery-as-a-Service Paradigm

The creation of the Lab is a large undertaking that includes teams of people with expertise in compute systems, software, data, and people in order to realize the formation of a Discovery-as-as-Service environment. As such, we believe that enabling deep collaboration across disciplinary and entity (i.e., business, government, university) boundaries is absolutely essential to the discovery process. Therefore, it is assumed that the formation of this environment requires the participation of subject matter experts in the areas of science, medicine, business, and society who bring the real-world challenges for which data and analytics can be applied. As one of the Lab's first Client Principle Investigators expressed it,

> *"…you know, I'm not sure how far you [the Lab] can go for a number of reasons with this big data and analytics center. There is an area where we [the Client] could probably generate a high amount of interest very quickly… and nobody here [the Client] can even come close to duplicating anything of that effort. So you [the Lab] are fully essential to doing this and on the other hand, you [the Lab] probably need a lot of help from us in figuring out how to actually go about demonstrating scientifically that it's a useful…"*

The technology system is being designed and built as a Cloud. As with other types of cloud systems, such as Infrastructure-, Software-, or Platform-as-a-Service (see Mell and Grance, 2012), the Lab's technology foundation includes a compute platform and software stack as the runtime infrastructure (similar to a Platform-as-a-Service). Unique to the Lab is access to a library of datasets, analytical tools, and models, along with tools and intelligence to access expertise and know-how beyond that of the end user's knowledge boundaries to enable a Discovery-as-a-Service paradigm.

In characterizing the Lab as a service environment, it is intended to be a setting in which both science and business can interact to explore potential solutions to solve challenges through the intersection of expertise, data, and analytics that goes beyond the purely technical notion of a cloud system and "X-"as-a-Service. Being a service environment requires actions to build a support infrastructure that includes the obvious: a compute environment that allows for the implementation and running of data and analytics (i.e., hardware systems, software systems, and the applications that run upon them). However, it also needs to be able to support the not so obvious: social and spatial systems (i.e., the manner and the set of places in which work gets done) that allow experts from different fields who use different vocabularies and have different perspectives on a particular challenge the ability to work together and accomplish a common goal. These largely invisible social and spatial systems include elements beyond what one

[2] http://www.research.ibm.com/client-programs/accelerated-discovery-lab/index.shtml
[3] http://worldswaterfund.com/wci-overview.html
[4] http://researcher.ibm.com/researcher/view_project.php?id=4903

would find in a standard cloud service environment, elements such as interaction, communication, and the potential for co-opportunity (the purposeful, and sometimes serendipitous, exploration and identification of opportunities through cooperation) to transpire through networks of people, location, and timing.

Our role is to enable a supportive human experience for the communities of people who use, contribute to, and build the environment. For the purpose of this case, the Lab "users" grossly filter into three categories of *Participant*, that of: *Partner*, which is defined as IBM employees (essentially researchers, but also employees from other IBM divisions); *Client,* which is defined as IBM customers (that is, people who are not IBM employees); and *Maker,* which is defined as the people charged with designing, building, and enabling the Lab. This is a categorization of convenience where we have sub-divided Lab users by their affiliation.

Service-Dominant Context for Discovery

The challenge we have is to design, develop, and deliver a service experience for discovery in the context of using big data. In order to do this, we needed to tease meaning from the building a compute environment and technology system rhetoric and chose to view the challenge through a service science lens. As such, we will emphasize the mutual nature of the co-creation of value, where Lab participants act jointly and cooperatively towards a common goal (Maglio and Sphorer, 2008). For example, very often, Clients share their data with the Lab so that Partners can operate on that data to tackle a challenging problem and then provide a product in the form of a report and/or analytical tool – representative of a goods-dominant model in which value creation is based on transaction and distribution (e.g., a unit of output) (Vargo et al., 2010).

However, part of the Lab vision is for there to be analytical tools and data sources that are collected and curated into libraries by the Makers and/or Partners. These pre-existing libraries then afford flexibility in partnerships with Clients to collaborate in a unifying environment on a particular analytical challenge. In this example, we provide two samples of service-dominant value co-creation: the first is the creation and keeping of libraries in which both Makers and Partners jointly participate and create assets for the Lab for future, easy access by all Participants; and the second, the affordance of business partnership models that invite and support the Client to have a direct stake in the development of a solution. This is representative of a service-dominant model in which value creation is based on relationships-of-exchange and the application of competencies by all parties involved (e.g., a process of all parties applying resources) (Vargo et al., 2010).

A Framework for Discovery

The Lab is in the midst of evolving from a traditional transactive (goods-dominant) value model to a forward-looking resource (service-dominant) value model in the way that partnerships and work is formed and enabled. For this paper, it means designing a client experience that goes beyond technical infrastructure as a service and merely delivering insight as a unit of output, to providing resource elements (such as technology and expertise) that encourages and empowers joint participation and co-creation. As a service environment, the authors have chosen to view the Lab as a system-of-systems that are distinguishable, but not separable: technical, social, and spatial. We specifically chose this characterization to be able to make use of what has been understood about the design and development of services in the emerging field of Service Science (see Kieliszewski et al., 2012, for a discussion and example).

The Participant's service experience is envisioned as seamless, taking place across and within the technical, social, and spatial systems (Figure 1). We have positioned the three systems within the context of discovery, or the "What" that is to be vested through co-creation. Discovery, on this view, is enacted as a route through this territory. Each system brings with it a set of resources, whether the resource is an algorithmic tool (technical), a team or individual (social), or a particular location (spatial), and Participant experience is represented as configurations of resources through time. Clients, Partners, and Makers interact with different patterns of resources as discovery is supported and takes place. For the Participants, the experience of the context of discovery should not seem disjoint. Indeed they may be, and arguably should be, completely unaware of certain resources that are in play for other Participants. Depending on their role, an individual's interaction with the resources will be patterned differently, depending on the specific technologies, people, and places that are engaged. Ultimately, the phenomenon of discovery is expressed as a configuration of technology, social, and physical space with a common goal of co-creation. In the big picture view, we hope to be able to map project teams' journeys through this space and to provide navigational assistance.

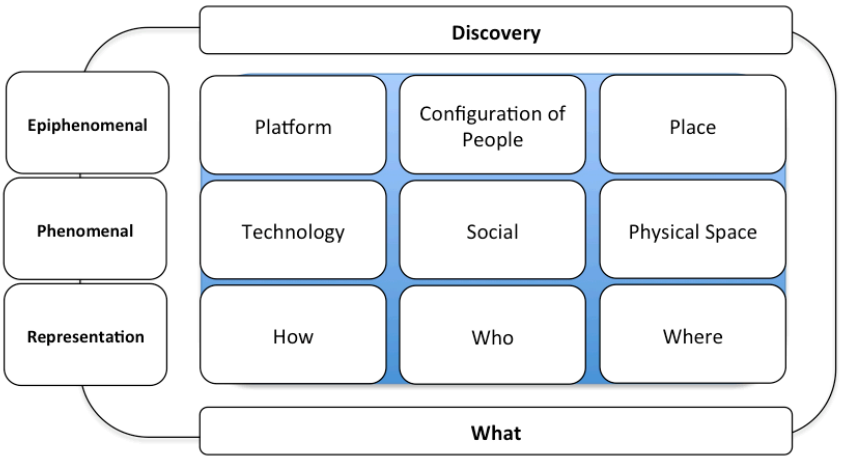

Figure 1. The Lab represented as a system-of-systems that are distinguishable, but not separable and that are representative of technical, social, and spatial elements for collaboration

The following sections discuss three early-stage investigations to explore and start to identify the resource and co-creative patterns of Participants. The first section discusses what it means to "discover" and perform work in a living lab. The second section focuses on bringing together heterogeneous teams through information sharing. The third describes mapping the service experience within the context of big data and discovery.

APPROACH

The three investigations presented here have been conducted independently, but not without knowledge of the independent threads. Each has been undertaken to study and characterize the Lab service environment, and each investigation uses participant research and participatory design techniques to engage with Lab Participants. Although the investigations have different sole purposes, their combined intent is to bring forth insight from Participant views for enabling and executing "discovery". They examine the experiential work environment that is user-centered and intended to support the co-creation of value.

What is Discovery?

As mentioned above, the Lab seeks to provide a client experience that accelerates discovery in the context of big data. From the outset, we knew that not only were there different discovery practices already in play in the larger context from which the idea of the Lab emerged, we also knew that a term such as "discovery" would already have many definitions. In an initial probe, we sought to understand what Lab Participants – Customers, Partners, and Makers – took discovery to be, broadly speaking. We began by interviewing Participants to investigate and establish an initial framework of discovery. This effort had three related purposes: to inform a next iteration of the service experience map (discussed in a following section), to inform the emerging management practices in the Lab, and to identify success factors for the three participant groups. In this paper we address findings only for the first two.

Interviews were conducted with eleven participants: five team leads of IBM research projects (Partners), five members of the Accelerated Discovery Lab team (Makers), and a Client Principal Investigator. (The latter who is part of a project that is widely viewed as a canonical example of what the Lab is setting out to accomplish.) The interviews were semi-structured allowing for ideas that arose in the course of the interview to be pursued or to probe further especially when the conversation took a turn. Each interview lasted 30 minutes and was intended to prompt reflection on their motivation for getting involved in the Lab, what counts as discovery for them and why, what matters to the business and to science, and their perspective on criteria for success.

The data consisted of management presentations, research papers, and audio recordings of the interviews that were transcribed by a transcription service. The data were coded according to topics introduced in the interviews (e.g., motivation, criteria for success). An interpretive analysis was performed, resulting in a number of themes. Among the themes relevant to this paper were (1) the breadth of views about what counts as discovery (not in itself surprising, given the fact that this was during the first year of the Lab's being actively working); and (2) the lack of awareness of who all was involved in the Lab, where they worked (in the Lab space, at Almaden (but outside of the

Lab space), or at some other IBM location), and what technological resources were visible to them. By and large some Makers talked about technology, the founders (who count as Makers) talked about the vision, and the Partners talked about the problems they had in getting started using the resources of the Lab.

Two dimensions of discovery emerged out of this analysis. The first dimension is called the *discovery maturity axis*. The discovery maturity axis characterizes the extent to which a project team (generally composed of the three types of Participant) anticipates whether there are known answers to a question or challenge at one end of the spectrum, up to not knowing if the answer to a question or challenge is even knowable at the other end of the spectrum. Thus, at one end of the spectrum there is an assumption that the answers are known and need to be found. Then as a middle area, knowing there must be answers but they are not obvious nor is the way to find them obvious. At the other end of the spectrum are the "unknown, unknowns" – where the participants do not know what they do not know (Figure 2).

For instance, in the game *Jeopardy!* (a television game show started in the US in the 1960's and still on the air today), IBM's Watson technology bested the human contestants[5]. In this game each question asked is known to have an answer. For the human contestants, it was a matter of learning and memory. For the technology there was a similar approach, machine learning and search. This is not to say that it was not exceedingly difficult for both human and computer. Interestingly, some of our interviewees viewed the Jeopardy! version of Watson not to be a case of discovery, while others were willing to include it in the spectrum. (And, due to the complexity of the game show, this version of Watson would most likely qualify somewhere between what is searchable and known, and what is not obvious but knowable on the discovery maturity axis.) This disparity in viewpoints can be seen in the following two quotes from interviewees as they reflected on what counts as discovery for the Lab.

> From a Partner (materials scientist): *They [re: Watson] could be finding things that already exist that were hard to find…but for me…it's [discovery's] suggesting new connections between things…new material [that] might be good at doing something else because you found out that it has some similar properties.*
>
> From a Partner (computer scientist): *But to me discovery is actually being able to find something you hadn't thought about. …And in some ways one can do that – Watson does a piece of that. But we've got to take it to the next step and look for and try to deduce what we haven't looked for yet and for which information is not yet available.*

In contrast to the Jeopardy! version of Watson, machine learning and natural language processing algorithms have demonstrated value to aid the research of cancer treatments as mentioned above. Yet it has been assumed by the researchers that there could be additional unidentified p53 genes (a cellular tumor antigen) that may be of oncological value, but it was not known whether they could be found using these new technologies. This is representative of being closer to the other end of the discovery maturity axis that situates more serendipitous discoveries where someone is looking for one thing and stumbles onto another. Or in the case of big data, where the algorithms detect correlations across data sets that had not been suspected to exhibit relationships, as in the spatial and spatiotemporal data mining for insight into climate change (Zhou, Shekar, and Mohan, in press).

The second dimension is called the *resource maturity axis*. This axis characterizes the maturity of resources (e.g., analytic engines, capabilities or expertise of domain experts and data scientists). This axis anchors itself at one end of the spectrum as having existing tools, technologies, and expertise already available for use. In some cases it is known at the outset that new technologies will have to be developed. Already there are cases in the Lab in which the Client and the Partner have agreed to co-develop technologies. In others, the Partners agree to develop a new technology but the Client does not participate directly – a very transactional relationship. As time passes, requirements shift. In one project the understanding of what technology would be needed began to morph shortly after an approach was defined, an agreement was made, and work started. In other cases, as with the discovery maturity axis, it is also unknown at the outset of some projects what additional assets need to be developed.

[5] https://en.wikipedia.org/wiki/IBM_Watson

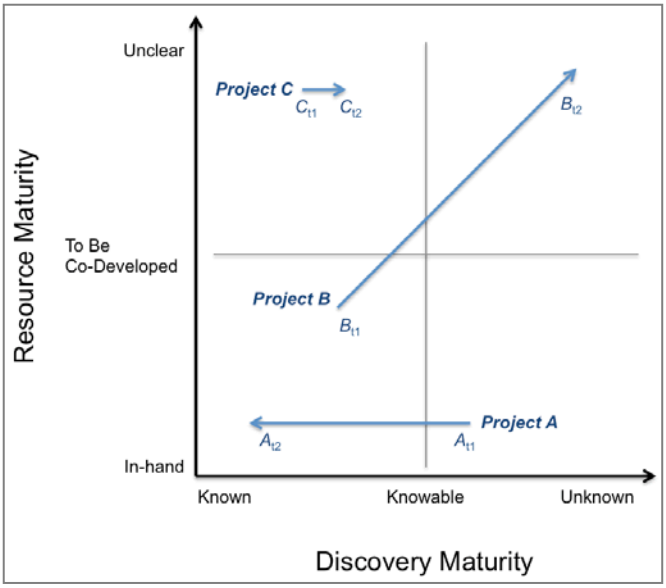

Figure 2. Project profiling matrix and sample project trajectories

These dimensions are meant to capture what each Lab project team is prepared to claim they know at the beginning of the project regarding (a) what they understand about what is to be discovered and (b) with what resources they will approach it. The intent is that placement and movement within the dimensions define a project profile that can help manage expectations of all three types of Participant. These dimensions should be revisited at regular intervals over the course of any project, and it is expected that the initial placement in the matrix will change as more is learned. For example, the Project A team (in Figure 2) determined, to the best of their knowledge when scoping the work, that a particular discovery challenge could be solved with existing tools, but the tool mix and/or expertise to enable the discovery was not well known. Only after starting the work and being introduced to other factors did they find that the discovery challenge could be hastened due to known solutions. By tracking these developments, the Lab will gain an understanding of the initial proposed discovery challenge and be able to establish profiles and predictable trajectories of the projects so as to better manage awareness and expectations among the three Participant parties.

Bringing Heterogeneous Teams Together

This work was undertaken because sharing of information is an essential activity among members of a project team. With the array of big data and discovery projects entering the Lab (as sampled in the previous sections), implications of an increasingly interdisciplinary team composition needs to be better understood to guide the development of our collaboration processes and tools. Information and knowledge sharing has been extensively studied over the past decades, often with a homogeneous population and with a particular emphasis on specific contexts such as the academic environment, the healthcare setting, in a virtual team configuration, or of engineers (Sonnenwald et al., 2004; Fidel and Green, 2004; Talja, 2002; Ellis and Haugan, 1994). More recently, the challenge of knowledge integration in heterogeneous, interdisciplinary teams has become a focus as this type of team composition has become more prevalent in everyday work and play (Salazar et al., 2012). These challenges and opportunities of information sharing and integration within a heterogeneous team of varied backgrounds and expertise (Hsu et al., 2014) are key to co-creation within the context of big data and discovery activities. The purpose of this inquiry is to gain insight into the information sharing practices of the interdisciplinary Participants of the Accelerated Discovery Laboratory, starting with one project.

To begin this investigation, six one-hour interviews were conducted with six members of a single project team affiliated with the Lab, which had already been working together for one year, who represented two of the three Participant groups: Maker and Client. The Repertory Grid Interview Technique was used to structure and focus the interviews. Through this technique, participants are asked a minimal probe question to elicit a set of nouns (e.g., objects, states, or qualities) called “Elements”. After the Elements are named, successive trios of Elements are selected and the participant is asked to group the two most similar Elements together. Still working with the two selected similar Elements and remaining one unselected contrasting Element, the participant is asked to describe the characteristic thought to bind the two similar Elements and also provide the characteristic thought to describe the

contrasting Element. This secondary exercise with the participant results in a set of adjectives that are used to form contrasting poles called Constructs. The data collected through this technique can then be analyzed for themes. The benefit of this technique is that the interviewee is able to directly express what and how they see and experience a subject completely in their own words and voice.

The interviews were conducted in person with the team members located at the Lab and through a combination of teleconferencing and web-conferencing with team members at remote locations. Our participants were asked a very minimal prompt of, "what is shared in the project?" This was done to elicit Elements and Constructs around the topic of information sharing within a heterogeneous project team. This also gave our Participants the opportunity to use their own vocabulary – both naming the nouns of what is shared, and the adjectives that describe them – to express their experience of information sharing in the team. The interviews were audio-recorded, transcribed, and then Leximancer (version 4.0)[6] was used to perform content analysis and develop a concept map.

The largest concept cluster found was "work" (near the center in Figure 3). This was reassuring but not surprising given the interviews were focused on practices relating to information sharing to enable work. The concepts of *team, project, shared, research, information, doing, and product* also occurred frequently in the interviews and found to be closely related to the *work* concept. Less frequently occurring concepts such as system, demo, email, discussion, meetings, use case, and idea were also evident but did not occur as often (smaller circles) or as having as close a relationship to *work* (distance on the map).

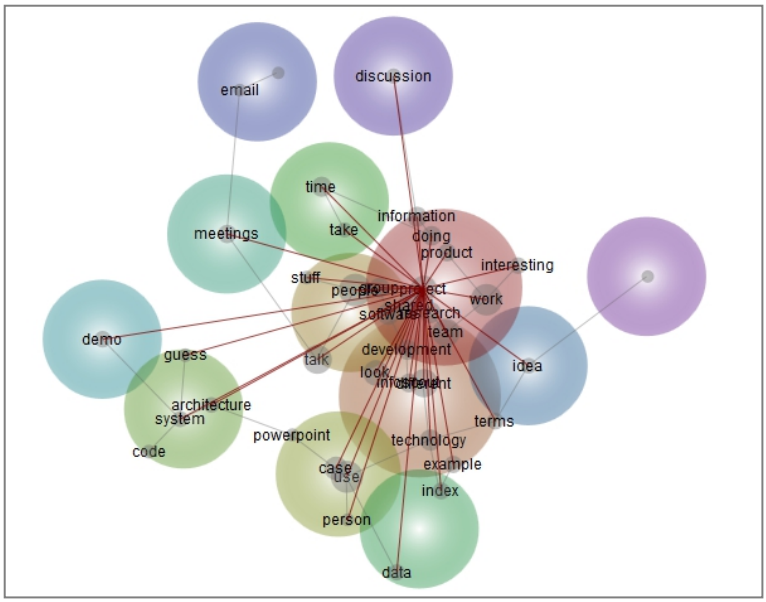

Figure 3. A high-level concept mapping using Leximancer 4 of the six interview transcripts

Three themes emerged after more detailed analysis: the dependence upon semi-structured, descriptive visualizations (such as presentations) particularly in the early stages of information sharing and teaming; the gradual unfolding of a shared vocabulary and an incremental building of common ground; and the use of the simplest collaboration tools throughout all stages of the team's work. Following is a short description of the emergent themes and example content is provided for each.

Theme 1: dependence upon semi-structured, descriptive materials. At the start of a project, as the team members first come together, participants often utilized pre-existing materials, or material prepared in advance of a discussion (often by one person) in group discussions to introduce their ideas, viewpoints, and previous work. These often are unstructured or semi-structured PowerPoint presentations or documents presented in written form with a narrative. Examples of this include product road maps, planned direction, customer needs and requirements**.** Early on in the collaboration and teaming, these materials typically represent an individual view or particular facet of the work thought to be important and that ought to be taken into consideration by the team. As the team works together over time, there is more going back-and-forth between this individual work and iterative collaboration occurring in discussions. As one interviewee noted:

[6] https://www.leximancer.com

"To some extent, specifically in terms of the way we work..., it's not always collaborative in some sense. So it's kind of we both present to each other.... we're not using anything interactive so it's pretty much premade PowerPoint."

Theme 2: the gradual unfolding of a shared vocabulary and an incremental building of common ground as a foundation for discovery, and for unique contributions. For this team, vocabulary is emergent in the work of the group together, and not formally defined at the beginning. Some team members may share a common background, and thus understand that they share a perspective and terminology. But when team members do not have that shared context, stories and examples are used as an aid to create context and bridge differences in how individual team members talk about the work. In this case, the interviewed participants were focused on software technologies and analytics, hence constructs such as scenarios (e.g., stories that illustrate work) and use cases (e.g., activities that define the work within the story) are used to evolve a shared team mental model and the words associated with aspects of the model. In the quote below, the interviewee first notes the shared understanding that exists with Co-leader A, and then describes the process to build a common vocabulary within the team with those from different contexts.

"Well some of the benefit actually of working with Co-leader A is that we share a common background. They used to be on the development side so they worked on some of the same products or within the same sort of product family. So we kind of share a strong vocabulary with them. But then as we expanded that group and brought in others on the research side I think the way we've typically reached a common vocabulary is just by working through different scenarios, use cases, and we kind of start to narrow down or converge on some common terminology or, you know, you said this, do you mean that or, you know, those sort of things, and reach some sort of consensus."

Theme 3: Simple and familiar collaboration tools are used throughout the project lifecycle to facilitate information and knowledge sharing. The participants on the team for this investigation do not all work at the same location. However, they work on the same continent, but in different time zones. Given these circumstances, they are dependent upon tools and technologies that afford remote information sharing and collaboration. What was found was that the simplest collaboration technologies (in particular, the use of conference calls) to bring remote team members into a discussion or meeting are typically used. The burden of setting up and getting everyone connected to a (more complex) collaboration tool is a significant obstacle and can consume precious minutes during a meeting. If the overhead is too high, the decision might even be made to abort the use of the collaboration tools (supporting Pirkkalainen and Pawlowski, 2014). Shared artifacts (e.g., photo of whiteboard drawing created during a discussion) are often sent out to attendees after the meeting is over. This may lend itself to being an additional barrier because the people who are not in the room are experiencing less in the meeting by not being able to see the whiteboard drawing during the meeting. The difficulty of utilizing collaboration tools for remote meeting attendees is highlighted in the following observation:

[Talking about collaboration tools for meetings and using PowerPoint slides prepared in advance] "…at the moment sharing tools aren't that good. They're just clumsy to use, I think, slow and awkward."

Negotiating the path to a shared understanding is only part of the work of an interdisciplinary team working on big data and discovery; the critical (and intangible) aspect is creating the capability for each individual to bring their unique expertise to bear on the objective of the group in a collaborative setting – but both are needed.

Mapping the Experience

One of the core components to the vision of the Accelerated Discovery Lab was a streamlined and seamless Participant experience, where teams and individuals could work with data, analytical capabilities, and experts on big data and discovery research. The challenge in delivering on the vision early in the life of the Lab was that there wasn't a shared view for what this vision meant from the Partner's and Client's point-of-view. This section describes the challenges that motivated the development of a service experience map to provide an end-to-end model as a reference for the Makers when communicating how different pieces of functionality would/could/should come together and to then locate requirements and dependencies between technical and interaction capabilities.

The Lab has multiple Maker teams working on pieces of functionality to enable the Lab's service environment. This functionality ranges from finding-out about the Lab (e.g., web-presence and informational way-finding), to setting-up a project, to progressively exploring the library of data sources and analytical services and finding additional

expertise, to contributing to the libraries, to departing. These, and other, pieces of functionality will impact how a Participant experiences the Lab capabilities and facilities and ultimately their overall discovery journey. Part of the general challenge in delivering services through a cloud-like environment is that little is known about user heuristics or success measures for such an environment (Väänänen-Vainio-Mattila et al., 2011), let alone one that is designed for a discovery paradigm.

It turned out that, although the Makers had a systems architectural view of the Lab, what was missing was a shared awareness of the impact of the technological and communication interfaces on the actions or activities of all intended Participants – and in particular, upon the Partners and Clients. Due to this lack of common understanding and little user research guidance, we were motivated to create a common view of the connections between Participant actions and the supporting service ecosystem. The purpose of the experience map was to communicate a proposed end-to-end service experience from the point-of-view of our Partner's and Client's objectives and actions (i.e., the *Customer Actions* in Figure 4). More generally it was also designed to aid in establishing a shared mental model of the holistic service environment (e.g., Sætrevik and Eid, 2013; Wildman et al., 2012), and serve as a boundary object that teams could use when communicating their role and/or contribution to the overall vision (Carlile, 2002; Star and Griesemer, 1989).

The experience map is based on *service blueprinting*. The general service blueprinting methodology and examples are well documented in the field of service design (e.g., Shostack, 1984; Bitner et al., 2007; Patrício et al., 2011). As a technique, it can be used to communicate a range of service associations that range from strategic innovation to understanding operational and functional inter-connections (Bitner et al., 2007). This is different from an architectural diagram in that the actions of the customer (our Partners and Clients), instead of the capabilities of the technology, are central to determining all other interactions. In this case, service blueprinting was used as a technique to create a common view of the connections between the Partner and Client actions, Maker actions, technology interfaces, and hardware and software support systems.

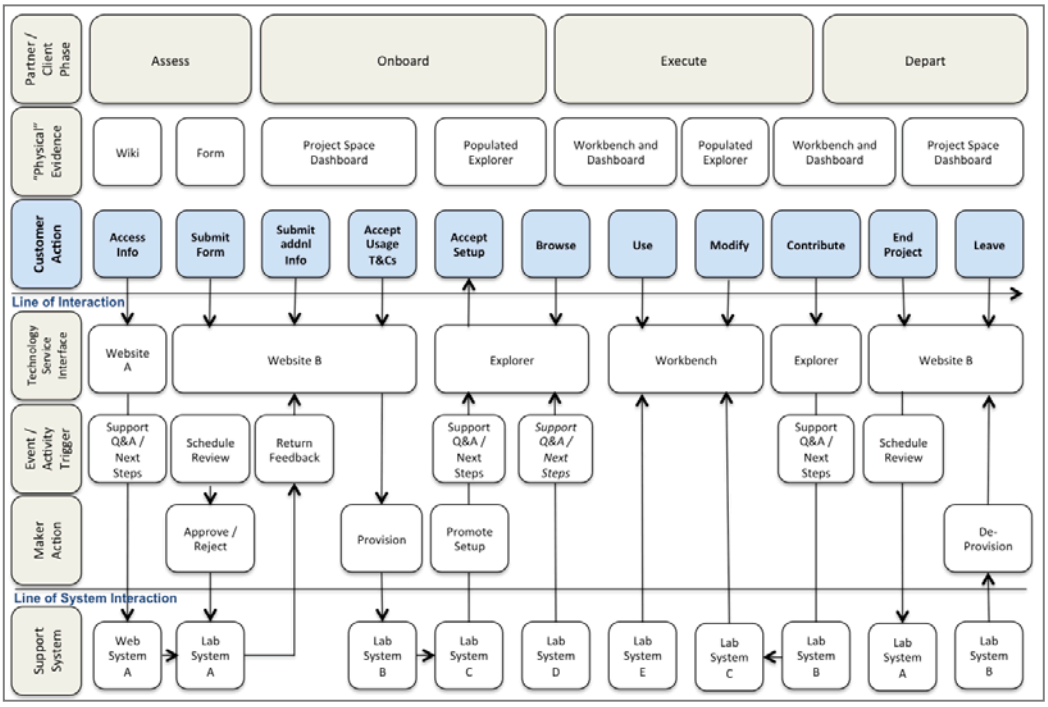

Figure 4. Service experience map created to establish a shared mental model of the Lab's functional connections with Partner and Client (customer) actions

This particular service blueprint was created around fundamental customer actions as the focal point that would need to be supported as an end-to-end service experience. These fundamental, macro-level actions (such as accessing information about the Lab or browsing the data and analytical libraries) were linked to the physical evidence that enables the customer to perform an action (typically a website or software interface) and the alignment of early-stage and proposed technologies to support the actions (elements below the *Line of Interaction* in Figure 4).

Interviews, brainstorming, and participatory design activities with individual Makers and small groups were the techniques used to elicit the Maker's perspective (most of whom have technical systems and software expertise and some of whom have expertise in user design and work practices) to create the initial Lab service blueprint. During the interview and participatory design activities, each participant had the Partner and Client in mind. This was evident by language such as, "we shouldn't make the user have to do…." However, the initial contradiction in enabling the Partners and Clients was that the primary focus of the Makers was on ensuring the *Support Systems* would work – as one Maker stated:

> *I do systems. ...And computer science doesn't do systems. We do database or analytics or Big Insights. We tend not to worry about how you attach hardware, software, networking and OS and all that sort of stuff together.*

Without a doubt, the development of the support systems is critical to the Lab. However, without a shared mental model of the interconnections (and interdependencies) to the support systems, the Partner and Client actions could easily and unintentionally be overlooked or dismissed as something to be addressed later in design, development, and implementation.

Resulting notes and drawings from the individual and small group activities were used as guiding input into the initial version of the service experience map, which was then socialized with key Maker stakeholders and decision-makers. Upon completion of the initial map, it was presented to all of the Makers at a weekly architecture meeting. The response was mixed, with some Makers voicing correction (in particular, with the lack of support system detail in the representation) – initially viewing the experience map as an architectural diagram versus an illustration of connections and interactions between Makers, Partners, and Clients with a common goal of enabling discovery. As such, each box on the diagram could easily be conceived of as a door to a set of architectural and interaction requirements in and of itself. However, as presentation, discussion, and time passed, the purpose of the map became apparent and led to greater understanding by the Makers of the generalized discovery lifecycle that would need to be supported. The map is mentioned in discussions during Maker meetings, with Maker members sometimes waiving their hands and pointing to an invisible map that is in front of them with the assumption that it has informed and been internalized by the meeting attendees, referring to particular phases and activities that need attention or are being worked through.

DISCUSSION

A set of interviews early in the life of the Accelerated Discovery Laboratory revealed a sense of vagueness about what discovery in the Lab means to all its Participants (which should not be surprising for that point in the Lab's development). They also revealed a fragmented understanding of who was part of the Lab, what they were doing, and how the work would unfold. The results of each of the investigations presented in this paper are early-stage and with on-going research continue to evolve and their ideas continue to mature. In the following, we provide additional insight into the findings of our work and ideas for future work.

The three investigations presented in this paper share a common theme of enabling the discovery service experience – examining what that means to scientists and business people, evolving the language and practices around the theme, and arriving at a shared viewpoint to enable the theme. We believe that central to the theme of discovery service experience are ideas that can be borrowed from Service Science, in particular those that explore concepts of service-dominant models and value co-creation, and that this experience can be represented as configurations of place, people, and technology through time.

The concept of project profiling was developed as a way to profile and track projects along two axes: discovery and resource. The two dimensions are meant to capture what the project team is prepared to claim they know at the beginning of the project regarding both what they understand about what is to be discovered and with what resources they will approach it. Future work is needed to validate these axes and perhaps to develop more. A tracking system that checks in on the course of any given project at regular intervals still needs to be developed. It is expected that initial project settings will change, but it will be important to begin to understand how they do and why. By tracking these developments, the Lab will gain an understanding of project profiles over time, and, ultimately the trajectories of the projects so as to better support and manage expectations among the three Participant types.

The study of heterogeneous group information sharing and integration is considered to be nascent, both in the literature and within the context of big data analytics and discovery. What we are finding is that teams need to negotiate a common team foundation, but nurture the unique disciplinary aspects of the team. Maintaining both is important and supports the notions of value exchange. The goal is not to make a team homogeneous in its expertise and thinking, but to better support and enable (and accelerate) cross discipline language and understanding. As this research progresses, we are further investigating the emerging themes and development of team practices to validate definitions or understanding, particularly early formation of a project. In addition, we will be focusing on the use and introduction of technology mediated practices for information sharing. Special attention is being paid to place and the temporal and engagement conflict between local and remote meeting attendees, and the techniques used by heterogeneous teams to build common ground across disciplinary boundaries.

Creation of the service experience map based on Partner and Client actions is considered a first step in establishing a common point-of-view and shared mental model of the service experience. In this paper, we report only on the first iteration of the map. Since it was communicated in mid-2013, the map is still referred to by Makers when context and a common view is needed. However, it has been almost one year since its inception and we've learned more about expectations of our Partners and Clients that need to be better captured in the map. In addition, the Maker teams have had a year to design and iterate on the development and implementation of capabilities – elements that also need to be revisited and revised. Future work includes updating this service experience map and also examining the larger service ecosystem – the context for which this map resides – to investigate ideas that start to establish constructs of accelerating discovery and patterns of relationships-of-exchange and how or if they result in value co-creation.

CONCLUSIONS

In this paper we discuss understanding the need to try out ideas of how to accelerate discovery in a real-world setting, at the very same time that we are learning what it means to "discover" using big data and analytics. It is our experience that there is something fundamentally different about the combined challenge of bringing together both big data capabilities and people who have different work practices and yet a shared, or at least a sharable, objective. It requires collaboration aimed at co-production amongst participant communities to manifest the co-creation of discovery. The authors' goal is to inform and support a service environment through the design, development, and delivery of a service experience that will address and facilitate the goals of all Accelerated Discovery Laboratory Participants for the purpose of discovery. Design of the environment and support for each of the Participant communities is challenging on its own. For this endeavor to succeed we also need to be able to effectively bring people together across disciplines to share their intuition, knowledge, and expertise while working together in a computationally and data rich environment. Creating a framework that captures the journey through technology, social, and physical space with a common goal of co-creation will help us to better understand how discovery is practiced and to provide it meaning.

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Section 11

Service Innovation and Governance: Reframing the Concept of Service Innovation

Reframing Innovation: Service Science & Governance

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ABSTRACT

If we believe in innovation, change that improves quality of life, and we believe that service innovation can accelerate these positive changes in business (for customers) and society (for citizens), then we need to ask what rules of the game help maximize service innovation? Our paper aims to reframe the Rules of Innovation from a Service Science perspective as the study of different, interconnected, complex "human-centered value co-creation systems" in business and society. As an emerging trans-discipline, Service Science draws on many existing academic disciplines, creating a new whole, while enhancing the parts without replacing them. This requires a change in perspective focusing on the fact that Service Innovation opportunities (in education, research, practice and policy) depend on the improving interactions with other service systems strictly connected to the capability to perceive the service context. Consequently, we believe that *new governance mechanisms* might support policy makers at any decisional level (regional, local, national) contributing the useful scaling of new service innovations in health, education, government, finance, hospitality, retail, communications, transportation, energy, utilities.

Keywords: Service Science, Service Innovations, Innovative Governance, T-shaped People, Value co-creation

INTRODUCTION

Over the years, there have been many approaches to innovation, created and re-invented on the basis of the ability of researchers and abductive pratictioners in different fields.

If we believe in innovation, change that improves quality of life, and we believe that service innovation can accelerate these positive changes in business (for customers) and society (for citizens), then we need to ask what rules of the game help maximize service innovation?

The purpose of our paper is to reframe the Rules of Innovation from a Service Science perspective as the study of diverse, interconnected, complex "human-centered value co-creation systems" in business and society.

Today, innovation moves towards sustainability. The innovation processes aiming at a sustainable chain involve many actors, such as research centers, governments, businesses, intermediary organizations and NGOs. Such innovation processes entail difficulties of improvement about the alignment of perspectives and about the reframing of issues, identities and processes in interaction between actors. Accordingly, in our study, the question is: What reframing processes within and between actors of the different whole service chains are useful to interpret a new conceptualization of innovation and how can be shared these reframing processes?

FRAMEWORKS FOR REFRAIMING INNOVATION: SERVICE SCIENCE AND GOVERNANCE

The current trend - dominated by the services and coopetition logic (Zinledin, 1997) - shows that a new model of innovation emerges day-by-day increasingly connected and driven by social and environmental needs. In other words, innovation becomes a process linked to lifestyle characterised by the collective well-being and based on the collaborative and integrated efforts to achieve it.

Therefore, reframing innovation implies a shared and collaborative development investing global community and that requires continuous co-creative solutions between sub-systems involved. Addressing these trends is coherent with the assumption that the world is facing complex challenges that cannot be solved in individual or self-referential manner: it is about sharing the opportunity to interpret innovation as a co-evolutionary process among multiple consonance partners.

In this sense, the concept of innovation must go beyond the traditional ontological meaning and achieve a vision of sustainability. Primarily, sustainable innovation involves changes in approaches to environmental, social and economic factors that take into account more and more of the potential for widespread positive externalities and are able to suggest actions, especially enlightened governance (Piciocchi and Bassano, 2009) able to conceive, implement and share them. In fact, no individual, company or government may be so enlightened, so pervasive, so strong that it interpreted by itself any reframing. In other way, the contribution of each sectoral system, any system, central or peripheral is needed to define a cultural change coherent with a new conceptualization of innovation.

The first logical step is that sustainable innovation is able to provide solutions and new opportunities in respect of one of the basic assumptions of the SSME + D: Whole Service System is achieved through related capabilities for shared competencies (Spohrer et al., 2011). In this way, our work is a contribution in relation to how it can be turned on a sustainable innovation and who can take decisions and how to be able to develop interest and ensure collective benefits.

Service Science lays the foundation for understanding service systems in business and society. As an emerging trans-discipline service science draws on many existing academic disciplines, creating a new whole, while enhancing the parts without replacing them (Spoher et al., 2010).

This requires a change in perspective studies and management focusing on the fact that Service Innovation opportunities (in education, research, practice and policy) depend on the improving interactions with other service systems which are strictly connected to the capability to perceive the service context.

Unquestionably important is the relationship of interdependence between the economy, society and environment. (Giddings et al., 2002) advocate a holistic vision that breaks down boundaries between sectors and disciplines, it allows to reread and reinterpret economic dynamics from the perspective of coopetition: the interconnection is the key to sustainable development and, therefore, to achieve reframing innovation.

Sharing this setting means set innovative processes on a nested service model that can ensure switching and/or interconnection between the innovation of a certain system and innovation of the overall system which includes it.

Reframing innovation requires focusing on the perspective of complex systems and the management of complexity, rejecting the simplifications induced by reductionism, anachronistically based on particular solutions (individual) and specific (micro).

If we agree with this reflections, then sustainable innovation can be defined through some key principles:

- structuring system complexity in workable pieces, maintaining its entirety. This means recognizing the relevant sub-systems and components - not mere elements - of the whole system (value per position for value co-creation);

- sub-systems, as ecological systems, should be seen in the frame, eco-systems that are able to survive and develop if and only the whole system evolves.

Both principles are consistent with the evolutionary logic win-win situation in which the sub-systemic components (actors) have an important role to play but complementary.

In innovation terms, the evolution of the innovative paradigm had the following dynamics:

Technology based vs Market based vs Social based

In the technology-based evolution, the key driver was the GDL: the need for the business to generate, through the production of material objects, punctual profits, neglecting social costs and negative environmental externalities. In this sense, innovation frame was coherent with win-loose relational logic.

In the market-based evolution, the innovative driver was the opening of the experience. The business must ensuring product customization through the emotional stimulus required to mitigate the GDL to the assumptions of the differential SDL. In this sense, innovation frame has been characterized by the gradual transition from the logic win-loose to win-win relational logic.

Based on the actual social evolution, the key drivers are the target of the overall well-being and the shared benefit, which is the definitive passage from GDL to SDL: the tendency to meet the social needs and build relationships and partnerships useful to increase the whole value and its equitable distribution is ensured by a new frame of innovation characterized by win-win relational logic, finally.

FINDINGS

As Service Innovations impact individuals and institutions, from family to community to enterprise to district, city, country, state, nation, and continent we believe that *new governance mechanisms* might support policy makers at any decisional level (regional, local, national) contributing the useful scaling of new service innovations in health, education, government, finance, hospitality, retail, communications, transportation, energy, utilities.

Reframing innovation is coherent with social evolution. This means we have to interpret the transformation of business on the basis of two approaches (Prahalad and Krishnan, 2008):

1) personalized experience, defined in the market led evolution of innovation (P_{exp});

2) access of resources, defined in the socially led evolution of innovation (R_a).

According to the first approach, competitive advantage of differentiation has led companies to move towards the centrality of the Individual and focus on its experience at a time to improve customization.
In symbol, optimum is Pexp = 1.

Unfortunately, the breadth of the markets - induced by globalization and pervasiveness of ICTs - does not admit that any business entity, no matter how great and efficient it is, is not by itself able to interpret alone the first approach. This means that we need to rethink the business from the outsourcing perspective or move the focus on the ability to access resources and not necessarily to the allocation /ownership of resources themselves.
In symbol, optimum is $R_a = G_r$.

Therefore, reframing innovation in complex scenario implies business have to tend to realize both conditions of value creation optimum in global eco-service systems:

If P_{exp} tends to 1
and
R_a tends to be equal to G_r
then
***INNOVATION is* viewed as well as**
a complex process of social nested networks

Neoclassical theory (Smith, 1990; Guston, 2000) explains production performance and competitive advantage of firms in terms of their relative resource endowments (Hall, 1994), while the role of knowledge was seen as exogenous to the production system (Freeman, 1995). The emergence of the ecological paradigm (Freeman, 1991; Lundvall, 1992) has shifted the focus on innovation systems justified by the triple helix model (Etzkowitz and Leydesdorff, 1997) – see Fig. 1 – , based on university-business-government relations. This model is interactive and virtuous for innovation, it is designed as well as sinergic recursive interaction between three institutions traditionally isolated, but now necessarily have to be connected in a cross-institutional relations (Sutz, 1997).

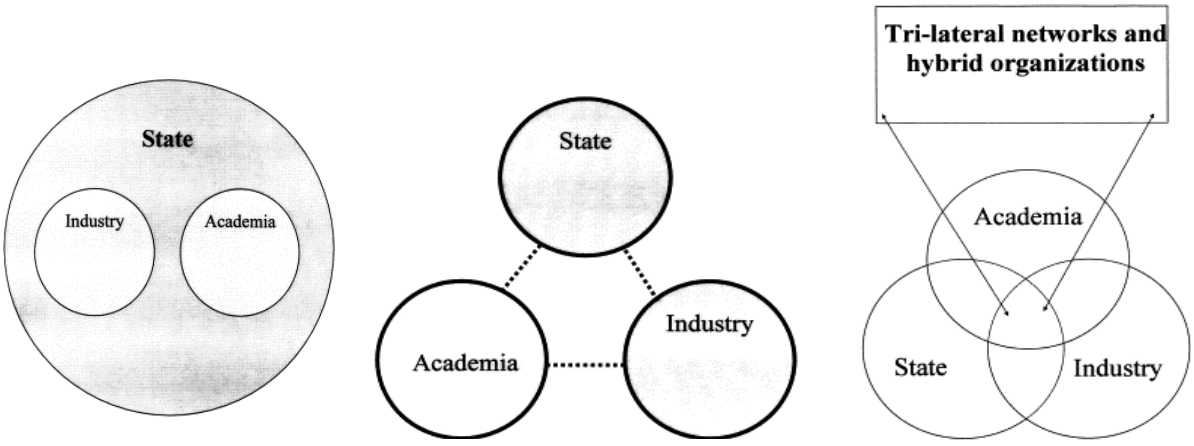

Figure 1. Triple Helix configurations (Etzkowitz and Leydesdorff, 2000)

According to the model, in local service systems, while government plays a coordinating role in social development and local networks - regional leaders - the bridge university-business emphasis the concept of academic entrepreneurship focused on the processes of generation, accumulation and implementation of Knowledge for Innovation and Development (Chatterton and Goddard, 2000).

Functionality and applicability of the model propeller lies in the ability to interpret innovation in the light of: 1) local/regional network of companies and other organizations in a limited geographical area; complementary industries, availability of a stock of social capital/human governance collaborative based on trust and cooperation between actors (Lundvall and Johnson 1994; Niosi and Bas, 2001).

Table 1: The triple helix model – The role of institutional actors for reframing innovation in nested service system (Adapted from Gunasekara C., 2006)

Key element of regional innovation system	Generative role	Developmental role
Regional agglomeration, or clustering, of industry	Knowledge capitalisation and capital formation projects, centred on firm formation and co-location of new and existing firms near the University	Entrepreneurial activities, as well as regionally-focused teaching and research, not necessarily linked to capital formation projects
Human capital formation	Integration of education and knowledge capitalisation activities, specifically, firm formation, through teaching incubators; Development of generic, advanced training programs to support firm formation and cross-institutional mobility by organisations and people	Stronger regional focus on student recruitment and graduate retention Education programs developed/adapted to meet regional skills needs Learning processes regionally-informed
Collaborative governance	Driver of regional innovation strategy, centred on knowledge capitalisation and capital formation projects; by analysing strengths and weaknesses and bringing together industry and government to forge innovation strategy	Shaping regional networking and institutional capacity, through staff participation on external bodies; provision of information and analysis to support decision-making and brokering networking between national and international contacts and key regional actors

The configuration of the triple helix and the excellent Pexp = 1 and Ra = Gr refers to a smart governance structure and dynamics of the relation between the actors university-government-business (Piciocchi *et al.*, 2012).

In nested social networks,

- whether governance can be considered as the result of a continuous transformation of the governance structure and practices according to functional the new business and societal liberalism;

- whether Service Systems are: a) dynamic configuration of resources, b) a set of value co-creation mechanism between suitable entities, c) an application of competencies -skills -knowledge any person (s) in job roles or stakeholders, d) an adaptive internal organization responding to the dynamic external environment, d) ensure mutual learning and feedback to benefits or outcomes of value co-creation , etc.) to enable complex viable structure to respond to environmental change, where environmental change is mostly generated by other systems viable,

then Smart Mechanism of Governance (SMG) to assess skills and expectations mediated human needs a conceptual re- interpretation of government as an institution (structure) as well as practice (system) according to functional new deal of governance in service systems as we called *governmentality* (Foucault, 1991).

This reformulated governance conceptualization is coherent with the needed reframing innovation. In fact, the interpretation of innovation process in social way suggests to embrace the bottom-up logic in networking governance (Triantafillou, 2004; Piciocchi and Bassano, 2009), based on shared knowledge and trust.

This assumption implies a change of perspective in terms of service systems viability. If smart governance – according to the triple helix model – is able to create and develop value co-creation mechanisms and to guarantee systemic equifinality, based on a continuous process of mediation of stakeholder expectations (customers, citizens, etc.), then in nested service systems, innovation depends on the capability of a multilevel governance (Rosenau and Czempiel, 1992) useful to insure value co-creation and equifinality through a social cooperation and collaboration, in short coopetition (Spohrer et al., 2013).

PRACTICAL IMPLICATIONS

The human perception of context of the service is a relevant element for recognizing and inspiring next generation service innovators and promoting service innovations.
This is strictly connected to service logic which sees the world as interconnected people and organizations, participating in service systems and platforms, where providers, customers, citizens, governments, and other stakeholders work together to co-create value and co-elevate capabilities.

The sustainability of this social innovation needs relations based on established consonance to achieve integrated and synergic resonance (win-win logic). In trust terms, social innovation can support service systems viability if the interaction between government-business-university moves from calculus-based trust (win-loose logic) to identification-based trust (win-win logic).

As we have assumed the sustainability of social innovation, the three sub-systems university- business-government could evolve in nested service system if we are able to overcome their traditional overlap and accept a new deal of their proactive integration. This proactive integration of rules needs to create a collaborative relational structure adequate to interpret change according to a reformulated innovation in social extension.

The dynamic relationship of co-opetition - example in GM/Toyota, IBM/ Apple, Volvo/Mitsubishi , SAS/Lufthansa - justifying the need of reframing innovation are convincing academics and practitioners that the nested social service systems have a greater capacity to innovate.
In particular, the best performance is explained in terms of:

1) the benefits of entrepreneurial spirit;

2) the benefits of synergistic effect;

3) the benefits of strengthening the brand and specialization;

4) the benefits of economies of scale at affordable cost;

5) the benefits of risk reduction;

6) benefits of information and experience.

If a business system integrated is able to have these powers, then the system itself and its sub- systems - as synergic and co-finalized components of the whole - are viable over time and may base their competitive advantage on a collaborative values system (CVS). In fact, CVS improves the viability of nested service systems on the basis of three elements (Faulkner, 1992):

1) strategic adaptation;

2) cultural adaptation;

3) organizational method, government structure and governance dynamics.

In this way, reframing innovation requires a new style to create nested service systems networks; this kind of networks allows to all interacting nodes - even independent - to work together for addressing the challenge of innovation in synergistic competitive manner.

The problem is the configuration and the stability of governance configuration.

Figure 2 presents the creation of an "area of stem cells" adaptation (Ranga and Etzkowitz, 2013) of the ovals of Cassini (Hazewinkel, 2001), which shows four configurations of the transition from independent status to the interdipendent status: it represents equal the three sphere weight that rather in concrete could be differently played by each of the three components of multilevel governance, especially in terms of different role played in the innovative development of nested service network systems. The formalization of a space for innovation is achieved through relations and resources and the creation of new institutional formats.

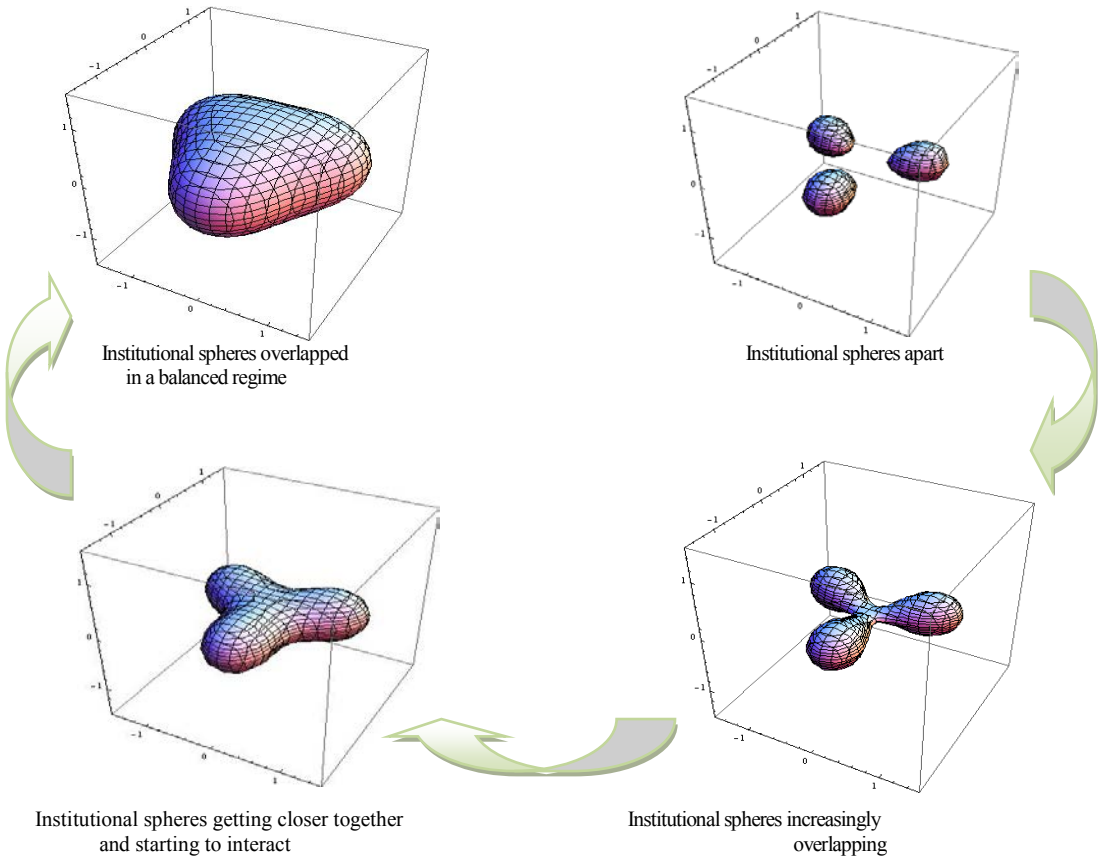

Figure 2. Interaction between the Triple Helix institutional spheres in the formation of a Collaborative Space of Innovation (Adapted from Ranga and Etzkowitz, 2013)

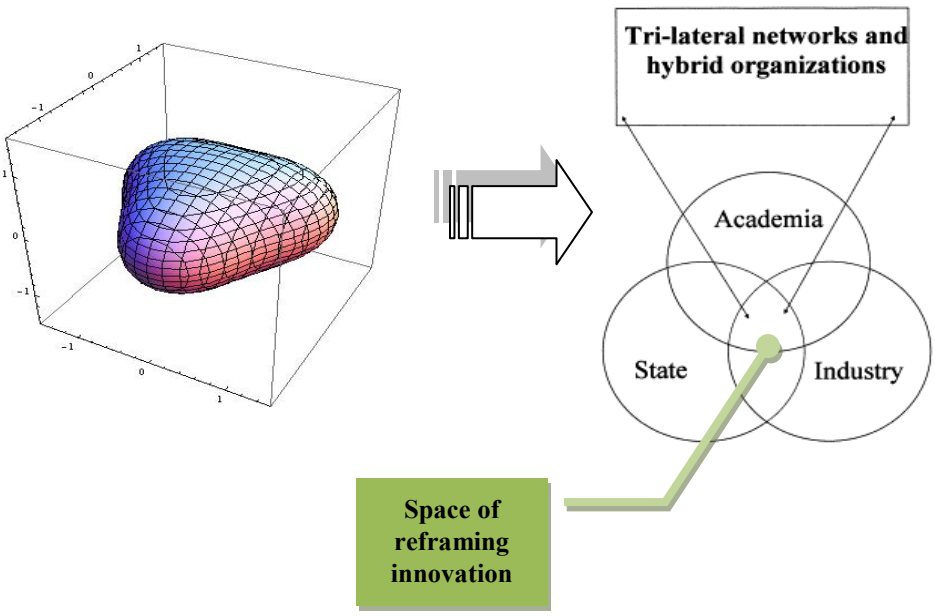

Figure 3. Balanced multi-sphere as nested service systems network (Our elaboration)

Tri-lateral networks and hybrid organizations appear like balanced multi-spheres construction in structure and in system dynamics. In this way, we can assume both like a co-created and interactive space inside which it is possible to conceive the needed reframing innovation.

In fact, nested service network – based on knowledge, creativity and collaboration – represents "space of innovation" where complex organizations/institutions are related into hybrid network co-finalized to develop economic and social context through innovative activities: development of entrepreneurial potential, growing talent and building a sustainable competitive advantage.

CONCLUSIONS AND RESEARCH LIMITATION

There is no such thing as a "new best service" - only "new service which is the best for a specific context" which is a proposition evaluated by multiple stakeholders. A service innovation culture where "presence" is cultivated (Senge et al. 2004) can help ensure that positive consonance/resonance is achieved for all stakeholders who directly or indirectly co-create service systems and partecipate to their value creation process.

In our work, we don't know how the sustainability perspective applied for reframing innovation process is relevant to explain how the role of human resources will be critical in terms of Talent. In fact, in Service Science terms, the "shape of a professional's" means the capabilities that professionals can apply when they are involved in problem solving and when they are communicating with other professionals as part of a project team (Spohrer et al., 2010:10). T-Shaped professionals are individuals with Talents for producing global value co-creation; this kind of professionals are able to manage decisional uncertainty in a complex scenario. The talent capability of to know "what to do" – targets and ends – and to do "what they know" – i.e. their competences and means – (Spohrer et al., 2010:12), is an essential human ingredient to interpret innovation in a social view and implement related virtuous process through a cultural transition of all components of nested service systems.

To establish mutually beneficial relationships with other service systems promoting the development of T-shaped people with both deep discipline-based problem-solving skills and broad multi-disciplinary communications skills.

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The Use of Electronic Banking Services in Italy: the Case of Credit Cards

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ABSTRACT

Among the electronic banking services, that of credit cards can be considered as an index of standard of living. Although Italy is one of the leading developed countries, the use of credit cards, and more generally of electronic payment instruments, is not widespread compared to other western countries. Our aim is to investigate such differences highlighting their socio-economic implications, for example in terms of competition in the credit card markets. Using the most recent Bank of Italy Survey on Household Income and Wealth as data source, we employ count data models in order to identify the socio-economic, demographic and geographic variables affecting the number of credit cards held by Italian households. Results show that the considered variables are statistically significant in explaining the process. Particularly, we find that the geographic location is an important determinant of families' behavior. This result is consistent with the socio-economic gap between the North and the South of Italy. Other relevant predictors are the level of education, the gender and the marital status.

Keywords: Banking Services, Payment cards, Credit cards, Count-data models, Financial markets

INTRODUCTION

A credit card is a system of payment since it allows the cardholder to pay for goods and services without using cash. This presupposes that the card issuer has granted a line of credit, mostly uncollateralized, from which the user borrows to either pay to the seller or withdraw cash from an ATM. In case of revolving credit card, the cardholder does not pay his balance in full each month, but in installments and the issuer charges an interest rate.

These characteristics of credit cards entail many economic issues. Firstly, from an industrial organization perspective, the credit card industry can be viewed as a network industry, like electricity supply, telecommunications and railroads.[1] In fact, the participation of a new economic agent to the network involves positive externalities for other participants.

More precisely, credit cards are two-sided network goods (Rochet and Tirole 2004; Rysman 2009) as the benefits for the users depends on the number of sellers in the network and, similarly, the benefits for the sellers increase with the number of the users (Chakravorti 2003). In turn, these network effects give rise to competion policy issues

[1]See Economides (1996) for an introduction to the economics of networks.

(Carlton and Frankel 1995; Lemley and McGowan 1998).

In this context, the fact that consumers hold or use credit cards from multiple networks is known as "multi-homing"' and in some theoretical models it is of great importance in determining the outcome of the industry (Rochet and Tirole 2003; Guthrie and Wright 2007). Empirically, however, it is not clear what should be intended for multi-homing (Snyder and Zinman 2008). More precisely, two issues arise. First, one should establish whether what matters is merely the possession of multiple credit cards or even their actual use. The second question concerns the substitutability between debit cards and credit cards in deciding whether a given cardholder is a multi-homer or not.

Secondly, since credit cards allow borrowing without applying for personal loans, there exists an incentive in building up large debts (Loke et al. 2011). White (2007) argues that the sharp increase in bankruptcy filing rates in the United States from 1980 to 2004 has been due to the growing credit card debt of families. Castronova and Hagstrom (2004) model the credit card demand as a two-stage decision: first, cardholders obtain the right to borrow within a certain limit; then they borrow a fraction of that limit. Using the Survey Consumer Finances as data source, they conclude, among other things, that consumer who want to borrow more do not apply for an higher limit, but hold more credit cards. Thus, the multiple credit cards can be seen as a device to access to more financing.

Although borrowing by means of credit cards could seems irrational, given the high interest rates charged and the large profits earned by issuers (Ausubel 1991), some authors have maintained that this behavior is nonetheless consistent with economic theory (Zywicki 2000). Brito and Hartley (1995) show that consumers could be willing to pay high interest rates on credit card debts in order to avoid the costs of bargaining with financial institutions or those associated with precautionary money holding.

If so, another apparent contradiction emerges. Data show that many consumers simultaneously hold costly credit card debts and low-return liquid assets, so that it would be rational to repaying their outstanding balances (Gross and Souleles 2002; Telyukova and Wright 2008). However, this action (known as "co-holding") can be explained as an attempt to self-control compulsive buying or the need to complete transactions for which a credit card cannot be used (Gathergood and Weber 2012).

In the light of these considerations, it is of interest to study the factors affecting the choice of holding multiple credit cards. On one hand this could be a first step toward a more in deep understanding of multi-homing.[2] On the other hand, these factors influencing the number of credit cards held by an individual could help in predicting family bankruptcy end explaining the "co-holding" phenomena.

In the literature, several econometric techniques have been used to model the credit card ownership of individuals or households. If the focus is on the choice between to use or not use credit cards, the natural choice is the logit or probit models (Yayar and Karaca 2012). Other studies, such as (Pulina 2011), try to identify the factors affecting the type of credit card used by means of a multinomial logit model. When data on the number of credit cards held are available, several authors (Kinsey 1981; Chien and Devaney 2001; Tan et al. 2011) have used the tobit model. However, since the variable under consideration is a nonnegative integer, it can be better to resort to count data models as, for example, in (Loke et al. 2011).

In this paper we aim at investigate the determinants driving the credit card ownership and analyse the implication of socio-economic, demographic and geographic variables in the card payment system. Following the approach of Loke et al. (2011) we focus on the number of credit cards held by households and employ count data models. Particularly, we estimate both Poisson and negative binomial models and compute the marginal effects of the covariates on the number of credit cards held. The data used in the empirical analysis come from the most recent Survey of Household Income and Wealth (SHIW) conducted by the Bank of Italy.

We found that factors such as age, income, wealth, sex, geographic location, education and marital status are effective in explaining the number of credit cards held by Italian household, with the last three exerting the stronger impact.

The paper is organized as follow. The next section highlights the main features and some trends of the Italian credit

[2]The two concepts are not overlapping but clearly multiple credit cards are a necessary, although not sufficient, condition for multi-homing.

card markets. Section 3 illustrates the econometric models used, while Section 4 is devoted to the description of data and variables. Results are presented and discussed in Section 5. Finally, the last section draws some conclusions.

SOME TRENDS IN THE ITALIAN PAYMENT CARDS MARKETS

Credit card belongs to the broader category of payment cards which also includes debit cards and prepaid cards. Debit cards are generally issued by banks to account holders. They can be used to withdraw from ATMs or instead of cash when purchasing good and services. Withdrawals and payments are debited to the cardholder almost in real time. Put another way, the cardholder is not allowed to pay the money back at a later time as for credit cards, so that enough funds must be available on the bank account when the debit card is used.

A prepaid card can be used only after it has been loaded with funds by the holder. Like a debit card, it allow to withdraw or to pay good and services but without necessarily holding a bank account. Basically, it works in the opposite way of a credit card, because instead of buying something to pay later, the holder pays in advance what will be bought afterwards.

Table 1 reports some trends in the number of payment cards issued in Italy in the years 2003-2012. The same data are depicted in Figure 1. The number of credit cards remained fairly constant during the period reaching a total of about 12,000 units in 2012. On the contrary, debit cards followed an increasing trend and experienced a negative growth rate only in 2009. Currently, they amount to almost 40,000 units, which are the 56% of the payment cards circulating in Italy.

As regards prepaid cards, their growth has been impressive. They increased from 677 in 2003 to 18,804 in 2012, which is to say a compound growth rate of 44% per year. In 2011, the number of prepaid cards has passed that of credit cards (14,203 and 12,189, respectively).

TABLE 1: Number and percentage growth rate of payment cards,Italy, 2003-2012

Year	Credit cards		Debitcards		Prepaidcards	
	Num.	Growth	Num.	Growth	Num.	Growth
2003	11,681	-	28,163	-	677	-
2004	11,607	-0.63	29,493	4.72	789	16.54
2005	13,379	15.27	30,744	4.24	3,288	316.73
2006	13,677	2.23	32,611	6.07	4,461	35.68
2007	14,486	5.92	33,097	1.49	5,805	30.13
2008	14,385	-0.7	35,527	7.34	8,208	41.4
2009	13,921	-3.23	33,185	-6.59	10,627	29.47
2010	13,022	-6.46	36,174	9.01	12,362	16.33
2011	12,189	-6.4	37,550	3.8	14,203	14.89
2012	12,102	-0.71	39,707	5.74	18,804	32.39

Source: Our elaboration on Bank of Italy data.

As Figure 2 shows, the per capita number and value of transactions realized by credit cards has increased over the years. In 1992, on average, Italian people aged 18 and over used their credit card 4 times spending 395 euros.[3] Thirteen years later, these figures were 10 and 737, respectively.

Like in other countries (Chakravorti 2003), also in Italy the credit card industry has been under the scrutiny of antitrust authorities, even in recent years.[4] This is not surprising, since, as it is evident from Table 2, both the issuing and the acquiring[5] credit card markets are highly concentrated, with CartaSì as a leader. The CR4 concentration

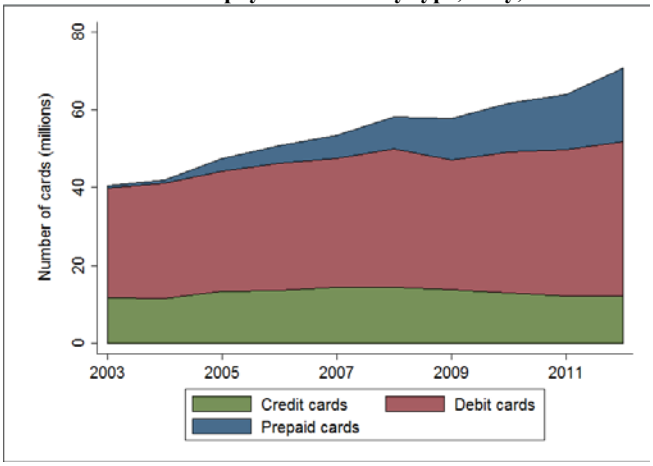
[3] In constant 2000 euros.

[4] See Italian Competition Authority (2004, 2009, 2010).

[5] Acquiring is the process that enables merchants to accept the credit cards issued to consumer by bank and other financial institutions.

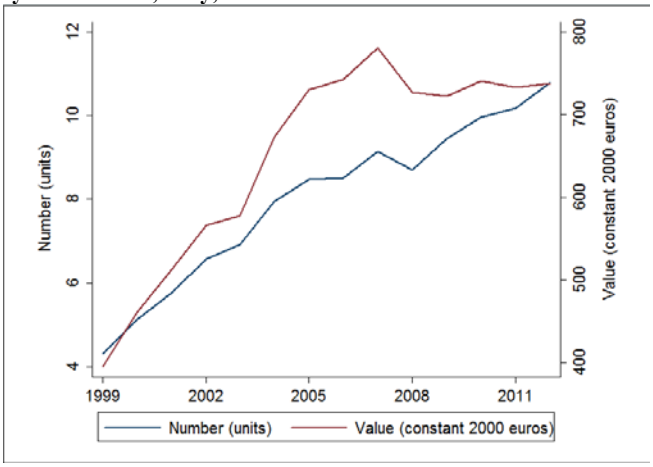
ratio[6] is 66.1 in the former market and 85.9 in the latter.

FIGURE 1: Number of payment cards by type, Italy, 2003-2012



Source: Our elaboration on Bank of Italy data.

FIGURE 2: Per capita number and value of transactions realized by credit cards, Italy, 1999-2012



Source: Our elaboration on Bank of Italy data.

[6] In economics, the CR4 is one of the most used concentration ratios and it is computed as the sum of the market shares of the four largest firms. Like others concentration ratios, such as the Herfindahl–Hirschman Index (HHI), it measures the degree of monopoly power exerted by firms in a given market.

TABLE 2: Market shares in the credit card issuing and acquiring markest (percentages), Italy, 2008

Issuer	Market share	Acquirer	Market share
CartaSì	43.4	CartaSì	39.7
Unicredit	10.2	Key Client	21.7
Intesa Sanpaolo	7.8	Setefi	16
DeutscheBank	4.7	Antonveneta	8.5
BNL Paribas	3.8	Banca Sella	6.8
ICCREA	2.6	DeutscheBank	2.8
UBI	2.2	Unicredit	2.5
Key Client	1.9	BNL Paribas	1.1
Antonveneta	1.9	Others	0.9
BPER	1.7		
CREDEM	1.2		
Others	18.6		

Source: Italian Competition Authority.

METHODOLOGY

A very commonly used technique for modelling count data is the Poisson regression. Given a set of N independent observations $(y_i, \boldsymbol{x}_i)$ where y_i is a count and $\boldsymbol{x}_i$ is a vector of covariates, assume that y_i given $\boldsymbol{x}_i$ is distributed as a Poisson, that is

$$f(y_i|\boldsymbol{x}_i) = \frac{e^{-\mu}\mu^{y_i}}{y_i!} \quad (y_i = 0, 1, 2, \dots). \tag{1}$$

The conditional mean is parametrized as

$$\mathrm{E}(y_i|\boldsymbol{x}_i) = \mu_i = \exp(\boldsymbol{x}_i'\boldsymbol{\beta}), \tag{2}$$

where $\boldsymbol{\beta}$ is a vector of parameters to be estimated.[7] Since $Var(y_i|\boldsymbol{x}_i) = E(y_i|\boldsymbol{x}_i) = \mu_i$, the model is heteroskedastic. It can be easily estimated by maximizing the log-likelihood function, which is given by

$$\ln L(\boldsymbol{\beta}) = \sum_{i=1}^{N} \{y_i \boldsymbol{x}_i'\boldsymbol{\beta} - \exp(\boldsymbol{x}_i'\boldsymbol{\beta}) - \ln y_i!\}. \tag{3}$$

The equality between the mean and the variance of the Poisson distribution, also known as equidispersion property, is very often rejected by data, since the variance exceeds the mean. A simple solution to this problem is to assume a Negative Binomial (NB) distribution for y_i (given $\boldsymbol{x}_i$), which allows a more flexible modeling of the variance. The NB distribution writes as

$$f(y_i|\boldsymbol{x}_i) = \frac{\Gamma(y_i + \alpha^{-1})}{\Gamma(y_i + 1)\Gamma(\alpha^{-1})} \times \left(\frac{\alpha^{-1}}{\alpha^{-1} + \mu}\right)^{\alpha^{-1}} \left(\frac{\mu}{\alpha^{-1} + \mu}\right)^{y_i} (\alpha > 0;\ y_i = 0, 1, 2, \dots) \tag{4}$$

[7]Note that, by (2), $\mu > 0$.

where $\Gamma(\cdot)$ is the gamma function and α is an additional parameter to be estimated. The mean and variance are now $E(y_i|\boldsymbol{x}_i) = \mu_i$ and $Var(y_i|\boldsymbol{x}_i) = \mu_i + \alpha\mu_i^2$. If the conditional mean is still parametrized as in (2), then the log-likelihood becomes

$$\ln L(\boldsymbol{\beta}) = \sum_{i=1}^{N} \left\{ \sum_{j=1}^{y_i-1} \ln(j + \alpha^{-1}) - \ln y_i! - (y_i + \alpha^{-1}) \ln[1 + \alpha \exp(\boldsymbol{x_i}'\boldsymbol{\beta})] + y_i \ln \alpha + y_i \boldsymbol{x_i}'\boldsymbol{\beta} \right\}. \quad (5)$$

Note that if $\alpha = 0$, (4) reduces to the Poisson distribution (1), which means that the Poisson model is nested within the NB model. Then one can choose between the two models by means of an LR test of $H_0: \alpha = 0$ against $H_1: \alpha > 0$. Given the expression of the conditional variance of the NB model, this is equivalent to test for overdispersion (Long and Freese 2001).

Alternatively, both a Wald test and an LM test are available. The former can be performed using the t test statistic of the estimated α parameter, while the latter requires testing the significance of α in the following auxiliary OLS regression:

$$\frac{(y_i - \hat{\mu}_i)^2 - y_i}{\hat{\mu}_i} = \alpha\hat{\mu}_i + u_i, \quad (6)$$

where $\hat{\mu}_i = \exp(\boldsymbol{x_i}'\boldsymbol{\beta})$ are the fitted values of the Poisson model and u_i is an error term (Cameron and Trivedi 1998).

With the estimated parameters at hand, marginal effects can be calculated. The effect of one-unit change in the j-th regressor on the conditional mean, evalueted at the sample mean of the covariates, is given by

$$\text{MEM}_j = \frac{\partial E(y|\boldsymbol{x})}{\partial x_j} = \beta_j \exp(\overline{\boldsymbol{x}}'\boldsymbol{\beta}). \quad (7)$$

A better approach (Bartus2005) is to use (7) (with $\boldsymbol{x}_i$in place of $\overline{\boldsymbol{x}}$) to compute the marginal effect over all individuals and then taking their average, that is

$$\text{AME}_j = \frac{1}{N}\sum_{i=1}^{N} \beta_j \exp(\boldsymbol{x_i}'\boldsymbol{\beta}). \quad (8)$$

Besides, for a dummy variable, one should use the finite difference method. In this case the marginal effect is the change in the conditional mean when the variable changes from 0 to 1. Formally, let $\boldsymbol{x}_i = [\boldsymbol{z}_i\ d_i]$ and $\boldsymbol{\beta} = [\boldsymbol{\beta_z}\ \beta_d]$, where d_i is the dummy variable. Then

$$\text{AME}_j = \frac{1}{N}\sum_{i=1}^{N} \{\exp(\boldsymbol{z_i}'\boldsymbol{\beta_z} + \beta_d) - \exp(\boldsymbol{z_i}'\boldsymbol{\beta_z})\}. \quad (9)$$

DATA AND VARIABLES

The data used in this study come from the Survey of Household Income and Wealth (SHIW) conducted by the Bank of Italy in 2010.[8] The survey involved 7951 households, which are representative of the Italian population. The respondent was the head of the household, who supplied information on composition of the family and the socio-demographic characteristics of its members, employment, income and consumption, wealth, use of the payment instruments and relationship with the financial intermediaries. While some questions concern every member, some others involve the household as a whole.

[8]The survey is carried out since 1977 every one or two years. We used the most recent available data.

The variables drawn or constructed from the dataset[9] are described in Table 3, while their descriptive statistics are shown in Table 4 and 5.

CRECAR is the number of credit cards held by the household and represents our dependent variable. On average, each family in the sample holds 0.47 credit cards. However, about the 68% of the sample have no credit cards, while a large portion (about 30%) holds one or two. The maximum number of credit cards held is seven. The variable is overdispersed, since its variance is equal to 0.8.

As regressors we consider two distinct sets of variables.[10] The first set includes the following variables:

- the age of the head of household (AGE). It is expected that households whose head is older held more credit cards. However, behind a certain threshold value the relationship should invert and become negative. To test this hypothesis, we include the square of AGE (labelled as AGESQ) as an additional regressor;

- the number of the household members (NCOMP). Larger families are likely to own more credit cards, so the expected sign of the corresponding coefficient is positive;

- household net wealth (WEALTH). A larger wealth should reflects an higher standard of living and thus the propensity to hold more payment instruments. Moreover, for wealthy people, increasing the number of credit cards held could be a way of showing their social status (Gan et al. 2008). Then we expect a positive coefficient for this variable;

- the household net disposale income (INCOME). Households that earn more should fulfill the income requirement for credit card eligibility more easily, so it is expected that this variable positively affects the credit card ownership.

The second set of covariates aims to capture the effect of geographic and other socio-demographic factors and consists of the following groups of dummy variables:

- *Geographic location* (NORTH, CENTRE and SOUTH). This group of dummies records the location where the household resides. As it is well known, in Italy the level of social and economic development reduces going from North to South. Thus, assuming NORTH as the reference group, we expect the sign of the SOUTH coefficient to be negative, that is households located in the southern regions should possess less credit cards. By the same reasoning, the CENTRE variable should negatively impact on the number of credit cards, but its effect should be lower in magnitude;

- *Municipality size* (SMUN, MMUN, LMUN). These variables consider whether a given household resides in a small (up to 40,000 inhabitants), medium (from 40,000 to 500,000 inhabitants) or large (more than 500,000 inhabitants) municipality, respectively. Considering SMUN as reference, both MMUN and LMUN coefficient are expected to be positive, since living in a more dynamic social and economic environment - as it occurs in larger cities - should foster the credit card ownership;

- *Sex* (MAL, FEM). Both variables are either zero or one depending on the gender of the family head, being MAL the omitted category. The sign of the FEM coefficient is not a priori determinable;

- *Education* (NSC, CSC, HSC, BDP). By means of this group the effect of education is considered. The head of family could have no education (NSC), attended the compulsory school (CSC), hold a high school diploma (HSC) or attained a Bachelor/post-graduate degree. Again, considering the first variable as the reference group, the coefficients of the remaining dummies should exhibit a positive sign. Indeed, more educated individuals are expected to be more confident in using a

[9]The dataset is freely available at http://www.bancaditalia.it/statistiche/indcamp/bilfait/dismicro.

[10] Before proceeding, it is worth noting that CRECAR is available only at a family level, while most of the variables we are going to discuss in the text concerns the head of household (see Table 3). Then we are assuming that the latter variables give a good description of some characteristics of the household considered as a whole. This seems to us to be a better solution with respect to resort to some index based on all family members' data.

larger number of credit cards and managing additional bills;

- *Marital status* (MAR, SIN, SDW). Here we take into account whether the head of family is married (MAR), single (SIN) or separated/divorced/widower/widow (SDW). Married people could possess multiple credit cards in order to manage the family balance sheet more efficiently. On the other hand, not married individuals (especially singles) could be more prone to credit card ownership because of a more free lifestyle. Thus for this variables we have no a priori knowledge about the sign of their coefficients. As before the omitted category is the first one (MAR).

Summing up, and jointly considering the reference groups defined above, the "base"' head of houseold is a married male, with no educational qualification and living in a small municipality located in the North of the country.

Moreover, on the basis of the figures reported in Table 5, we can state that the most frequent profile in the sample is a married male, who has completed the compulsory school and residing in a medium sized city of northern Italy.

TABLE 3: Descrption of the variables

Variable	Description
CRECAR[a]	Number of credit cards held by the family members (dependent variable)
AGE[b]	Age of the head of household
NCOMP[a]	Number of the household members
WEALTH[a]	Net wealth (real assets + financial assets - financial liabilities)
INCOME[a]	Net disposale income of the household
DUMMYVARIABLES	
Geographiclocation[a]	
NORTH[*]	North
CENTRE	Centre
SOUTH	South
Municipalitysize[a]	
SMUN[*]	Small municipality (up to 40,000 inhabitants)
MMUN	Medium municipality (from 40,000 to 500,000 inhabitants)
LMUN	Large municipality (more than 500,000 inhabitants)
Sex[b]	
MAL[*]	Male
FEM	Female
Education[b]	
NSC[*]	No educational qualification
CSC	Compulsoryschooldegree
HSC	High schooldegree
BDP	Bachelor's degree or post-graduate qualification
Maritalstatus[b]	
MAR[*]	Married
SIN	Single
SDW	Separated/divorced or widower/widow

[a]Variable (or group) refers to the household as a whole.
[b]Variable (or group) refers to the head of household.
[*] Reference group.

TABLE 4: Summary statistics

Variable	Mean	Std. Dev.	Min.	Median	Max.
CRECAR[a]	0.47	0.8	0	0	7
AGE[b]	58.37	15.76	18	59	99
NCOMP[a]	2.49	1.26	1	2	12
WEALTH[c]	0.27	0.54	-0.08	0.17	26.12
INCOME[d]	33.27	24.61	-0.87	27.69	587.78
Observations	7951				

[a]Units – [b]Years – [c]Millions Euro - [d]Thousands Euro

TABLE 5: Dummy variables summary statistics

Variable	Obs.	Perc.
Geographic location		
NORTH*	3477	43.7
CENTRE	1699	21.4
SOUTH	2775	34.9
Municipality size		
SMUN*	3486	43.8
MMUN	3738	47
LMUN	727	9.1
Sex		
MAL*	4335	54.5
FEM	3616	45.5
Education		
NSC*	365	4.6
CSC	4626	58.2
HSC	2061	25.9
BDP	899	11.3
Marital status		
MAR*	4956	62.3
SIN	993	12.5
SDW	2002	25.2
Total	7951	100

*Reference group

EMPIRICAL RESULTS AND DISCUSSION

Using the data set described above, both the Poisson and the NB models have been estimated by means of maximum-likelihood. Estimation results are reported in Table 6. In the Poisson model most of the estimated coefficients are significant at least at the 5% level. However, the test based on the auxiliary OLS regression (6) rejects the null hypothesis of equidispersion ($\alpha = 0$). The same apply to the result of the LR test. Furthermore, both the Akaike (AIC) and the Bayesian (BIC) information criterions are higher in the case of the Poisson model. Thus, the NB model has to be preferred to the Poisson model and in discussing results we will focus on the former of the two.

Nevertheless, the overdispersion is not severe. In fact, the estimated α is small (0.09 in the auxiliary OLS regression and 0.08 in the negative binomial model) and the parameter standard errors of the two models are very similar.

From the third column of Table 6, we see that, in the NB model, 14 regressors out of 16 have a statistically significant impact - generally at the 1% level - on the number of credit card held by Italian households.

The coefficient of AGE is positive, while that of AGESQ is negative, which implies an inverted U relationship between the age and the number of credit cards. Put differently, this means that the number of credit cards held

increases as age increases, but only up to a certain value, from which it decreases. From the estimated coefficients, this value is equal to 0.0836/(2*0.0009) = 46.44, as can also be seen from Figure 3, which plots the number of credit cards as a function of the age for the base level individual and setting all variables but dummies to their means.

The last column of Table 6 reports the average marginal effects (AME) of the negative binomial model computed according to (8) and (9). For AGE the AME is -0.006, which means that, on average, one more year of age is associated with 0.006 fewer credit cards. Thus the impact of the age on the credit card ownership is fairly small.[11] The NCOMP parameter is not significant, meaning that the number of credit cards is unaffected by the household size. Maybe, this variable would be better measured if it was net of the number of children in the family. Actually, they are not legally able to own a credit card.

The household net wealth (WEALTH) is significant but, contrary to what was expected, it exerts a negative effect on the quantity of credit card. The magnitude of the marginal effect, however, is negligible: if wealth increases by one million, then number of credit cards reduces by only 0.027.

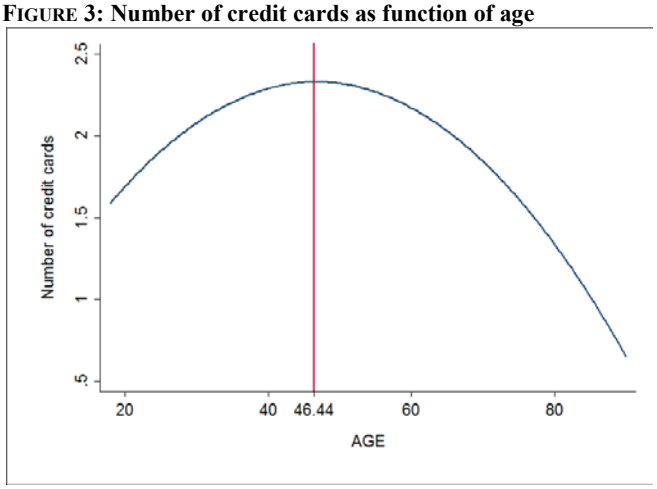
Instead, the number of credit cards increases with income (INCOME) by 0.005 for each additional thousand euros or, which is the same, by 5 for each million euros. Thus, when considering the economic well-being of households, the decision on how many credit cards to hold seems to be driven mainly by income, although its effect is not so high.

Turning to the dummy variables included in the model, those associated to the geographic location (CENTRE and SOUTH) are both strongly significant and negative, confirming that, as one moves from North to South along the country, households tend to hold fewer credit cards. As already noted, this can be explained by the lower level of socioeconomic development prevailing in the southern part of Italy. Particularly, households living in the South own 0.338 fewer credit cards than those residing in the North (which represents the reference group). The same applies to families located in the central Italy, but the effect is much lower (0.078).

Among the variables recording the size of the municipality where the household lives, MMUN and LMUN, only the former is significant and shows a positive sign. Looking at the magnitude of the marginal effect, we can state that the number of credit cards held by families living in medium sized cities increases by 0.038 with respect to that held by families residing in small municipalities. We also found that households whose head is a woman possess fewer credit cards than households with a male head, although the difference is quite small (0.089). The number of credit cards held is higher when the head is more educated, as shown by the positive sign of the coefficient CSC, HSC e BDP. Particularly, families whose head attended the compulsory school hold 0.237 more credit cards than those whose head has no education. If the head of household attained a high school diploma or a Bachelor/post-graduate degree, then the family holds 0.593 and 0.707 credit cards, respectively, more than the reference group. In other word, an increasing relationship between the number of credit cards held and the level of education seems to exist. Finally, households held fewer credit cards, if their heads are single or separated/divorced/widower/widow. The marginal effects are 0.135 and 0.156 respectively.

[11] However, since the relationship is not linear, the marginal effect varies with the age.

FIGURE 3: Number of credit cards as function of age



CONCLUDING REMARKS

In this paper we have studied the determinants of the use of one of the major electronic banking services (credit cards) by Italian families. Using data from the most recent Survey of Household Income and Wealth (SHIW) conducted by the Bank of Italy and count data models, we have found that factors such as wealth, income and geographic location of the household, and socio-demographic characteristics of the head of household are effective in predicting the number of credit cards held. Among those factors, those exerting a stronger impact are the location where the household resides and the level of education and the marital status of the head of household.

More precisely, families living in the South of Italy and whose head is single or separated/divorced/widower/widow possess fewer credit cards, while families whose head is more educated held more credit cards. These results could be of help in understanding some characteristics of the credit card market such as “multi-homing” and “co-holding”.

Perhaps, other factor could be included among the determinants of the number of credit cards, but the availability of data and the absence of a theory that could guide this choice are quite binding. A possible solution would be the use of panel data and then the modelization of unobserved heterogeneity. We leave this for future research.

TABLE 6: Estimation results – Dependent variable: CRECAR

Variable	Poisson	Negtive Binomial	
		Coefficient	AME
Constant	-4.8751***	-4.6994	-
	(-0.5380)	(-0.4839)	-
AGE	0.0907***	0.0836***	-0.0062***
	(-0.0101)	(-0.0098)	(0.0008)
AGESQ	-0.0010***	-0.0009***	-
	(-0.0001)	(-0.0001)	-
NCOMP	0.0205	0.011	0.0053
	(-0.0198)	(-0.0185)	(0.0089)
WEALTH	-0.0765*	-0.0565**	-0.0272**
	(-0.0461)	(-0.0233)	(0.0112)
INCOME	0.0088***	0.0108***	0.0052***
	(-0.0011)	(-0.0008)	(0.0004)
Geographic location			
CENTRE	-0.1281***	-0.1402***	-0.0783***
	(-0.0389)	(-0.0413)	(0.0226)
SOUTH	-0.8516***	-0.8312***	-0.3381***
	(-0.0501)	(-0.0489)	(0.0179)
Municipality size			
MMUN	0.0868**	0.0783**	0.0380**
	(-0.0354)	(-0.0371)	(0.0180)
LMUN	0.0015	-0.0302	-0.0139
	(-0.0583)	(-0.0600)	(0.0274)
Sex			
FEM	-0.1906***	-0.1882***	-0.0885***
	(-0.0352)	(-0.0381)	(0.0175)
Education			
CSC	1.7168***	1.6971***	0.2370***
	(-0.4667)	(-0.4113)	(0.0237)
HSC	2.5368***	2.4975***	0.5928***
	(-0.4673)	(-0.4120)	(0.0823)
BDP	2.7523***	2.6606***	0.7072***
	(-0.4692	-0.4134	(0.0354)
Marital status			
SIN	-0.3100***	-0.2982***	-0.1347***
	(-0.0603)	(-0.0654)	(0.0268)
SDW	-0.3745***	-0.3549***	-0.1561***
	(0.0611)	(0.0614)	(0.0241)
Overdispersion test	0.09	-	
	(0.0002)	-	
F test	-	17.55	
	-	(0.0000)	
Log-likelihood	-5879.35	-5870.57	
Parameters	16	17	
AIC	11790.70	11775.15	
BIC	11902.39	11893.82	
Pseudo R^2	0.2158	0.1954	
Observation	7951	7951	

Significant at: *** = 1% level; ** = 5% level; * = 10% level. Standard errors of parameters and elasticities and p-values of the tests in parentheses. For the Poisson model standard errors are robust.
Reference groups: NORTH, SMUN, MAL, NSC, MAR.

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Latent Theoretical Constructs of Service Dominant Logic

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ABSTRACT

Purpose. The paper explores latent theoretical constructs of Service Dominant Logic (SDL). As pointed out by Leroy *et al.* (2013), there is a risk of premature black-boxization to consider closed the debate on SDL perspective (Vargo and Lusch, 2004; Vargo and Morgan, 2005, Vargo *et al.,* 2006) in marketing and management theory. SDL is acquiring an iconic status thereby precluding any further controversy. This theoretical paper on the debate of SDL in management theory (Vargo and Lusch, 2011; Lusch and Vargo, 2011; Achrol and Kotler, 2006) aims to assess its distinctive contribution, also latent one, and eventual pitfalls. This assessment is carried out identifying, selecting and analyzing the main literature on the topic (conference papers, working papers and management reviews articles).

Design/Approach/Methodology. The research design is innovative because it adopts a methodology of text mining on SDL literature base to zooming in its latent theoretical constructs, and authors' speculative reflections, to zooming out for SDL theory advancement.

The literature on SDL - 78 among papers, working papers and management reviews articles - has been examined through a text mining software in order to classify and analyze the literature corpus as unique text corpus by the means of k-means cluster analysis on a multidimensional scaling (MDS) chart.

Findings/Originality. Originality is in the research design. Very few are the literature reviews based on statistical text mining techniques. The expected finding is to assess the real scientific contribution at the date of SDL, identifying its latent theoretical constructs.

Research Limitations. The research has a descriptive and explorative nature. It hasn't been explored, at this stage of research study, any empirical validation.

Implications. To identify further literature research directions for SDL definitive consolidation. The paper is mainly a theoretical one. Managerial implications might be only incidental.

Keywords: Service Dominant Logic, S-D Logic, Marketing Theory, Service Marketing, Service Science.

INTRODUCTION

During the last ten years S-D Logic has nurtured a long debate in marketing on dominant paradigm shifting. Even through the S-D Logic paradigm has been settled in the marketing theory, this paper will demonstrate that it has transcended its literature original domain. At the date the debate hasn't produced yet a clear response. The paper aims to contribute to this debate zooming in explicit literature on the S-D Logic in order to identify its latent theoretical constructs. The (intermediate) purpose is to make clear, at the date, the dimensions and evolutionary patterns in recent years of S-D Logic literature. Speculative reflections by the authors on latent theoretical constructs will be useful for a better understanding of differential contribution of S-D Logic to the marketing and, more in general, management theory.

Several Authors have assessed the impact of Vargo and Lusch's early paper (2004) in marketing and service marketing literature. Leroy *et al.* (2013) have pointed out that the aforementioned paper received the Harold H. Maynard Award[1] and is the most-cited[2] article in the Journal of Marketing over the 2000-2009 decade. Kunz & Hogreve (2011), on the basis of a quantitative research on service marketing articles citations, quotes the paper among the most influential (ranking=12th) service-related publications over the period 1992–2009. The Authors also measure the "prospect factor", namely the potential expected influence of the article over the next period in service marketing discipline. Lush *et al.*' paper, published in 2007, is third ranked (2.00) in respect to "Multichannel Customer Management" (4,98) and "Analysis of customer retention and churn rates" (3,19).

The relevance of Lusch and Vargo's contributions (Lusch and Vargo, 2006, 2011; Vargo and Lusch, 2004, 2008, 2012; Vargo, 2009, 2011; Vargo et al. 2010a, 2010b; Lusch and Nambisan, 2012; Lusch et al. 2007, 2008) has been also the consequence of a successful positioning in literature based on contraposition to G-D Logic traditional paradigm (GDL). During the last decade we have assisted to a continuous process of thinking refinement, clarification by the same Authors. It has been aimed not only to assess the evolution of the paradigm, but to maintain high the interest for the topic, too. Several call for collaborations in scientific community and forums[3] have been launched or participated by the same Authors in order to further deepen and discuss the potentialities of this new dominant "open paradigm". That wave of participation has produced inevitably strong interest towards the topic and increased citation performances.

THEORETICAL BACKGROUND

The S-D Logic paradigm.

In 2004 Lusch and Vargo "*believe that the new perspectives is converging to form a new dominant logic for marketing, one in which service provision rather than goods is fundamental to economic exchange*". That in opposition to the marketing management school founded in 1950 (Drucker, 1954; McCarthy, 1960; Levitt, 1960; McKitterick, 1957). The latter, identified as Goods-Dominant Logic (G-D Logic), traditionally leverages on the marketing mix process, or the "4 P's" (Kotler, 1967, 1972) as implementation framework.

According to G-D Logic (Plé and Cáceres, 2010), value can be seen as a two-stage sequence (Gronroos, 2006;

[1] Harold H. Maynard Award recognizes the author(s) of the article that has made the greatest contribution to the advancement of marketing theory and thought.

[2] With over 3,370 citations in a nine-year period (2004-2013), this article ranks third among all scientific articles on marketing of all time.

[3] In 2005, the University of Otago in New Zealand; in 2007, the Academy of Marketing Science World Conference in Verona, Italy; in 2008, The Forum on Markets and Marketing sponsored by the University of New South Wales in Sydney; in 2009, The Naples Forum on Service held on Capri, Italy. The second FMM (2010) was sponsored by Cambridge University. The Forum on Markets and Marketing held at the University of New South Wales, Australia, in 2008 and at Cambridge University, UK, in 2010, were organized by Robert Lusch and Stephen Vargo to extend the central ideas of S-D Logic.

Vargo and Lusch, 2008). First, value is created by the firm during the production process, namely, in terms of added value. This value is subsequently destroyed by the consumer at the moment of consumption. G-D Logic posits that value creation and value destruction are separate and unilateral, that is, they are not interactive. Instead S-D Logic does imply that value is always co-produced and service provision is relational. Briefly (Vargo and Lusch, 2004), marketing has moved from a goods-dominant view - in which tangible and discrete output and transactions were central - to a service-dominant view, in which intangibility, exchange processes, and relationships are central. Vargo and Lusch (2004), in accordance with both Gummesson (1998) and Gronroos (2000), extend the Logic that the enterprise can only offer value propositions; the consumer must determine the value and co-create it participating to the co-production process.

Vargo and Lusch (2004) clarify the different contribution of operant and operand resources to marketing activities, recalling Constantin and Lusch's (1994) definition. Operand resources are resources on which an operation or act is performed to produce an effect. Operant resources, instead, are employed to act on operand resources (and other operant recourses). Under a goods-centered dominant logic, customers, like resources, became something to be captured or acted on ("segment" the market, "penetrate" the market, and "promote to" the market), in hope of attracting customers. Share of operand resources and share of (an operand) market was the key to success. The relative role of operant resources began to shift in the late twentieth century thanks to Zimmermann (1951), Penrose (1959), Hunt (2002).

Lusch *et al.* (2008) develop further ten (initially eight) foundational premises of S-D Logic, even thanks to the contribution of scientific community in terms of suggestions for further evolution.

The recent evolutionary steps of S-D Logic paradigm

During the last years S-D Logic had experienced several evolutionary steps proposed by the same SDL scholars. In 2006, Lusch and Vargo pointed out:

- service is the best term to qualify the emergent theory of marketing as "*the application of specialized competences (knowledge and skills), through deeds, processes, and performances for the benefit of another entity or the entity itself*";

- all economic entities, as customers and firms, are resource integrators;

- co-creation of value and 'o-production make the consumer endogenous, and are also nested concepts with the former superordinate to the latter in the same way, and with similar implications, as the relationship between service and goods in S-D Logic;

- value creation is a process of integrating and transforming resources, which requires interaction and implies networks. Since service-for-service implies all parties are both value-creators and value beneficiaries, the implication is that the offerer-customer and supply-demand distinction vanishes;

- there is a prevailing G-D Logic lexicon that implies: (1) the connotations of the SDL words are oblique, if not orthogonal, to the ideas it is espousing; and/or (2) what it is trying to explain is often misunderstood.

Lusch and Vargo (2006) advocate a collaboration between the firm (and relevant partners) and the customer allowing for a strategic orientation that informs the more tactical "Four P's." "Products" are viewed in terms of service flows, in which the service is provided directly or indirectly through an object; "Promotion" is reoriented toward conversation and dialog with the customer; "Price" is replaced with a value proposition created by both sides of the exchange; and "Place" is supplanted with value networks and processes.

Lusch *et al.* (2007) extend S-D Logic rationale to firm competitive advantage, addressing nine propositions developed on the basis of the nine foundational premises (at the time) of S-D Logic:

Vargo and Lusch (2008) reaffirm a lexicon confusion deriving from G-D Logic scholars elaboration of S-D Logic paradigm. The Authors mainly clarify that "S-D Logic of marketing," as presented, appropriately, propose an experiential/phenomenological understanding of value. They also argued that the S-D Logic is naturally coherent with social marketing and issues of ethics, and more in general societal issues and non-profit marketing. But evolutionary is the consideration that S-D Logic is not a theory—law-like generalizations, ability to both explain and predict. (e.g., Hunt, 2000). They recognize S-D Logic as "*mindset, a lens through which to look at social and*

economic exchange phenomena so they can potentially be seen more clearly.

Vargo (2009) proposes and elaborates a new S-D Logic conceptualization of relationship that transcends traditional ones. Co-creation and service exchange imply a value-creating relationship or, more precisely, a complex web of value-creating relationships, rather than making relationship an option. In particular contexts, optimal (for the firm), normative relationships might include repeat patronage (i.e. multiple, relatively discreet transactions).

Merz *et al.* (2009) demonstrated that brand scholars have shifted their focus over the past several decades from viewing a brand as an identifier to viewing it as a dynamic and social resource. Brand value under a S-D Logic perspective (Ballantyne and Aitken, 2007; Fyrberg and Jüriado, 2009) is co-created with all stakeholders and, at the same time, determined by the value collectively perceived by the stakeholders their own lives. Furthermore, it shifted from viewing internal and external customers as exogenous to the brand value creation process to viewing them as endogenous. Finally, the branding literature shifted from viewing brands as operand resources, and directly connected to the market offering, to viewing brands as operant resources that exist independently from the market offering.

In 2010 there were some contributions inspired to S-D Logic in supply chain field. Performance-based logistics (PBL) has been defined by Randall *et al.* (2010) as a strategy for improving the performance and lowering the cost to sustain complex systems (e.g., passenger aircraft, defense systems, and high-speed rail) during the post production phase of their life-cycle. PBL is a reshaping of business model by MRO (maintenance, repair, operation). This mode of contracting is starting to re-shape how MRO service contracts are being formed. In essence, PBL is about contracting on performance, rather than tasks or inputs by the service provider[4].

S-D Logic (Vargo and Lusch, 2004; Lusch *et al.*, 2008; Vargo *et al.*, 2010a) has been recognized as a potential philosophical foundation for "service science" from Maglio and Spohrer (2008). Service science is an interdisciplinary field that "combines organization and human understanding with business and technological understanding to categorize and explain the many types of service systems that exist as well as how service systems interact and evolve to co-create value" (Maglio and Spohrer, 2008, p. 18). Service systems are "*value co-creation configurations of people, technology, value propositions connecting internal and external service systems and shared information*" (p. 18).

Chandler and Vargo (2011) elaborate the concept of value-in-context: the interaction among various actors contributes to value co-creation. The Authors propose a multilevel approach for conceptualizing context, which is composed of micro, meso, and macro levels, as well as a meta layer that allows for oscillation among the other three levels of context. This view on value-in-context emphasizes the recursive nature of value co-creation in service ecosystems. In this view, as actors interact to co-create value for themselves and for others, they not only contribute to individual level of experiences, but also contribute to the formation, or contextualization, of the social context through which value is being derived. This social context is composed of several interconnected relationships (Chandler & Vargo, 2011) and the social norms or ''institutions'' that guide the interaction as well (Edvardsson *et al.*, 2011; Lusch and Vargo, 2011). Akaka *et al.* (2012) extend this concept. "*Value-in-context suggests that value is not only always co-created, it is also contingent on the availability and integration of other resources and thus is contextually specific* (Vargo *at al.*, 2010b)". But they evolve further the concept affirming that "*the success of a firm can be recast from a logic that focuses on making better products to increase market share in existing markets to one of designing new markets and redefining existing markets and thus dominating them*".

Lüftenegger *et al.*(2012), propose a canvas model to adapt S-D Logic to business strategy design. The model is based on three variables: market relationships, business competences and business resources. Firstly, the market relationships answer the question: "*how do we relate with our business environment in a service dominant business*?". Secondly, the business competences, answer the question: "*how do we enact our business relations in a service dominant business*?". Finally, the business resources answer the question : "*what ingredients do we need to enact our service dominant strategy*?".

[4] For example, in the case of Rolls Royce, the service provided to maintain engines is being remunerated on the basis of how many hours the engine is "in the air", a concept known as "power by the hour".

Lusch and Nambisan (2012) give a broadened definition of service innovation: it can be considered the re-bundling of diverse resources that create novel resources that are beneficial (i.e., value experiencing) to some actors in a given context; this almost always involves a network of actors, including the beneficiary (e.g., the customer). They offer a meta-theoretical foundations of S-D Logic service innovation: service ecosystem, service platforms, and value co-creation.

Specifically, actor-to-actor networks imply the significance of service ecosystems. Resource density and resource liquification imply the relevance of service platforms. Finally, resource integration implies the significance of the roles and processes underlying value co-creation and brings the focus on the mechanisms that can enhance such activities.

Major criticism towards the S-D Logic paradigm

Achrol and Kotler (2006), argue that "*the distinction between operand and operant resources is not important ontologically. In theory no resource is inherently operand or operant; it is only a function of the level of explanation and the role (explananda or explanandum) that the variable (resource) plays in the theoretical scheme. Labor and capital are both operand and operant resources. So are knowledge and information. When resources are created or acquired, they are operands. When they are applied to a problem, they are operants*".

On the same side of criticism even Campbell *et al.* (2013) "*We thus come to a critical realization; the operant (knowledge, skills, mental life, information) is only available within and through the operand (material life), and the type and quality of operant is dependent on the type and quality of operand resource in which it is embedded. …… The operand therefore sets the possibilities and the limits of the operant. Thus, any theory of service must theorize the bodies that perform service work, the material objects used to deliver it, and the material that it generates, three areas on which we elaborate*". They propose to see operant and operand resources co-evolving interdependent, so organizations will re-visit operand resources in a new light, not merely as static stuff, but as intelligent entities whose properties are not always "worked on", but rather followed by, humans.

As summarized by Lusch and Vargo (2011), O'Shaughnessy and O'Shaughnessy (2009) consider, "*S-D Logic a backward step for the marketing discipline"*. More specifically, they suggest that S-D Logic: *[. . .] is neither logically sound nor a perspective to displace others in marketing (p. 784); it does reflect an "[. . .] indifference to theoretical considerations" (p. 784); it has had a "considerable impact among marketing scholars, particularly in the USA" (p. 785); it is promoted "as the single best perspective for marketing is regressive" (p. 785); it represents a "wrong-headed advocacy of technology at the expense of explanatory theory" (p. 791).*

Leroy *et al.* (2013) affirm that exists a risk of premature black-boxization of the concept; however, believing the controversy on the subject to be far from over. There is a "*current inability of the concept S-D Logic to account for the heterogeneity of the reality of exchanges and, in particular, BtoB exchanges*. *The concept indeed functions more as a metaphor than as a genuine scientific construct"*. In order to forestall the value co-creation black box, they propose a scale for observing reality that allows any researcher to zoom in to better determine the level of granularity that suits the inquiry at hand.

METHODOLOGY

Some Authors (Van Mele, 2006; Nicolini, 2009; Leroy *et al.,* 2013) have emphasized the benefits of continuously switching theoretical lenses in literature topic repositioning. This approach has been named (Van Mele, 2006) ZiZo (Zooming in and Zooming out) approach. The research design is innovative because it adopts a methodology of text mining on S-D Logic literature base to zooming in its latent theoretical constructs, and authors speculative reflections on theoretical repertoires, to zooming out for S-D Logic theory advancement.

The research approach is qualitative (Sawhney, 2004; Gummesson, 2005; Spanjaard and Freeman, 2006; Cantone and Testa, 2010, 2011). However, it is both based on qualitative data (literature text corpus sentences) and statistical because it recurs to a statistical text mining technique to reduce the researcher interpretive subjectivity.

The research questions are the following ones: 1. which are latent theoretical constructs of S-D Logic and their evolutionary patterns (zooming in)? 2. What is the differential contribution of S-D Logic in marketing discipline

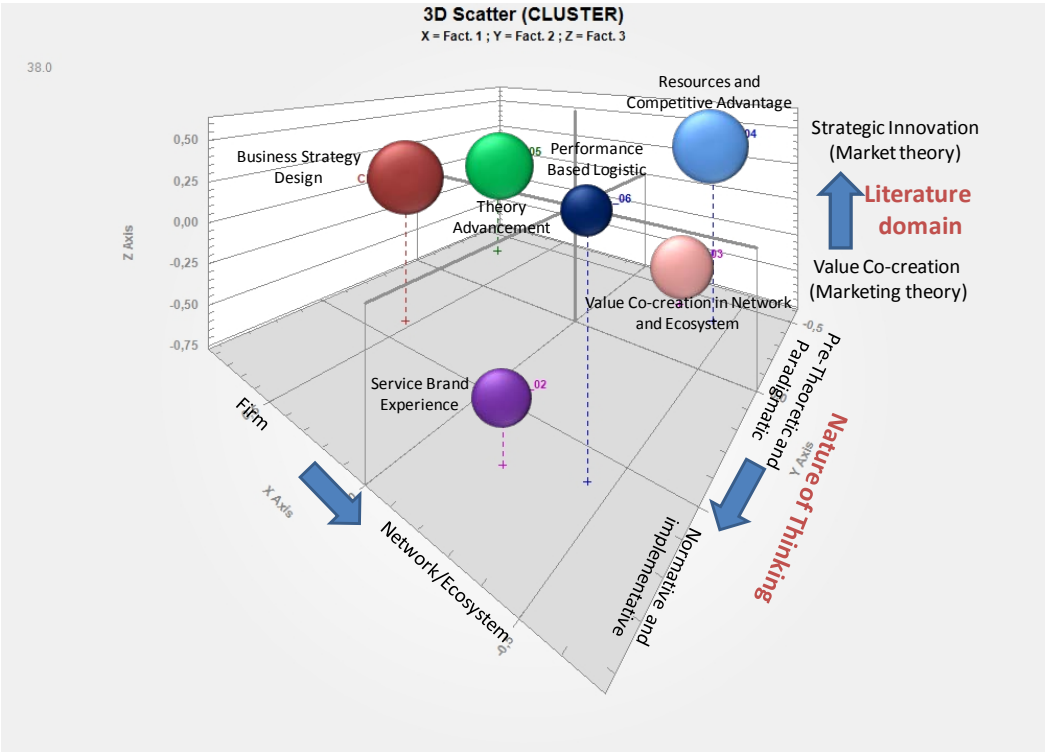
evolution (zooming out)? The literature on S-D Logic has been acquired through a text mining software in order to classify and analyze the literature corpus as unique text corpus by the means of k-means cluster analysis on a multidimensional scaling (MDS) chart. They have been collected 78 among papers, working papers and reviews articles on S-D Logic starting since 2004 (when has been written the first article of Vargo and Lusch). Among 78 articles, 12 are contributions of the same Lusch and Vargo, founders of the S-D Logic paradigm.

Literature corpus text was analyzed by using a text-mining technique and software, an established social science research methodology. The objective was to identify interesting patterns and relationships in textual data (Feldman and Sanger, 2007; Lancia, 2004), by completing a thematic clustering analysis. Cluster analysis is a powerful procedure that is used to represent the contents of the text corpus through a few significant thematic clusters. They are also identified on latent semantic axes, described by lexical units that characterize the literature's sentences submitted to the analysis.

FINDINGS

As stated above, the cluster analysis identifies the macro (semantic axes) and micro (clusters) latent concepts, namely, the "latent (macro and micro) theoretical constructs of service dominant". In giving interpretation to the clusters the researcher is aided by several sentences that the software identifies as very inherent with the meaning of the specific thematic cluster and keywords or lemmas (groups of keywords with the same semantic root) much more related to the specific cluster. The following sections report the main findings of the theoretical investigation. The procedure of cluster analysis, conducted by the text-mining software, has allowed to identify six theoretical repertoires (latent S-D Logic theoretical constructs), also defined "thematic clusters", distributed within a three-dimensional graph, as described in Figure 1.

Figure 1: the macro and micro latent theoretical constructs of S-D Logic.



The first observation that can be made is that clusters 5, 4 and 6 are correlated, positively or negatively, to x axes; clusters 2 and 5 are correlated, positively or negatively, to y-axes; clusters 2 and 1 are correlated, positively or negatively, to z-axes; no clusters are located in a barycentric position in respect to the three axes. It was decided to

start with what is called the second axis (x-axis), trying to analyze the meanings of each cluster, considering the keywords that co-determine each theoretical repertoire in order to interpret and name each latent dimension.

Cluster 1[5]. The most important keywords explaining this cluster are *SDL*, *dominant*, *paper*, *study*, *research*, *framework*, *empirical*, *strategy*, *concept*, *strategic business definition*, *conceptual*, *model*, *theoretical*, *analysis*, *orientation*, *implication*, *question*, *project*, *canvas*, *experiment*, *industry*, *Harry Potter*, *qualitative*, *design*, *ontology*, *explore*, *DT*, *step*, *GDL*, *observation*, *subject*, *propose*, *sustainability*, *identify*, *questionnaire*, *management*, *phenomenon*, *imp*, *idea*, *statement*, *analytic*, *examine*. These words highlight the attention of literature on S-D Logic, counter running to Goods-Dominant Logic as a conceptual exploratory research framework (canvas) to design a business idea. The following statements are the ones that most clearly express the meaning assigned to the cluster:

- *Because service design is concerned with the design of services, in practice and in research, it makes sense to compare the design discipline with SDL. In this paper, however, I have chosen to explore SDL and design thinking (DT) rather than SDL and service design. The main argument for this is that SDL includes both services and goods in the notion of service* (Edman, 2009).

- *In Section 5, we identify the elements of a Service Dominant strategy. In this section, we use the identified elements to construct a service dominant strategy model: the service dominant strategy canvas (Lüftenegger et al., 2012).*

- *This view implies that strategy is concerned with developing elective resources and capabilities that "correspond to key success factors in the target market" (Day, 2004, p. 19).The SDL draws on a number of ideas that have been in the literature for some time (Day, 2004); scholars have integrated the theoretical aspects of the SDL. Drawing on the literature, the paper integrates the SDL's managerial implications. Specifically, the paper examines the SDL's impact on a) firm personnel and b) the market's competitive dynamics (Finney at al.,* 2011).

In accordance with all the statements analyzed, it is clear that the literature references expressed the concept "*business strategy design"* under a S-D Logic. In fact, they have been associated in the sentences references to Service Dominant Logic, Business Canvas, Strategic Orientation, Design Thinking, mainly under firms and businesses perspective. Therefore, the label assigned to the cluster is "Business Strategy Design".

Cluster 2[6] is described by the following keywords: *experience*, *company*, *brand*, *customer*, *art*, *complaint*, *negative*, *Hotel*, *complain*, *disclosure*, *co-creation*, *incident*, *behavior*, *perception*, *IC*, *response*, *co-production*, *guest*, *University*, *unfavourable*, *communication*, *Item*, *artist*, *participant*, perceive, *word-of-mouth*, *image*, *student*, *professor*, *stakeholder*, *provider*, *recipient*. This cluster refers to the brand experience and the key concept in S-D Logic of value co-production and value co-creation. It also refers to some studies carried out under the S-D Logic paradigm on art and artist and university students co-creating brand experiences. To support this interpretation we report in the following main statements that best represent the cluster:

- *These experiences certainly are invaluable and more attractive to customers. Clearly, the "shared experience" satisfies customers more than just "information sharing". It enhances value co-creation by connecting people to share great experiences around cooking. With Cookpad, customers reduce the time they need to learn about preparing food and learn from others' experiences* (Doan *et al.*, 2013).

- *Etgar (2007) noted that the primary motive for co-production is the desire on the part of individuals to customise experiences to suit to their needs. Within art experiences this is very pertinent. An exchange between two focus group participants demonstrated how individuals customise art experiences to heighten the positive impact of those experiences* (White *et al.*, 2009).

- *For example, Prahalad (2004) focused on co-created brand experiences. This Author proposed that*

[5] For cluster 1, which expresses 17.69% of the total cultural space, the keywords have been subject to analysis; *chi ²*, which is the indicator of the relationship between words and clusters, has a value between 1527,376 and 106,956.

[6] The weight of cluster 2 is equal to 12.46% of the total cultural space, even in this case we proceeded to analyze all the elementary context units and keywords with *chi²* between 2715,136 and 110,898.

"experience is the brand". Brodie et al. (2006) defined the service brand in other way: "service brands facilitate and mediate the marketing processes used to realize the experiences that drive co-creation of value (Nguyen *et al.*, 2012).

These aspects consistent with the S-D Logic considerations. The brand experience is co-created by consumers through individual experiences, such happen in the art world or Cookpad service. In contraposition to customer-based brand equity model (Keller, 2002), the brand knowledge isn't a response to firm identity building but it is a "Service Brand Experience", the label assigned to cluster 2.

The thematic cluster[7] 3 is characterized by the presence of the keywords: *actor*, *network*, *interaction*, *relationship*, *integration*, *social*, *value*, *exchange*, *ecosystem*, *integrate*, *integrator*, *co-creation*, *resource*, *relational*, *beneficiary*, *creation*, *counterpart*, *particular*, *access*, *transaction*, *rule*, *structure*, *phenomenologically*, *system*, *individual*, *activity*.

In accordance with all the statements analyzed, it is clear that the literature cluster expresses the latent driver of social system value that is phenomenologically created in the ecosystem and or in the network by several actors, even institutions, participating them. To support this interpretation we report in the following main sentences that best represent the cluster:

- *"In this service-ecosystems view, the exchange of service is mediated by networks of interconnected relationships in three ways: (1) networks enable actors to access resources through the development of exchange relationships, (2) networks provide a variety of resources for actors to adapt a particular resources with their unique assortments, and (3) networks enable actors to integrate resources within a broader social context to derive unique experiences while developing new norms and meanings (i.e., shared institutions) and contributing back to the social context through which value is derived* (Akaka *et al.*, 2012).

- *Three central terms in networks are actors, resources and activities. Network actors control resources that add value for other network members, allowing each of them to concentrate on their core competences in an integrated systems perspective (Overby and Min, 2001). The network actors perform activities that combine various resources* (Fyrberg and Jüriado , 2009).

- *Thus, value co-creation is influenced by the shape of the network and norms and meanings that guide interaction among participating social and economic actors. Because social contexts differ, the value determined through use and context is heterogeneous in nature, and value co-creation relies highly on the quality of an actor's surrounding network* (Akaka *et al.*, 2012).

In accordance with these descriptions it was decided to refer to this cluster 3 as "Value Co-creation in Network and Ecosystem".

The thematic cluster[8] 4 is characterized by the presence of the keywords: *resource*, *operant*, *firm*, *operand*, *competitive advantage*, *skill*, *knowledge*, *competence*, *capability*, *proposition*, *specialize*, *source*, *source*, *benefit*, *human*, *employee*, *intangible*, *customer*, *learn*, *procurement*, *tangible*, *application*. These words highlight the attention that literature on S-D Logic pay to operant and operand resources as source of competitive advantage of the network. The customer is considered an operant rather than an operand resource. Operant resources are intangible ones and related to skills, knowledge and competencies: they are human side and always the result of learning pattern by the actors in network and ecosystem.

The following statements are the ones that most clearly express the meaning assigned to the cluster:

- *S-D Logic recognizes technology as bundled, operant resources. New technologies are created by developing new operant resources, finding novel ways to embed operant resources in operand resources and/or finding ways to " liquefy " (Normann 2001) operant resources (i. e., unembed them from operand resources so that they can be*

[7] The cluster 3 shows the 17.85% of the total cultural space. We have considered only lemmas with value between 2410,245 and 100,205.

[8] The cluster 4 shows the 21.78% of the total cultural space. We have considered only lemmas with value between 2940,494 and 102,912.

employed separately) (Lusch *et al.,* 2007).

- *Operand resources are passive resources that require action to make them valuable, whereas operant resources are active resources that are capable of creating value. Competences are embodied in operant resources and the acting of operant resources upon other resources is what constitutes service* (Poels, 2010).

- *Therefore, if operand resources act as distribution mechanisms for operant resources, and the acquisition of these operand resources by the customer may act as a means of satisfying higher-order needs (i. e. enhancing the customers' own operant resources), then how are operant resources integrated? Allee (2008) proposes that intangibles (i.e. operant resources) get to market in two ways, either through conversion to monetary value or rough conversion to a negotiable form of value that can be used more informally as a type of barter* (Peters, 2012).

In accordance with all the statements analyzed, it is clear that the literature on S-D Logic posts expressed the concept of "*operant and operand resources and competitive advantage*". The concept is broader of that considered traditionally under firm theories, in that resources and competencies (operant and operand resources), interacting and integrating each other differently, produce competitive advantage at firm, network and/or ecosystem level, determining the advantage on other firm, network or ecosystem. Therefore, the label assigned to cluster is "Resources and Competitive Advantage".

The thematic cluster[9] 5 is located within the quadrant at the top on the right quadrant, highly correlated to the x-axis, but negatively respect to z-axis. It is characterized by the presence of the keywords: *S-D Logic*, *theory*, *science*, *market*, *G-D*, *discipline*, *issue*, *Vargo*, *think* , *foundational*, *literature*, *ethical*, *foundation*, *Lusch*, *paradigm*, *article*, *premise*, *special*, *Journal*, *economics*, *scholar*, *Shaughnessy*, *FPs*, *ethic*, *lexicon*, *concept*, *Service-Dominant*, *discuss*, *academic*, *general*, *evolution*, *CCT*, *Spohrer*, *mainstream*, *central*, *perspective*, *shift*, *claim*, *ground*, *term*.

It is related to a cluster characterized by S-D Logic literature related to the paradigm setting, in particular due to Vargo and Lusch's paper (2004), "Evolving to a new dominant logic for marketing" published on Journal of Marketing, proposed a general evolution of marketing discipline and ten foundational premises to bring the marketing far from G-D Logic, traditional approach to overcome.

In the following some sentences that better represent the cluster profile:

- *Marketing theory, almost by any definition, implies normative theory. A theory of the market, on the other hand, suggests a positive theory of exchange. "As Hunt (2002) has stressed, normative theory normatively rests on a positive foundation: " good normative theory is based on good positive theory"* (Vargo *et al.*, 2010b).

- *However, S-D Logic does operate as a framework for developing theory, at a paradigm level or way of thinking about how the world works (although we have consistently disclaimed paradigm status). Although S-D Logic is not a theory per se, we do believe that building theory from an S-D Logic foundation is the ultimate goal* (Vargo, 2011).

- *We believe that S-D Logic provides a framework for theorizing, confirming, and refining the theoretical foundation of service science. To have evolutionary potential, however, both S-D Logic and service science must be co-created. We therefore invite others to create the appropriate conceptual foundation for this new science* (Lusch *et al.*, 2008).

These aspects, which are consistent with the paradigm foundation of S-D Logic, have allowed this cluster to be labeled as "Theory Advancement".

The thematic cluster[10] 6 is located within the quadrant at the bottom on the left quadrant, highly (and negatively) correlated to the x-axis. It is characterized by the presence of the keywords: *cost*, *consumer*, *user*, *decision*, *PBL* (*Performance Based Logistic*), *price*, *supplier*, *buy*, *lower*, *performance*, *improve*, *buyer*, *repair*, *site*, *information*,

[9] The cluster 5 shows the 20.62% of the total cultural space. We have considered only lemmas with value between 3533,191 and 102,937.

[10] The cluster 6 shows the 9.59% of the total cultural space. We have considered only lemmas with value between 1471,718 and 102,841.

reduce, *equipment*, *investment*, *purchase*, *program*, *reliability*, *high*, *decrease*, *risk*, *inventory*, *internet*, *increase*, *maintenances*, *Cookpad*, *production*, *broker return*, *sustainment*, *plan*, *contract*, *forecasting*, *order*, *on-line*, *content*, *avoidance*, *bus*, *transport*, *TWX-21*, *forecast*, *OEM*, *CT*, *product*.

We highlighted a series of issues related to some specialist content related to buyer-seller relationship and Performance-Based Logistic. The sentences that describe this cluster are the following:

- *PBL uses supplier knowledge and investment to improve the reliability of the system, decrease cost, and then share in that cost avoidance. Suppliers typically have the greatest knowledge of where opportunities exist to improve products and reliability. Typically, upstream suppliers have lower costs and greater cost avoidance potential* (Randall *et al.*, 2010).

- *PBL converts these pools of cost avoidance into a performance-based incentive. The supplier network harvests any cost savings for a predetermined period to recoup and reward their investment and risk. Periodically, new baselines are established for supplier performance and costs. The new baselines pass cost savings on to the customer* (Randall *et al.*, 2010).

- *System reliability: PBL provides greater reward potential for investment driven improvement than sales-driven repair. Improved reliability reduces the volume of repair transactions, decreases sustainment costs, and improves system performance* (Randall *et al.*, 2010).

Coherently with its profiling content, it was decided to label cluster 6 as "Performance Based Logistic".

Starting from the evidence arising from the cluster analysis, it was possible to give an interpretation to the meaning of the three factors (axes x, y, z) in the cluster's map as well as described in Figure 1. The x-axis is explained positively by the clusters 2 (Service Brand Experience), 6 (Performance Based Logistics) and 1 (Business Strategy Design), and, negatively, by the clusters 4 (Resources and Competitive Advantage), 5 (Theory Advancement), and 3 (Value Co-creation in Networks and Ecosystem). Therefore, we decided to assign meaning of "Nature of scientific thinking" to the x-axis. In fact, S-D Logic was founded as a pre-theoretic paradigm in order to advance marketing theory respect to G-D Logic. During the time the reflections of the same Authors have been deepened on the role of the resources (operant and operand) for competitive advantage and, subsequently, on the new meaning of network and ecosystem in value co-creation and S-D Logic perspective. Recent years, due to the calls for papers of the same S-D Logic Authors, new scientific contributions have been presented in order to make the perspective more normative and theoretic. There have been new researches on important topics like brand experience and engagement under value co-creation perspective, and Business Strategy Design exploring the topic of Business Model Innovation under the arising Markets Theory perspective. Performance Based-Logistic, instead, is related on the modalities under which seller and buyer may evolve towards a new configurations of service relationship, that permits traditional suppliers reconfigure value system in order to internalize some buyer (maintaining, repairing, monitoring) activities, increase profitability and create more value for the buyer.

The y-axis is explained positively by the clusters 1 (Business Strategy Design), 5 (Theory Advancement), and negatively by clusters 3 (Value Co-creation in Network and Ecosystem), 6 (Performance Based Logistics), 2 (Service Brand Experience), 4 (Resources and Competitive Advantage). Therefore, we decided to assign the meaning "Perspective of theoretic investigation" (firm vs. network and ecosystem one) to the y-axis. In fact, the S-D Logic, as the positioning of cluster 5 in the matrix underlines, has been created in order to review G-D Logic which, as is well known, considered the marketing management model and marketing mix leverages under the firm perspective. Even though during its evolutionary pattern it considered some other topic under the firm perspective, such as Business Strategy Design, recent years it has widened its perspective in order to assess the contribution of value co-creation under business network view and in the overall service ecosystem. Resources and competencies (operant and operand resources) are interaction and integration of tangible and intangible resources in business network or wide ecosystem. The Performance Based Logistics has been developed under S-D Logic and Service Science perspective. In fact, the buyer-seller relationship is evolving under the new perspective in a network relationship. S-D Logic overcome the traditional demand-offer and/or buyer-seller distinction. Brand is the value co-creation that arises in the context when several actors experience the firm value offering in a social and/or business context.

Finally, the z-axis is positively explained by the clusters 6 (Performance Based Logistics), 4 (Resources and Competitive Advantage) and 1 (Business Strategy Design), negatively by the clusters 2 (Service Brand Experience),

3 (Value Co-creation in Network and Ecosystem), and 5 (Theory Advancement). Therefore, the meaning of "Literature domain" is assigned to z-axis. In fact, as showed by the positioning of cluster 5, S-D Logic started as a value co-creation marketing theory. Recent years the Authors have tried to exploit the topic in a different direction towards strategic innovation focus and new markets theory. In fact, Performance Based Logistic is mainly related to Service Model Design in industrial relationship in order to gain competitive advantage and win to win performance in network among those traditionally named buyer-seller relationships in G-D Logic. The topic is much more related to Business Model Design than network relationship. Alike Business Strategy Design is related to the definition of business equation in new venture initiatives. Resources and competencies are the enabling resources that permit in the business network and/or the overall ecosystem to gain strategic innovation. Recently, in fact, S-D Logic Authors have published some contributions and launched calls in order to achieve a new "market theory" definition. The same recent contribution on Service Innovation can be considered coherent under this perspective. Concluding recent years S-D Logic had an evolutionary pattern contradistinguished by: a. shifting the nature of thinking from pre-theoretic to normative one; b. shifting the perspective from firm to network and ecosystem one; c. shifting the literature domain from value co-creation to strategic innovation and market theory definition.

DISCUSSIONS

S-D Logic is a paradigm presented in 2004 by Vargo and Lusch in counter run to traditional G-D Logic paradigm. The latter is a definition given by the same Authors to traditional marketing theory, identified with marketing management and marketing mix. Over the last decade there have been several calls in literature by the same Authors for scientific contributions in order to permit S-D Logic to overcame the pre-theoretic step and enter the subsequent step of normative dominant theory in marketing. At the date, S-D Logic remains pre-theoretic and, in our opinion, auto-centered. Meanwhile the several calls resulted in an over citation of S-D Logic in scientific community and its affirmation as mainstream general paradigm. We think S-D Logic gives a valuable contribution to: co-creation literature evolution; "contextualization of value" conceptualization; the rejuvenating of the general marketing theory. However S-D Logic can't be considered at the date an alternative to marketing and strategic management traditional theories.

During this period (2004-2014) there has been a shortage of empirical investigation on S-D Logic and still remains a lack of execution processes or normative implications for S-D Logic practitioners. The S-D Logic school hasn't been able to propose an alternative to marketing management and marketing mix processes. However, the Authors merit to have made explicit and integrated the relationship among some important emergent topics in marketing theory and thinking. "*New logic is considered dominant and bases its roots in various strands "historic" and that is the result of a long interpretative trail, the Service Dominant Logic (S-D Logic) (Vargo and Lusch, 2004, 2006), in which all common aspects of old theories can be integrated with a new dominant logic, that can represent the convergence of contemporary marketing thought*" (Barile and Polese, 2009).

In our opinion doesn't exist at the date a G-D Logic and a S-D Logic but still does exist a whole marketing theory that recent years was already evolving thanks to some important constraints: a growing impact of globalization in economy; a growing relevance of consumer voice in conditioning firm decision on marketing management and firm leverages of marketing mix; a growing importance of digital technologies in giving the consumers and society a relevant role in business environment; a growing awareness of value and co-creation as intermediate goals of marketing decisions and actions.

The marketing management process during last decades has been adapted to such aims. Not good nor service but value proposition is the ultimate goal of marketing action if considered under firm, and, in particular, customer perspective. In laddering techniques, for example, the role of value (terminal and instrumental) in offering had been already explored (a means-end chain model, Gutman, 1982). Fishbein's and Customer Satisfaction models have long time used to determine the "value in use" of value proposition for target customer. The benefit segmentation has solved the matter of segmentation of the potential benefits for customers deriving from firm value offering. The value co-creation isn't a novelty in marketing studies.

The debate on S-D Logic has proven that at the date doesn't exist an alternative to marketing management and marketing mix approach. The same Lusch and Vargo have affirmed "*this reorientation would not necessitate abandonment of most of the traditional core concepts, such as the marketing mix, target marketing, and market*

segmentation, but rather it would complement these with a framework based on the eight (subsequently ten) FPs we have discussed". But complement doesn't mean to substitute nor it can be considered a new marketing theory without a normative and implementation rules and processes. In S-D Logic, collaboration between the firm (and relevant partners) and the customer allows for a strategic orientation that informs the more tactical "Four P's." "Products" are viewed in terms of service flows, in which the service is provided directly or indirectly through an object; "Promotion" is reoriented toward conversation and dialog with the customer; "Price" is replaced with a value proposition created by both sides of the exchange; and "Place" is supplanted with value networks and processes (Lusch and Vargo, 2006).

S-D Logic theory is nearest rather than far from the assumption of the traditional marketing theory that in the long run has proved to overcome. The latter has proved to be flexible in adapting to some evolutionary emergent topics such as: value creation, value proposition, relationship marketing, value co-creation, consumer brand experience. It has proven to be evolutionary in its nature remaining open to research stream adaptation rather than becoming incoherent with them.

Moreover, S-D Logic has proven in the long run to be too ambitious in its evolutionary pattern. The same S-D Logic Authors have explored strategic management field through disseminating their contribution and implication on service science, resources and competitive advantage, strategic orientation, relationship marketing, network and ecosystem. S-D Logic Authors have leveraged on widening the scope of their thinking rather than deepening the implementation process of the same. It's quite difficult to imagine a paradigm that is urgent and effective in service marketing, marketing theory, supply chain management, service science, strategic management, and so on. It is an arguable signal for the theory appreciation that Strategic Management Society doesn't seem to pay strong attention to S-D Logic thinking, at the date.

RESEARCH LIMITATIONS

This paper present some limitations. It hasn't been considered all the literature on S-D Logic but only the explicit one or all the contributions (papers and articles) presented in the period investigated (2004-2013) and explicitly focused on the emergent topic. They are missing contributions that have cited S-D Logic but aren't explicitly focalized on the topic. The research approach is qualitative and descriptive, based on text mining methodology and speculative reflections by the Authors. The findings of the paper are going to be re-elaborated on the basis of the future discussions in the scientific community.

CONCLUSION

This paper is a theoretical contribution on S-D Logic impact in marketing and more in general management theory. It has been proposed a fine zooming in the literature on S-D Logic explicitly focused on this topic. The text mining analysis, in explaining the latent theoretical constructs of S-D Logic and its evolutionary patterns, has evidenced that during the last decade S-D Logic paradigm has transcended its literature original domain (marketing theory). During the last decade the questioning under a service and co-creation perspective on "Resources and Competitive Advantage", "Service Science", "Business Strategy Design", "Service Innovation" and "Network and Ecosystem" has moved the Authors towards the exploration of a new market creation theory. This evolution is much more related to the strategic innovation discipline rather than marketing one.
Proper this shifting of focus demonstrates that the paradigm hasn't been able in the last decade to produce a normative theory for marketing choices and a valid alternative to traditional marketing management and marketing mix processes. Nevertheless, S-D Logic has produced a relevant impact in literature in terms of citations, paper, article and forums and nowadays is doubtless a theoretical umbrella brand under which they are considered several topics not always near and coherent each other. An important merit of S-D Logic is to have rejuvenating marketing theory reviewing it, has contributed to improve co-creation value theory and "contextualization of value" conceptualization. The contribution to strategic innovation theory has to be evaluated in the long run. One of the proposal for the future is to monitor the scientific production of S-D Logic on markets theory creation, in order to eventually assess the differential contribution.

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Applying Ingredient Branding Strategy to Improve Competitiveness in Service Systems

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ABSTRACT

Intangibility is one of the main characteristics of services that create difficulties for users in perceived expectations of service. This viewpoint paper aims to highlight the role played by Ingredient Branding (IB) a strategy implemented to make service more effective. Thus, the paper focuses on the role IB plays in shaping the strategic communications. Starting from a literature review on Service Dominant Logic, Service Science Management Engineering + Design, Strategic Communication and IB, the role of this activity is studied within the service systems context. Then, in order to reach the goal of the paper, secondary sources were exploited generating qualitative data: illustrative examples show the practical use of IB strategies in the service systems. The main implication of the paper lies on the analysis of the important strategic work implemented by the members of the dominant coalition. The paper identifies two different IB strategies: "necessary" and "optional". It shows that there are links between service levels (expected-core service or extended-supplementary service) and IB strategies. By dealing with these links effectively, it appears that IB is a strengthening strategy that could offer distinct competitive advantage in service systems, promote the value proposition and encourage the value co-creation.

Key words: value proposition and value co-creation, ingredient branding, service branding, co-branding, service systems competitiveness

Paper type: Conceptual paper

INTRODUCTION

Branding theory has been developed mainly in the context of consumer products, yet most economies are characterised by companies selling services instead of products. Understanding how branding works in service markets is consequently, a priority. In this paper some of the distinctive features of ingredient branding (IB) (Siano et al., 2009) – a basic concept of branding management – are discussed in order to understand their process of evolution in the service sector.

Starting from this theoretical standpoint, the paper collocates IB strategy in the context of service branding, Service-Dominant Logic, Service Science Management Engineering and Design (SSME+D) and Strategic Communication (see Figure 1). Then we consider IB as a special form of alliance that enables service branding to be implemented. Subsequently, the paper presents indications on the state of the art and developments by means of illustrative examples.

The aim of the paper is to highlight the role played by IB strategy in order to make services more tangible. It is well known that intangibility is one of the main features characterizing services and contributes to creating barriers in terms of perceived consumer expectations of promised services. The paper aims to suggest a new perspective that considers IB implemented by firms mainly involved in the service sector.

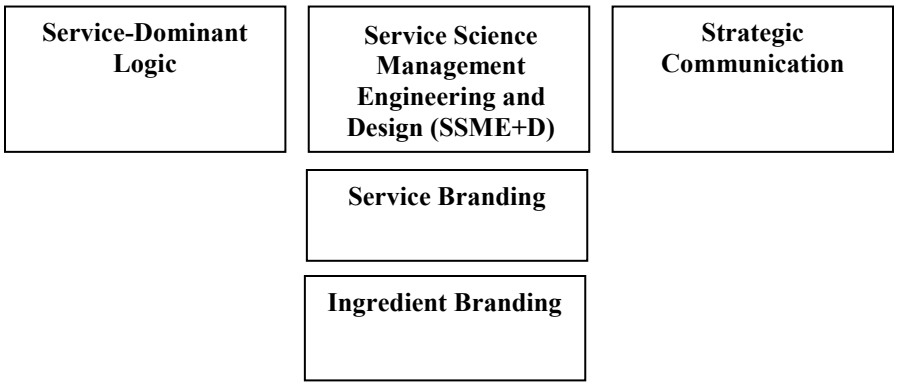

Figure 1. Theoretical steps to reach IB (Our elaboration)

A definition of IB in the service sector is presented in the paper, thus narrowing the gap in service and branding literature. In this respect, the following research questions are:
- it is possible to explore the role of IB in the service sector?
- it is possible to implement the IB strategy to make services more tangible, reducing the perceived risk experienced by users?
- it is possible to identify the specific corporate communication tools used by service companies?
To these research questions, the paper tries to answer in the following sections.

FRAMEWORKS FOR APPLYING INGREDIENT BRANDING STRATEGY TO IMPROVE COMPETITIVENESS IN SERVICE SYSTEMS

Service-Dominant Logic

The service-dominant (S-D) logic has provided impetus for developments in the field of marketing and at the same time it highlights the importance of co-creating a more marketing-grounded consideration about exchange/value. As scholars and researchers have pointed out, one of the most interesting factors discussed in the debate about S-D logic is that services are no longer considered as a particular kind of intangible element (in antithesis with goods) but, they are presented in a goods-dominant (G-D) logic term. For this reason, often, authors refer to the singular 'service' in S-D logic, "indicating a process of doing something for someone, rather than the plural 'services', implying units of output as would be consistent with G-D logic" (Lusch et al., 2008: 6). In brief, S-D logic presents

a new perspective that may address the never-ending debate focussed on goods versus services. Actually, it supposes that there is no difference between goods and services; therefore, service is noting else that a good used in "service provision". Taking into consideration the S-D logic, service seems to be the fulcrum of exchange and value creation; thus, there is no good-versus-service war according to S-D logic.

Moreover, several researchers have highlighted the fact that S-D logic seems to be based on a description of service that conflicts with established definitions. However, the new definition of service as "the application of specialized skills, through deeds, processes, and performances for the benefit of another entity or the entity itself" could be easily considered fully consistent with previously accepted ones. Actually it shows numerous similarities with Grönroos classification of services as: "processes consisting of a series of activities where a number of different types of resources are used in direct interaction with a customer, so that a solution is found to a customer's problem" (2000: 48). Both statements pinpoint that service has some G-D logic feature. Furthermore, the idea of service being the essential concept of exchange/value involves that the company, as a whole, has "to provide service to stakeholders, including customers, stockholders, and employees" (Lusch and Vargo, 2006). In addition, Service Science, the study of service system, combines organization and human understanding with business and technological understanding to categorize and explain the types of service systems that exist as well as how service systems interact and evolve to co-create value (Maglio and Spohrer, 2008).

Starting from these considerations, in the next paragraph, the paper focuses on the important role played by Service Science Management Engineering and Design, Strategic Communication, service branding and ingredient branding in sustaining and implementing the presented S-D logic.

Service Science Management Engineering and Design (SSME+D)

Service Science, Management, Engineering, and Design (SSME+D), or Service Science (SS) for short, is built on the top of Service Dominant (S-D) Logic and provides a framework for studying service systems by means of complex systems in which value exchanged is produced by various co-operating actors. In fact, these human-serving systems or service systems are the diverse, interconnected, complex systems that we live in, we study, and we work to change to benefit ourselves and future generations of humanity.

As an IBM research initiative, Service Science can be qualified as the study of diverse, interconnected, complex human systems in which value is co-created through different governance interaction (IfM and IBM, 2008). Furthermore, SS tends to promote a new discipline capable of responding (theoretically and practically) to the emergent research issue on Service Systems. The interdisciplinary project, deriving from studies on Computer Science (Spohrer et al., 2007), Human Behaviour (Mc Clelland, 1975) and on Organizational Theory (March, 1991) aims to sustain the concept of a new and better world which is socially, technologically and economically linked. In this respect, SS, starting from SDL, shifts to meet the needs of the society of Tomorrow; a society, based on the logics of a "systems of system" where the parts and not the parties are crucial and where the logics of role predominate (who does what for).

Service Systems represent sophisticated entities of value and knowledge which, seen as an extensive population of stakeholders interact on a cooperative basis to generate social and competitive advantage to be shared amongst customers, providers, authorities, competitors (Spohrer and Kwan, 2008; Gummesson, 2002, 2009). This implies that Service is none other than the result of applied competence (knowledge, expertise, resources, relationships) to generate benefits for other entities (Lusch and Vargo, 2004, 2008).

Growing competitiveness, the difficulty of the G-D logic to guarantee substantial and marked elements of differentiation and consequently, of distributional value, have embraced the relational-systems perspective in which value is seen as the synergistic result of inter-systems sharing and cooperative processes between structurally consonant and resonant actors in terms of objectives. In other words, value is not seen from a partial perspective of corporate benefit or in favour of other stakeholders, but rather in a global sense (whole value) the capability of the System to generate satisfaction and benefits both personal and for other entities (Golinelli et al., 2010).

"Applied expertise (skills and knowledge) for the entity itself (system)" (Maglio and Spohrer, 2008a; 2008b), necessarily shifts the perspective of analysis of value to where the goods themselves are interpreted as "mechanisms/objects of service distribution" (Lush and Vargo, 2004) and services as effective configurations of processes capable of differentiating and generating value for the stakeholders (Gummesson, 2002). The SSME+D approach furthermore acknowledges the value of human resources that guarantee competiveness and revitalize service systems even during recession.

In this perspective, to improve competitiveness, it is essential applying Ingredient Branding (IB) to service system which means that the offer is not merely focused on product and tangible benefits, but on the product, tangible benefits and intangible ones (in other words, service). In this situation, components co-evolve regardless of political changes and time factors (Spohrer et al., 2010).

Strategic Communication

Recently, systematic corporate governance and strategic communication have become fundamental issues in the agenda of managers, scholars and communication practitioners (Goodman, 2006; Invernizzi and Romenti, 2009).

In both management and corporate communication fields, scholars seem to be focussed on how to manage mutually beneficial relationships inside and outside the company (Grunig et al., 2002). This concept highlights the fact that the company is a social institution that generates value, in economic and social terms (Hall, 1993; Gupta, 2011; Shin et al., 2012) as it is also highlighted in Service Systems. This situation helps to understand why there is a renewed discussion about what role communication plays in a company (Goodman, 2005; Burchell and Cook, 2008). This topic leads to an integrated governance system: "Taken as a whole, this network of relationships constitutes a 'governance system' for the modern corporation" (Post and Carroll, 2006: 133), in which dialogue is the basis.

As has been noted, dialogue is the essence of corporate communication (CC). Actually, communicate with stakeholders has several positive consequences: it decreases conflicts, decreases risks and enhances assurance (Burchell and Cook, 2006: 163-166). Thus, strategic communication creates commitment and could generate positive organisational behaviour not only in the main company but also in its partners. This perspective inevitably implies that communication managers need to be aware of the nature and strategic role of communication (Holm, 2006; Hallahan et al., 2007; Van Riel and Fombrun, 2007; Cornelissen, 2008). Moreover, as many researchers suggest, they should be totally involved in all strategic decisions arranged in a company (Grunig et al., 2002; Goodman, 2006). When this happens, it creates a bidirectional communication that leads to an authentic dialogic practice in which all parts involved express theirselves and do their best to create a sustainable competitive advantage (Steinmann and Zerfa, 1993; Baum, 2004; Stoker and Tusinski, 2006; Raupp and Hoffjann 2012). These considerations lead to a communication-oriented organization, rather than to an organization in which communication helps to guide and influence all major decision making processes (White and Mazur, 1995; Dolphin and Fan, 2000; Bowen, 2009; Johansson and Ottestig, 2011). In this situation, governance, particularly communication activity, needs, a well established and harmonized management of communication relationships with various stakeholder groups (Van Riel and Fombrun, 2007; Cornelissen, 2008; Michael, 2012).

In particular, the paper focuses on the role Ingredient Branding (IB) plays in shaping the strategic communications (McCarthy and Norris, 1999; Desai and Keller, 2002; Lorange and Roos, 1992).

LITERATURE REVIEW ON SERVICE BRANDIG AND INGREDIENT BRANDING (IB)

Few research contributions have been published on service brands despite the fact that a service economy is developing today. Literature evidences that services have typically salient features, but to date, their implications for brand management have not been fully explored, especially in terms of achieving brand management goals thanks to strategic alliances. To understand how successful service brands can be developed and sustained, the paper argues that there is a link between branding services and the concept of IB, as a particular form of alliance. It appears that on the basis of brand management through strategic alliances, inspiration for service brand strategies can be evoked. Consequently, by taking IB into consideration, ways of limiting the problems of intangibility and heterogeneous quality can be found and opportunities for relationship building identified.

However, debate on product-service differences persists (Berry and Leonard, 1980; Blankson and Kalafatis, 1999; Berry and Leonard, 2000) and it is generally accepted that services can be difficult to identify because of the fact that they are intangible on both a mental and physical plane (Levitt, 1981; Rushton and Carson, 1985). In particular, discussion focuses on the fact that services are, different from products (Gronroos, 1990; Murray and Schlater, 1990; Cunningham, Lawrence, Young, Clifford and Moonkyu Lee, 1997;) and are characterized by numerous features, such as: intangibility, inseparability production/consumption, different degrees of quality and perishability (Rathmell, 1966; Shostack, 1977; Gronroos, 1978; Rushton and Carson, 1985; Bateson, 1995).

Starting from these observations on service brands, several authors have considered inseparability

production/consumption an opportunity (Onkvisit and Shaw, 1989; Norman and Ramirez, 1994) to concretize the concept of prosumer, a new kind of consumer who takes part in the creation of services as a co-producer of value and consequently, of brand too (Priporas and Poimenidis, 2008).

As concerns intangibility, it is important for companies to transform this feature by attributing a brand to their services, based on a solid corporate identity thus bringing to mind functional and emotional values (Heskett, 1987; Kotter and Heskett, 1992; Fournier, 1998; Melewar and Storrie, 2001). In addition, it is generally perceived that "tangible products differ in that they can usually, or to some degree, be directly experienced-seen, touched, smelled, or tasted, as well as tested. Often this can be done before buying" (Levitt, 1981: 96). On the contrary, services (intangible products) "can seldom be tried out, inspected, or tested in advance" (Levitt, 1981: 96).

Furthermore, in order to reduce differences in quality, it might be useful for companies in a preliminary phase to transmit to staff, values that are aligned with the brand (Kunde, 2000) then strengthen such cultural values by means of training programmes and communicational processes (Schein, 1984; Murray and Schlacter, 1990; Lovelock, Vandermerwe and Lewis, 1999). This could compensate for the fact that services cannot be standardized, as products can (Rathmell, 1966; Sasser, 1976).

Finally, as regards perishability, it is clear that good reputation linked with strong brand awareness might be a successful way of solving this problem.

Literature tends to focus either on the existence of pure products and/or services (Shostack, 1977; Gronroos, 1978) or as a continuum that links them (Rathmell, 1966). This also involves considerations about service brands. According to Levitt (1981) customers do not buy products/services, but have different expectations which could be considered a mix of tangible and intangible components connected, in other words, to functional and emotional values typical of brands. Although it is clear that a different approach is needed in managing service branding, this does not imply that the brand with its specific functional and emotional values, differs as concerns product and service sectors (de Chernatony and Dall'Olmo Riley, 1999).

The paper attempts to explore the service theory in terms of its implications for branding taking into specific consideration IB and its importance for building service brand. The point is that service brands, treated thanks to IB, shape something that, to some extent, is tangible. This challenging opportunity to convert an intangible element to a tangible one, is related to the fact that intangible service organisations involve numerous tangible resources as well. examples are catering and insurance for airplane companies and spa centres for hotel companies, etc.. According to de Chernatony: "the relevance of intangibility in service organisations is not the ratio of intangibles to tangibles required to provide the service. It is instead, about the way that good customer service is achieved and how the expectations of the brand promise are fulfilled" (1999: 21). For a service company this occurs by means of another of its key characteristic: the inseparability of production/consumption. In fact, the service is perceived as satisfactory when the customer experiences what is known as a "service encounter" (Bowen, Chase and Cummings, 1990; de Chernatony and McDonald, 1998). The latter, influenced by the attitudes and motivation of the service company staff, creates a balance between tangible and intangible resources in several specific service companies. It is fundamental consequently, that the brand and its values are accepted by the staff of the service company considering that service brands depend significantly on such acceptance.

According to the most recent service branding literature, the focus is shifting away from information and knowledge towards connectivity and relationships. The implication is a need to look at service branding from different theoretical perspectives that consider managing brand services by implementing strategic alliances between different brands (Ohmae, 1989; Lorange and Roos, 1992; Parkhe, 1993; de Chernatony, 1993; Dall'Olmo Riley and de Chernatony, 2000). A consistent brand provides a real alternative for service companies desiring differentiation (Melewar and Otubanjo, 2007). In fact, entities within Service System exchange competence along at least four dimensions: information-sharing, work-sharing, risk-sharing and goods-sharing. Services, in Service System approach, hence, are valuable because of their features in terms of co-creation, configuration of people, technology, value proposition connecting internal and external service systems and shared information. In sum, service is the application of competencies for benefit of others (Maglio and Spohrer, 2008).

In this context, the paper argues that a strong brand alliance can play an important role in services through reducing consumer perceived risk and overcoming low levels of trust (Mitchell and Greatorex, 1993; Mitchell and McGoldrick,1995). Among the different promotional alliances, IB plays a key role (Norris, 1992; Desai and Keller, 2002). IB is a special form of alliance between two brands, based on firm cooperation in designing and delivering the product, with particular emphasis on the recognition and identification of the components used in the end product (Pfoertsch and Mueller, 2006; Luczak et al., 2007). IB is an accepted marketing device (Norris, 1992;

Dover, 1997) although its significance has only started to emerge (Kotler and Pfoertsch, 2006). In today's global economy, companies have to establish and maintain competitive advantage, create commercial success in the market and provide criteria to differentiate them from the competition (Trinquecoste, 1999).

Until recently, the focus was on tangible, but has now shifted towards intangible resources, such as brands (Carpenter et al., 1994) and customer loyalty. For this purpose, companies and organizations favour branding efforts that create value for both consumers and companies. This has also had an impact on service marketing, where the fundamentals of IB apply. To succeed in finding customers for intangibles it is important to create surrogates (metaphors, similes, symbols) for tangibility (Levitt, 1981). For this reason, in today's fast-changing markets scenario, IB is becoming a major marketing strategy as demonstrated by the increasing number of products sold with embedded branded components. For Levitt brand promise, implemented also thanks to IB, could resolve the paradox about this specific feature characterizing services: "the most important thing to know about intangible products is that the customers usually don't know what they're getting until they don't get it" (1981: 100).

To clarify the relative concepts and characteristics linked to IB, the main features are outlined in Table 1 below:

Table 1. An overview of Ingredient Branding definitions and features

Definitions	**Authors**
"The strategy is an example of a broader marketing trend reflected by the increasing number of firms that are establishing brand alliances by linking themselves through their products or other aspects of their marketing program to other firms or brands".	Desai and Keller, 2002: 73.
"Ingredient branding is a special form of alliance between two brands, based on their cooperation for designing and delivering the product, with particular emphasis on the possibility to recognize and identify the used components in the final product".	Luczak et al. 2007: 125.
Features	
Branded ingredients affect consumer product quality perceptions, confidence in product quality perceptions, product evaluations, taste perceptions, purchase likelihoods, and reservation prices of host brands of varying quality.	Norris, 1992
Ingredient branding, in which key attributes of one brand are incorporated into another brand as ingredients, is becoming increasingly popular among marketers.	Rao, Qu and Ruekert, 1999 Shocker et. al., 1994
Ingredient branding offers a potential for successful brand management and increased profits for companies along with product offerings that create added value for the customer. If the customer understands and knows the function, features and benefits of a component (ingredient), he or she will pay more attentions to this offering, and if it creates a unique product offering it can lead to loyal and profitable customer relationships.	McCarthy and Norris, 1999 Havenstein, 2004
The ingredient branding surpasses the limitations and dangers of a too narrow and single-sided customer-supplier relationship.	Kleinaltenkamp, 2001
As the component brand is identified on the product containing the component, firms wanting to pursue an ingredient branding strategy need to cooperate with their customers to effectuate a co-branding alliance. While there are many studies on ingredient branding, most of them concern horizontal alliances instead of vertical ones.	Desai and Keller, 2002
Ingredient branding occurs when a component part or service of the end product is promoted to the final user. This promotion can occur from two perspectives: the manufacturer's perspective or the supplier's perspective.	Pfoertsch and Mueller, 2006

The elements highlighted in grey in Table 1 were selected as specifically suitable for our analytic study on IB.

In short, this alliance is cemented when a component part or service of the end product is promoted to the final user. Evidence would appear to indicate that branded ingredients affect consumer product quality perceptions, product evaluations, likelihood of purchase and reservation prices of host brands of varying quality (Norris, 1992). Certainly,

if the customer understands and knows the function, features and benefits of a component (ingredient), he will pay more attention to this offer, and if it creates a unique product offer it can lead to loyal and profitable customer relationships (Desai and Keller, 2002). Promotion can be from two perspectives: the manufacturer's or the supplier's (Pfoertsch and Mueller, 2006).

Furthermore, even if authors focus on manufactures – and therefore only take into account products - the paper highlights the fact that IB can benefit not only them but service providers too.

FINDINGS: SOME EXPLORATORY CASES VIGNETTES

Starting from the premise that it can be difficult for users to estimate the value of intangible services, it is important that they identify tangible signs of the intangible (Rushton and Carson, 1985). In this context, the IB makes tangible the perceived consumer expectations (Rushton and Carson, 1985).

In the service sector IB can assume different features depending on whether service, considered as an ingredient, refers either to core (basic) service components or to supplementary (additional and or auxiliary) service components (Grönroos, 1982; Normann, 1984; Eiglier and Langeard, 1987). This study presupposes that the expression core service corresponds to the expression service "expected" in the product level model (Levitt, 1980) or better, refers to all those attributes and characteristics that customers expect to receive from a required service. It concerns basic irrenounceable elements of the service that users know are available thanks to technological progress, safety rules and standard quality of life levels. A core service is, therefore, the basic promise that companies make to customers (Grönroos, 1982; McDougall and Levesque, 2000). Not guaranteeing a core service in its minimal levels of expected quality means that service companies do not reach the minimal standard level necessary for competing in the market. In other words, when the service, considered as an ingredient, is an integral part of the promised core service offered, IB plays a "fundamental" role because the ingredient service brand is useful for strengthening perceptions of tangibility and reliability and the promise of core service quality, essential for the competitiveness of the offer. In short, IB allows customers to identify corporate partners and allows for consequently, the traceability of the service, a guarantee factor for potential customers. Figure 2 shows that there is a link between IB in its quality of essential strategy and expected service level with respect to core service components.

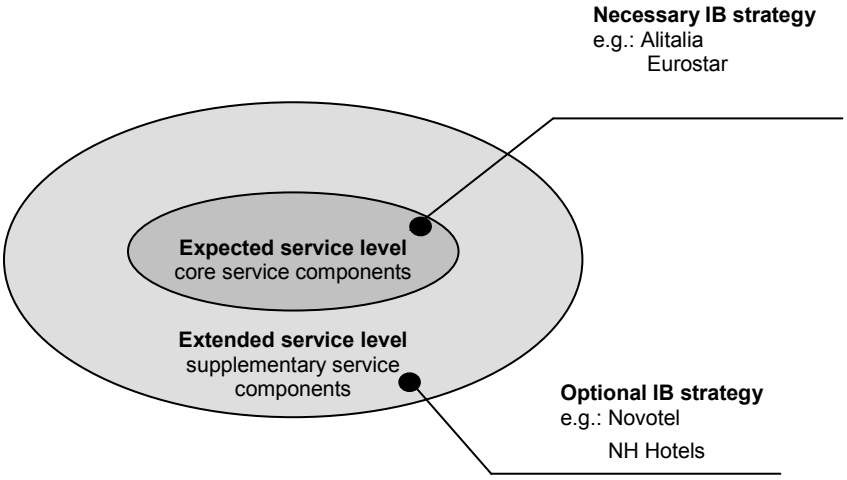

Figure 2. Links between service levels and IB strategies (Our elaboration)

For instance, the insurance available and meals served on board for passengers who have to take a plane or a train could be considered components of the core service that travellers expect to receive when they use the service. Companies involved in the transport sector service (e.g. Alitalia, Eurostar) and hotel chains (e.g. NH Hotels) apply IB to increase confidence in the core service thanks to the use of supplier brand image, or in specific cases, thanks to the insurance available and food served.

Aerea Italiana S.p.A. (Italian for Alitalia - Italian Air Company), is an Italian airline, which bought assets as a result of the liquidation process of the old Alitalia Company - Linee Aeree Italiane and the Company Air One. On January 2009, Air One and Alitalia began the process of merging their networks, their fleets and their entire administrative and commercial structure. The new Alitalia is run by private entrepreneurs who are well versed in quality of service and close attention to customers' needs. For this reason, Alitalia has clinched a successful IB alliance with the Group Chef Italia, particularly with the Society AIR Chef 2000.
Started in 1995 as part of the Group Chef Italia, the Society AIR Chef 2000 is a leader in the sector of in-flight catering and retail catering. Both the allied companies are fully aware that quality of service and close attention to customers' needs are essential for them to succeed and grow. Indeed, the new Alitalia and Society AIR Chef 2000 share the same main inspiration: passengers are the focal point of the company development strategy.
Offering both a complete service that provides not only flight service but also particular Italian cuisine, they show their commitment to providing top quality services on board so that every travel experience is characterized by a distinctive touch of Italian style. With regard to the co-branding activities put in place by both brands, Alitalia and Society AIR Chef 2000 have communicated their alliance through press releases and corporate web sites.
Moreover, specific determinants have played a role in this particular IB strategy. One of these is the previous existing strategic relationships between Alitalia and Society AIR Chef 2000 that started in 1995. This strategic relationships was expressed thanks to a core theme coherent to corporate mission and value system of the two companies.

Eurostar is the high-speed rail service directly linking the UK to France and Belgium via the Channel Tunnel. It started operating in 1994, providing city centre to city centre services. Eurostar has chosen Mondial Assistance to offer its customers travel insurance solutions tailored to their individual needs. Mondial UK is a leading provider of assistance and third party travel insurance administration, conducting business with or on behalf of major blue chip companies. In terms of IB, this concerned Belgium, France and the UK with a potential to insure up to 7.85 million passengers choosing to cross the English Channel with Eurostar during 2006.
Considering potential goals thanks to IB, Mondial Assistance have created an insurance offer that enables customers to purchase their insurance on the www.eurostar.com website at the same time as they book their trip. Eurostar and Mondial Assistance both have an excellent reputation and their expertise in e-commerce is widely recognised in Europe. It is therefore perfectly natural that Eurostar chose Mondial Assistance to implement IB. Thanks to IB, in fact, they can offer all their passengers – businessmen, families, skiers – very attractive insurance solutions and policies specifically adapted to their needs. Concerning the co-branding activities employed, both companies, Eurostar and Mondial Assistance have communicated their partnership through press releases and corporate web sites. In addition, several factors have influenced the IB strategy implementation. The previous existing strategic relationships between Eurostar and Mondial Assistance that began since Eurostar started operating in 1994. Moreover, the two companies decided to communicate to their publics trough a core theme coherent to their corporate mission and values.

The NH Hotels Group ranks third in the European business hotels classification. NH Hotels stands out in quality both as regards services and facilities, intended to please all tastes, uniform, and making the customer feel comfortable. The restaurants are another priority for hotels in the chain, offering customers first-rate cuisine. Furthermore, the prestigious restaurateur Ferrán Adriá has entered into an IB agreement with NH Hoteles, launching new concepts such as "nhube", pioneering spaces in the hotel sector combining food, leisure and rest for the chain's customers and with "Fast Good". Ferran Adriá, the famous Spanish chef is regarded as one of today's great innovators of world cuisine. "Fast-Good"'s gastronomic offer is simple and highly innovative as are the ingredients it uses for making traditional fast-food meals have until now only been used in haute-cuisine. Thanks to this IB alliance, NH Hotels, Ferrán Adriá and Fast Good are providing a number of areas which make the entire service functional and dynamic. Consequently, the service offered could be seen as a pioneering concept in the hotel world, which combines eating, leisure and relaxation for hotel guests, in other words, a revolution in the hotel sector. The first hotel destined to have an "nhube" will be NH Balboa, in Madrid – a pilot project for testing the new product, which will be adapted to meet the requirements of the guests and to reflect their suggestions and recommendations. "nhube" will subsequently be installed in other hotels belonging to the chain. Actually, the implementation of this IB strategy was influenced by the preliminary communication made by NH Hotels to reach Ferrán Adriá and Fast Good in order to involve them into promotional alliances

Novotel is an international brand of contemporary hotel designed for living. It is one of a number of hotel chains owned by the French hotel group Accor. Novotel is introducing innovative Internet areas in its hotels: the "Web Corner on a Mac" with 24-inch iMacs. Web Corners on a Mac are the result of the implementation of a joint IB strategy between Novotel and Apple in order to offer a useful supplimentary service to their customers.
Clients will have free access to the Internet, in 20-minute sessions, to all desktop functions. The first "Web Corner on a Mac," in the lobby of the Novotel Budapest Congress, was a huge success. In two months over 6,000 connections were made, equal to 100 per day. Moreover, in 2003, Novotel and Orange, a key brand of France Telecom, one of the world's leading telecommunications operators, joined forces to provide high-speed Internet access in more than 1,300 hotels across France operating under the different Accor brands. Thanks to this IB, Accor customers in France have high-speed Internet access at their disposal in lobbies, bars, meeting rooms and some guestrooms. Since October 2007, a further 220 hotels have extended their network coverage and are now totally WiFi-enabled, offering Internet access in all guestrooms and public areas. In addition, the partnership has expanded to include 50 hotels in Belgium and 80 in the United Kingdom. As part of its partnership with Orange, Accor offers its services to Orange mobile phone subscribers in France. In fact, customers can now book a room at any Accor hotel in the world simply by dialling 711 (travel section) from France.
With regard to the co-branding activities put in place by Novotel and Apple, they are communicated thanks to press releases. While, Novotel and Orange communicate their alliance through their corporate web sites.

However, on the contrary, when IB plays an "optional" role there is a different scenario; especially, where the core service is practically identical for all competitors, the choice of users can be influenced by the supplementary services offered. In this circumstance, the brand of the ingredient service is used to strengthen the perception of tangibility and reliability and the promise of quality of supplementary service components. Figure 1 shows that there is a link between optional IB and extended service level concerning supplementary service components. These components can make the core service more attractive to customers because they mean differentiating offers. In actual fact, they define the "extended" service, as additional services that distinguish the service companies' offer compared to other competitors. A service company can decide, therefore, to implement IB in order to strengthen the perception of tangibility of the "extended" service and to reinforce its traceability elements; two favourable effects that improve a service company's strong points and consequently increase its competitiveness factor. Examples of optional IB are developed in the hotel sector, where players tend to take advantage of the brand image of ICT suppliers (e.g. Novotel) and of fitness suppliers (e.g. NH Hotels) to differentiate optional services available at their hotels.

The NH Hotels Group has created another IB alliance with Elysium. The Elysium Spanish centre specializes in hydrotherapy, fitness and beauty. It is the hallmark of NH hotels and defines a new way of experiencing the hotel services, linking them with hydrotherapy centres, health and beauty, spas, massages, muscle therapy and specific treatments. Through their joint strategy, Elysium and NH Hotels have created places where the most important thing is to achieve high standard levels of relaxation, health and well being. For this reason, companies have opened similar centres in Marbella (Hotel NH Alanda), in Seville (Hotel NH Central Convenciones) and in Madrid (Hotel NH Eurobuilding). With regard to the co-branding activities put in place by NH Hotels, Ferrán Adriá and Fast Good, they have communicated their alliance through press releases and different sections of corporate web sites. As concerns the co-branding created by NH Hotels and Elysium, this is presented to customers in a section of both corporate web sites. In actual fact, NH Hotels Group and Elysium IB strategy was influenced by the previous existing strategic relationships between partners; the preliminary comakership communication made by NH Hotels to reach its partner in order to put into practice co-branding and then the core theme of the messages coherent to corporate mission and value system.

The secondary data concerning the case histories presented in this section were selected from company literature, company profile documents, press releases and content of web sites.

PRACTICAL IMPLICATIONS AND FUTURE RESEARCH

The intangibility of services necessitates the use of symbols, metaphors and other rhetorical devices of reality to render services more tangible and to raise customer perception and expectations of the promised service in advance. The main symbol used by service company is brand. It is largely assumed, that for a service company, its brand is a tool that enables greater customer perception of tangibility as the brand represents the organization which produces and supplies the service. Based on this premise, the central idea on which the paper focuses is that service companies should take advantage of this strategy considering that as thanks to IB, companies strengthen customer perception of tangibility enabling them to perceive promised service in advance. The reason for this could be due to the fact that the service is made more tangible by using at one and the same time, several symbols (brands). One consequence of the application of IB for service companies is that customer trust is increased not only because of the greater perception of tangibility created by the combined use of these symbols but also thanks to the fact that the positive perception of their own brand with brands of service component suppliers is strengthened. In effect, applying IB allows service companies to lever at the same time on their own brand image and on brand images of service component suppliers. Moreover, it is worth remembering that service companies could also take advantage of applied promotional alliance strategies in terms of sharing the costs incurred in implementing co-branding. Starting from the proposed analysis, several important practical implications for service companies could be underlined. About advantages of IB, it is necessary that managers of service companies develop skills to implement this strategy. However, the mayor managerial implications involve the optional IB strategy. Actually, applying this strategy, managers of service companies not only could make the service more tangible and reduce perceived risk experienced by users with regard to core services, but also, they could reach a more incisive positioning of supplementary services. In this way, they could differentiate the offer in comparison with competitors. Managers, in order to do better, have to take into consideration several relevant factors which play a very important role in implementing IB strategy. The examples show that three are the main factors: (1) the previous existing strategic relationships between partners; (2) the preliminary communication made by partners in order to involve all of them into promotional alliances (co-branding alliance); (3) the core theme of the IB strategy coherent to corporate mission and value system of involved service companies. In addition, the examples illustrated in the study, show, nevertheless, that IB is applied by means of an extremely limited number of communication media. These case histories show clearly that service companies use only two - press release and corporate website – communication tools to implement their IB strategy. Future research could verify whether these tools are widespread generally in other service companies and should this be the case, it could be useful to analyse if this potential underutilization of communicational tools could potential affect or not the efficacy of IB.

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The Access Rights to Communication Resources in the Smart Local Service System: First Insights

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ABSTRACT

This paper aims at highlighting the relevant role of Service Science perspective in place governance. The study conceptualizes a new form of territorial "governmentality" capable of managing the access to place communication resources and activating decision-making collaborative logics with stakeholders. The methodology envisages the integrating of Service Science Management and Engineering+Design and Viable Systems Approach. Smart local governance has to enable a broader access to place communication resources, regulating the access rights. "Open Governance" mechanisms and access to shared place communication resources facilitate the value co-creation process with stakeholders. The conceptual paper presents the typical limitations of the deductive approach. The paper argues that stakeholders play a proactive role in the creation, innovation and utilization of place-specific communication resources through high degree of interaction, availability and accessibility to a growing body of information. The paper offers new insights on local governance issue, emphasizing the role of the governance in ensuring stakeholders' access to communication resources. Developing improved methods to facilitate effective value co-creation process is valuable for a participatory and interactive approach in place communication management.

Key words: value co-creation, smart governance, access rights, Service Science Management and Engineering+Design (SSME+D), Viable Systems Approach (VSA), communication management.

INTRODUCTION

The territory is a system composed of a set of actors and resources, activities and relationships, driven by a smart governance system (Caroli, 2006). This paper aims at highlighting the relevant role of Service Science approach in the governance of territorial systems, conceptualizing a new form of local governance, capable of managing the access to place communication resources and activating decision-making collaborative logics with different stakeholder group. In fact, many value co-creation processes and interactions with stakeholders result from mechanisms for changing access rights to resources (Spohrer et al., 2008).

For this kind of analysis, it is necessary to reinterpret the managerial practices of local governance, referring to the new logic of "governmentality" (Foucault, 1982) that refers to the ability of policy makers to create the right conditions for the viability and survival of a territory, reconciling expectations of the different stakeholders involved directly and/or indirectly in territorial system.

The study intends to offer guidance to policy makers in order to improve place communication management and enhance the contribution of stakeholders in the creation and innovation of communication resources of place identity. A network of "beneficial relationships" with all stakeholders (Gummesson, 2008) is essential for the success of smart local governance (Valdani and Ancarani, 2000).

The remainder of the paper is organised as follows. In the following section, the methodological approach (SSME+D and VSA) is briefly described. This helps us to identify specific elements that can be used to develop a conceptual background for participative decision making process for corporate communication in a smart local system, which is the objective of the study. We then present the proposed framework and, at the same time, some examples that strengthen the arguments made in support of the idea that stakeholders can play a proactive role in the creation, innovation and utilization of place-specific communication resources. "Open governance" mechanisms and appropriate configuration of access rights to shared place communication resources facilitate the value co-creation process with them.

METHODOLOGY

Service Science Management and Engineering+Design (SSME+D) and Viable Systems Approach (VSA)

The methodological framework of the paper integrates the principles of two fields of study: Viable Systems Approach (VSA) and Service Science Management and Engineering+Design (SSME+D). The key-concept of VSA that has contributed to the shift to a dynamic interpretation of the territory is that of "system" (Golinelli, 2000, 2011; Trunfio, 2008). According to this logic, the territory does not represent a mere settled space (*static view*), but it is the result of interactions between systems and resources for the common purpose of survival (*dynamic view*). A territory becomes a system when it is possible to recognize a government able to establish a subjective order in the local area, to share with stakeholder group (Piciocchi et al., 2009)

Within the VSA perspective, there are three fundamental systemic conditions that characterize the business, social and local organizations (Barile and Saviano, 2011): (a) *openness*, the ability to exchange resources with the other systems in a selective manner; (b) *contextualization*, the search for viability through interaction with certain privileged entities, such as supra-systems that influence organization's survival, and (c) *dynamism*, the development of structure in accordance with emerging changes. The concept of *openess* is pivotal in territorial context: in open systems, there are exchanges of energy, matter, people and information with the external environment (Mele et al., 2010). Infact, Open system theory (OST) analyzes the relationships between the organizations and the environment in which they are involved, focusing on organizations' ability to adapt to changes in environmental conditions (Katz and Kahn, 1978).

The SSME + D approach is determined for the qualification of Local Area in terms of Smart Local Service System. It combines different disciplinary perspectives to drive innovation, competitiveness and quality of life through the services (Spohrer, 2010). Contrary to the assumption in the in Goods Dominant Logic (GD logic) or in Service Dominant Logic (SD logic) (Vargo and Lush, 2004), which consider goods and services as two distinct and opposed entities, SSME + D views them as two sides of the same coin: while "goods" refer to the tangible aspects of territory (structural dimension), "services" refer to the intangible ones (systems dimension – processes, interactions, informative exchange, adaptability). Consequently, according to this new approach, the service is "the systemic configuration of goods", the "product in action" (Golinelli et al., 2010), because it is derived from a process of sematization (sense-making) of the good, useful for creating the best conditions of consonance and resonance with the context.

The viable systems are designed as "systems of local services", or dynamic configurations of resources (people, technology, organizations and shared information) which create and deliver value to all systems (IFM and IBM, 2008). In particular, the SSME + D considers the service as a result of the interaction between the provider (the

territory) and the client (the stakeholder group): the main actors of a system of services. Both contribute to the co-creation of value of the services: the provider with his knowledge and expertise, the client with its resources.

CONCEPTUAL BACKGROUND

Access and access rights

The concept of "access" is a topic studied in various disciplines of the social sciences (political science, linguistics, sociology, communication, economics, etc.). In linguistics, "access" is often related to "lexical access" that is viewed as "a contextually, restricted, not independent process" (Swinney,1979). In sociology, "access" means to make use of knowledge, relation information, culture, services. "Access" becomes a keyword in the new society of networks in which users are always connected and the need for access to information and knowledge is continuous and invades every moment of life. Rifkin (2001) defines the current historical period as "the age of access": the new phase of capitalism characterized by the transition from an economy dominated by the market and the concepts of material good and properties, towards an economy dominated by established values such as culture, information and relation.

Intuitively, access rights deal with the social norms and legal regulations associated with resource access and usage. In political science, the object of access rights is the administrative document. Access to documents, governed by Regulation (EC) No. 1049/2001, is a crucial factor for the transparency in the European institutions politics. In order to facilitate access to data, the European Parliament has therefore established a special Electronic Registry that allows direct access to most of the European Parliament documents through a search form. Access right has been introduced for the first time in Italian legislation by law 1990, n. 241 and currently regulated in civic access context (D.lgs 33/2013). The holders of access rights are all stakeholders that have a direct, concrete and current interest, corresponding to a legal position and connected to the protected document in relation to which access is requested.

In Service Science, access rights are referred to different categories: properties (owned outright), contracts (leased rights), public uses (shared access), and personal relations (privileged access) (Spohrer et al., 2008).). In particular, owned outright refers all the rights and responsibilities associated with property ownership (e.g., to buy something). Leased-contracted has as a result certain rights more restricted than ownership (e.g., to rent a hotel room or a car). Shared access deals with public use resources (e.g., public roads and much of the information on the world-wide-web). Privileged access refers to inalienable rights (e.g., personal history and private thoughts).

In local context the access rights, above all shared access, play a significant role. They refer to the access to resources of public institutions: services, information, language, processes, metrics, knowledge, skills, data, documents. This study intends to realize how to configure the access rights to manage communication resource of place identity in territorial systems.

Place communication resources

A service system entity, also in a territorial context, is a dynamic configuration of resources. The types of resources include people, technology, organizations and shared information. With respect to place communication resources, in line with some basic assumptions underpinning the Resource-based view, they can be categorised as being either place-specific or non-place-specific. In particular, place-specific communication resources express the specific capabilities, strengths, core values, and/or historical references of a specific territorial system. They are rooted in the concept of place identity. Place identity arises from territorial vocation (Siano, 2001) linked to key features (tangible and intangible) of the territory offer which is defined as the natural inclination of a place to fulfill the stakeholders' expectations through value creation.

Place identity consists of all forms of symbolic expression, behavioral and informational-communicational through which local system is related with stakeholders (Siano et al., 2008). Place identity, place image - the set of beliefs, ideas, information than stakeholder have about a place (Kotler et al., 1993) - and place personality - territorial vocation that results from natural, historical and cultural features of a territory - contribute to create place reputation. The reputation of a local area is one of the most important intangible resources to build, maintain or consolidate the consensus of various stakeholders (Fombrun and van Riel, 2004).

Place communication resources, referring to how the territory can be communicated, described, told (also through social media), are included in of structural equipment of place identity. They are durable resources with medium-long term implications, the typical ones are (Siano et al., 2013):

1) keywords and symbolic elements - such as common starting points, core theme, brand mantra, message style, slogan, place visual identity (place brand), jingle (Olins, 1989; van Riel, 1995; Melewar and Saunders, 1998; Keller, 1999; Cornelissen, 2008) - intended to enable the identification and recognition of a place and ensure consistency in the messages' content.

2) owned (place) media, such as online communication channels (place web sites, place blogs, social network pages, etc.) and offline (tv business, corporate magazine) personalized in the contents.

3) guideline, intended to guide the activities of corporate communication. They are:

- sets of rules or heuristics related to the management and expression of place brand (Balmer and Gray 2003);
- the value statements and ethics codes (Schwartz, 2001), intended to guide the behaviors of the members of the territory and communication initiatives;
- participatory mechanisms, such as, for example, establishing common process rules (Christensen et al., 2008) in order to reduce the rigidity of a vertical and hierarchical communication structure and enable organization members to listen continually to various stakeholder groups and create an interactive dialogue with them;
- styles of place storytelling (Lichrou et al., 2010) deriving from place stories.

Usually, the creation, the sharing, the innovation of place communication resources require different categories of access rights: owned outright and leased rights (e.g., brand copyright, licensing, contracts, etc.) and shared access. We maintain, instead, that a widely shared access to these place communication resources is useful to design new and improved value co-creation mechanisms. The renewal of resource set, in fact, it is considered crucial for system survival and for the creation and maintenance of local competitive advantage. Smart local governance has an pivotal role in ensuring stakeholders' access to communication resources.

SMART LOCAL SERVICE SYSTEM AND ACCESS TO COMMUNICATION RESOURCES

In the "access era", the shift from ownership to access have determined profound changes in the way political institutions govern territorial system (Rifkin, 2001). Lately, access to government information, also in terms of communication resources, is receiving renewed emphasis. This emphasis reflects two trends: 1) a local government reinterpretation that stresses openness and transparency principles, and 2) increasing availability and continuing development of information technologies that allow institutions and individuals to find, share, combine and re-use government communicational contents (Dawes, 2010).

It needs a conceptual reinterpretation of the governance, conceived as an institution (structure) and practice (system), which requires the development of a new art of "governmentality" (Foucault, 1982; Rose, 1999; Dean, 2010) and describes a local area in terms of Smart Local Service System (SLSS). Smart Local Service System emerges from the integration of SSME + D and ASV: the territory is seen as a viable system (ASV) and in terms of a stable system of local service (SSME + D).

In this study, "governmentality" refers to the current structural change of governance based on the concepts of power and competence related to the configuration of a multilevel governance system: a new form of "governmentality" characterized by a reconfiguration of collaborative decision-making logic. A SLSS presents, structurally, a combination of resources (people, technology, organizations and specific communication resource for place identity), direct to reinforce co-creation of value. At systemic level, a SLSS consists of a network of cooperation and collaboration can strengthen competitiveness through the functions of a Smart Multilevel Governance (stakeholders) (see Figure 1). Thus, the territorial system has to reject the top-down approach, based on individual and despotic power and embrace the bottom-up logic of governance networks (Triantafillou, 2004; Trunfio, 2008; Piciocchi and Bassano, 2009, Piciocchi et al., 2012) built on a shared knowledge and trust relationship with all relevant territorial stakeholders.

Smart governance has to reconfigure access rights to communication resources, by mutually agreed to value propositions (Spohrer and Maglio, 2009). The rights of access (Vargo and Lusch, 2008) are affected by the degree of openness to external interaction decided by the local system governance (Saviano et al., 2010). The degree of openness depends on the relevance of the systems from which a territory receives inputs, and it is expression of structural elasticity and systemic flexibility finalized to the adaptability with external contexts (Siano et al., 2009). Thanks to its openness degree, the smart governance is able to interact with local and non-local stakeholders for the search of sustainable competitive advantage.

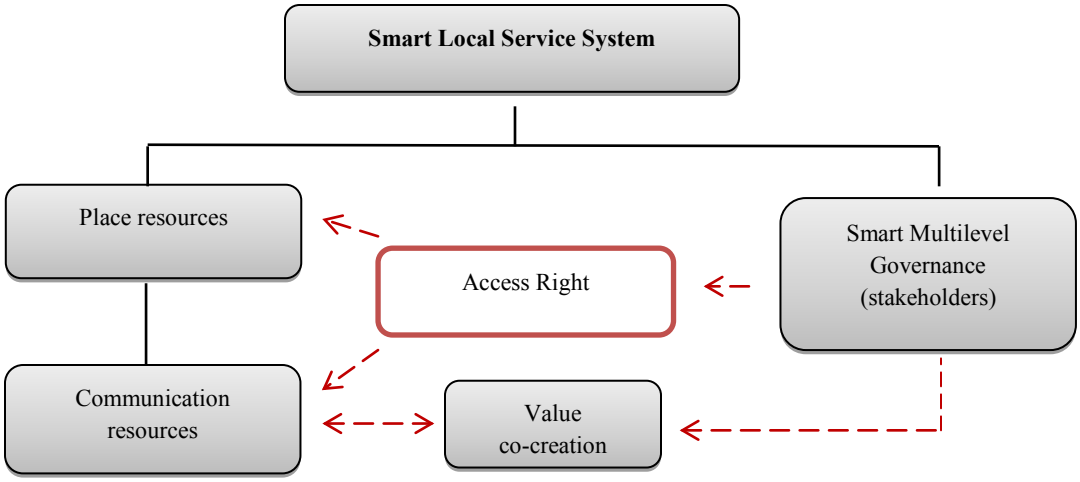

Figure 1. Smart Local Service System and access rights (Our elaboration)

Therefore, in order to enhance the contributions of territorial actor groups to place communication management, the smart local governance has to enable a broader access to place resource, above all place communication resources. "Open" government mechanisms and the access to shared place communication resources facilitate the value co-creation process with stakeholders. In service science, value co-creation interactions are mechanisms for changing access rights to resources referring to service system interactions and outcomes (Maglio et al., 2006), reinforcing the contributions of actor groups. In this perspective, it is important to reconfigure in territorial system the different role of stakeholder group of Smart Multilevel Governance in contributing to the creation or innovation of place communication resources.

CO-CREATION OF PLACE COMMUNICATION RESOURCES: SOME EXAMPLES

The access to resources means interaction, engagement, negotiation, giving the public the opportunity to take part in communication decision-making, creating contents with the local audience (Carpentier, 2011). More and more local resources offerings are designed to be accessed on the web. The participation of stakeholders on the online media is based on the principle of social empowerment (Constantinides and Fountain, 2008), defined as a process of sharing that tends to re-interpret the traditional processes of place communication. Empowerment is a process of territorial transformation and restructuring of the relationship between the territory and its actors to affect substantially on creation of place reputation.

Stakeholders play a proactive role in the creation, innovation and utilization of place-specific communication resources (Siano and Vollero, 2012; Siano et al, 2013), through high degree of interaction, availability and accessibility to a growing body of information. Stakeholders can provide important advice on keywords, slogans, jingles that identify a geographic area or share their experiences on a territory, from the perspective of place storytelling. Constant listening to the stakeholders offers interesting possibilities for enrichment and / or redefinition of the distinctive characteristics of a place, in term of keyword.

The case "Adopt a word" is an example of listening activities of stakeholders led by APT Emilia Romagna and addressed to improvement and enrichment of Wikipedia entries relating to the geography, history and culture of this Italian region. The initiative proposes to local stakeholders (citizens, tourists, etc..) to actively participate to the growth of the words of Wikipedia, through the insertion of text, images, links. The whole project takes place online through the website of the initiative (www.adottaunaparola.it) and social channels of Emilia Romagna Tourism: Twitter, Facebook and Flickr.

The ideas competition set up by the territorial entities to engage stakeholders in identifying the messages related to place identity are examples of how place communication can make use of the contribution of local stakeholders.

The Prague International Advertising Festival, for example, opened in April 2012 the contest "Slogan for Prague" to residents, visitors, communication professionals, etc. from different countries with the aim to identify a claim to be included next to city logo in every communication dedicated to tourism promotion. People of 21 different countries have responded to the initiative and most interesting contributions were evaluated by policy makers for future place communication campaigns.

Ideas, comments, suggestions and experiences of different stakeholders, thanks to the pervasiveness of social media, can be redesigned as new common process rules (CPR) (Christensen et al., 2008) in the field of communication management. In local areas, participatory mechanisms are necessary to help public institutions and stakeholders in the process of discovering new solutions that can affect the creation and utilization of place-specific resources. A sense-adapt-respond approach, together with co-creating processes (CPRs), supports the diffusion of communication capabilities that value two-way communication, dialogue and cooperation with stakeholders. These CPRs stimulate interactive relation, involvement and collaboration with internal and external stakeholders, enabling territorial system to adapt to environmental changes. Use of specific media, also in online context, enables to implement these rules in a process of value co-creation.

An example of CPR is provided by the Municipality of Copenhagen that, with the "Licence to Critique", aims to promote a culture of openness and self-reflective in which local stakeholders to feel free to express their thoughts on local government. With this slogan, the city explicitly invited its employees and citizens to reflect on the values of the organization, providing them with the "license to criticism", which translates into the ability to offer ideas and suggestions for the improvement of territorial policies.

In line with Gummesson (2006), we commended a many-to-many approach, which extends the notion of value creation to include interactions among networks of providers and communities of users/customers. This ensures an appropriate recognition of the role of other entities and interested parties in value creation process in the smart local systems.

CONCLUSIONS

The idea that smart place governance should be open, accessible and transparent requires a reinterpretation of governance mechanisms in terms of Smart Local Service System. The paper offers new insights on local governance issue, emphasizing the role of the smart local governance in ensuring stakeholders' access to communication resources. The openness of smart place governance is pivotal, in fact, to ensure the access to place-specific communication resource, in order to definite and reconfigure place identity, thanks to stakeholders' contribution. The place communication decision of policy makers can be influenced by instances of different local stakeholders group which, facilitated the support of digital media, contribute to affect the choices on the elements of place communication (Chadwick, 2003; Siano et al., 2008). The management of planned place communication processes (and influence of those unplanned), is a crucial challenge for the success in global competition between territories.

The importance of the local smart governance rises on its capability to seize the opportunities of relational exchange and to support the collective balance and positive interactions with local actors. Developing improved methods to facilitate effective value co-creation process in a local area defines a participatory and interactive approach in the management of communication. The adoption of a collaborative approach with stakeholders responds to the environmental changes and the progressive empowerment of users/citizens.

The different joint access rights, the sharing of resources, and mediator role of governance facilitate the common living and acting (of policy maker and stakeholders) and enhance the efficiency of the territory (Carrubbo et al., 2012). A SLSS, driven by a multi-level governance, is able to ensure the achievement of a distinctive competitive advantage for the territory through the creation of a positive place reputation.

The conceptual paper presents the typical limitations of the deductive approach based on literature review. The paper could be considered a first step in a stream of research on different aspects of smart local governance which are yet unexplored. This may implies new practices and research challenges in this field of study. In this perspective, it is important to reconfigure in territorial system the different role of stakeholder group of Smart Multilevel Governance in contributing to the creation or innovation of place communication resources.

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Section 12

Service Fascination

Success Factors and Approaches of Service Fascination – A Research Framework

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ABSTRACT

To gain competitive advantage many retailers, especially the ones of the fast moving consumer goods industry, aim at providing their consumers with unforgettable experiences across various channels. A lot of research has been performed in order to identify appropriate experiential criteria for achieving the highest possible consumer satisfaction. Nevertheless, researchers still lack knowledge regarding the impact of the individual experiential dimensions, the influence of technology as well as possibilities to measure the effects of system design features on perceived consumer experiences. A generalized concept is presented which aims at applying research findings on consumer experience for the strategic development of exciting self-service systems. Supported by an experiential design survey, a service fascination research model is presented to assess strengths and weaknesses of concrete self-service technology artifacts and the dependencies between their utilitarian and hedonic aspects as well as the user's technology readiness and trust. The approach and corresponding hypotheses are evaluated using the examples of an interactive fitting room as well as a social media mirror specifically designed to create positive emotions amongst young consumers.

Keywords: Technology Acceptance, Consumer Experience, Self-Service Technology, Service Fascination, Retail, Digital Natives

MOTIVATION

Achieving and retaining leadership in today's consumer goods industry requires the consistent renewal of not only products and services but also their presentation. Heading towards a service oriented economy, companies strive to be successful mainly by providing extensive services in a wide field of applications. After decades of price fights and cost reductions, practitioners now try to differentiate their companies from others by means of a much stronger focus on their consumers (Shaw and Ivens, 2005). This human-centered approach, putting the consumer in the center of all efforts, is intensively supported by a wide field of researchers (Douglas and Craig, 2000; Farinet and Ploncher, 2002; Parasuraman, 2000) and finally leads to a new, practice-oriented research stream called "Customer Experience" (Meyer and Schwager, 2007; Schmitt, 1999; Schmitt and Mangold, 2004; Verhoef et al., 2009). The concept sees every direct or indirect contact with the consumer as a potential starting point for economic competition (Berry et al., 2002; Pine and Gilmore, 1999). Verhoef et al. (2009) describe customer experience as a construct that "is holistic in nature and involves the customer's cognitive, affective, emotional, social and physical responses to the retailer." In contrast to traditional Customer Relationship Management (CRM) approaches the focus comprises emotional and irrational aspects of human behavior (Holbrook and Hirschman, 1982). Referring to Gentile et al. (2007), "such experience plays a fundamental role in determining the customers' preferences, which then influence their purchase decision."

Although literature depicts the general importance of customer experience as such, there is still a lack of knowledge about the impact of its distinct drivers, means of measurement as well as information about the influence of self-service technologies (Verhoef et al., 2009). While many researchers concentrated on E-Commerce applications in the past, more recent works, e.g., the ones conducted by Pantano and Corvello (2010) or Willow (2010), focus on improving the consumer touch points at the physical point of sale. Further research is done by Zagel and Bodendorf (2012), who identify the potential to create new, emotional and exciting self-service solutions for young and technology ready user groups by applying advanced technologies in retail environments.

Building on widely accepted models of customer experience as well as technology acceptance research, this paper describes a two-step approach to (1) to rate the manifestation of the experiential dimensions for concrete self-service artifacts and (2) to assess the correlations of elements influencing the overall experience of self-service use (cf. Zagel et al., 2014). The concept therefore enables researchers and practitioners to strategically build, to measure, and to improve consumer-oriented and technology-based self-service systems with the goal of service fascination[1].

As practical examples for self-service technologies in retail environments, two artifacts, an interactive fitting room as well as a social media mirror, are presented. They are compared and used to validate the theoretical model. Conclusions are drawn on how the services can be improved to better serve the consumer's functional and hedonic needs, leading to fascinating services.

THEORETICAL OVERVIEW

The Technology Acceptance Model

For identifying potential issues in the design and acceptance of technology-based systems, researchers have begun to build on theories of innovation diffusion (Rogers, 1962). The focus of most studies lies on identifying the influence of users' perceptions towards the adoption of new IT solutions. The Technology Acceptance Model (TAM) by Davis (1989) resp. Davis, Bagozzi and Warshaw (1989) is one of the most applied adoption and intention models to explain the usage of technology and the acceptance of information systems (see Figure 1). It is based on Ajzen and Fishbein's (1980) Theory of Reasoned Action (TRA). TRA explains a person's behavioral intention by dependencies on the person's attitude as well as subjective norms. Refining TRA, Perceived Ease of Use (PEOU) and Perceived Usability (PU) are considered the primary determinants of system usage. In this context Davis (1989) defines PU as "the degree to which a person believes that using a particular system would enhance his or her job performance", whereas PEOU is described as "the degree to which a person believes that using a particular system would be free of effort."

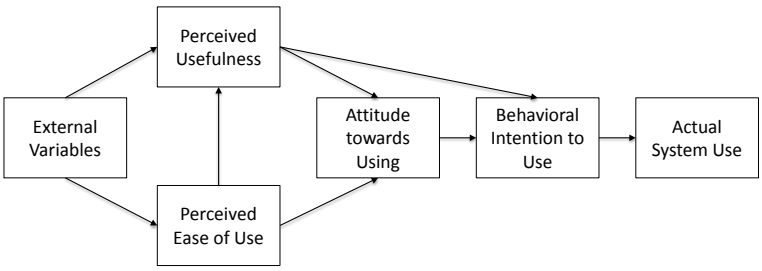

Figure 1. Technology Acceptance Model by Davis (1989) and Davis et al. (1989)

Both, PU as well as PEOU, are influenced by certain system design features, called external variables. Comparably to the TRA, the user's perceptions originating through interaction with a technology determine the user's attitude towards using the system. This attitude then determines the Behavioral Intention to Use (BI) and in turn also the Actual System Use.

Throughout the last decades the traditional TAM has undergone several modifications and extensions. In 2000, Venkatesh and Davis (2000) proposed the so called TAM2 that integrates social influence processes (e.g., subjective norm, voluntariness, and image) as well as cognitive instrumental processes (e.g., job relevance, output quality, and result demonstrability). It was possible to explain the influence of peers on the adoption of new services. As attitude

[1] "Service Fascination can be described as an extraordinary positive emotional state arising through conscious and subconscious effects of self-service technology use." (Zagel et al., 2014)

has been found to only partially mediate PU and BI it has not been adopted in TAM2 and most of the other extensions. With TAM3, Venkatesh and Bala (2008) developed a refined model in order "to understand how various interventions can influence the known determinants of IT adoption and use." It includes eleven determinants of PU and PEOU as well as Voluntariness and (previous) Experience as moderating factors. But the model is also used in various other fields of acceptance research. Lee et al. (2003), Pantano and Di Pietro (2012), as well as Legris et al. (2003) provide detailed overviews on TAM literature. Most extensions of the traditional TAM deal with the explanation of how external variables influence the willingness to use systems. Legris et al. (2003) state that "there is no clear pattern with respect to the choice of the external variables considered." Nonetheless, they can be used to better understand "what influences PU and PEOU." While in early publications authors concentrate on the investigation of subjective norms (Venkatesh and Davis 1996, Venkatesh and Davis, 2000), education (Agarwal and Prasad 1997), or prior experiences with the system (Taylor and Todd, 1995), more recent studies focus on hedonic factors (Chiu et al., 2009; Du et al., 2010; Hsu and Lu, 2004; Sonderlund and Julander, 2009; Tseng and Lo, 2011) and security in interactive and especially online systems (Chen et al., 2004; Gupta and Xu, 2010; Tsanakinjal et al., 2010).

A Concept to Assess the Experiential Effects of Technology Use

The traditional TAM and widely accepted models of customer experience research serve as a basis for creating a measurement construct to assess the experiential aspects of self-service technology design as well as a causal model used to analyze the effects of experiential self-service system design characteristics towards service fascination. In this context, self-service systems are defined as "technological interfaces that enable consumers to produce a service independent of direct service employee involvement." (Meuter et al. 2000) Following Pine and Gilmore's (1999) understanding of experiences, the goal of the proposed concept is to create, to measure, and to improve self-service systems for active user participation and interaction. Comparable to the model described by Kano et al. (1984), the proposed concept integrates basic dimensions (perceived usefulness and perceived ease of use), rejection dimensions (trust) and experiential dimensions (experiential design), supported by technology readiness as a mediator (cf. Zagel et al. 2014). The underlying idea is that an easy to use system that provides value for the user and does not involve any risk can be made exciting by strategically integrating experiential design elements (affective, cognitive, behavioral, sensorial, and social dimensions).

The first part of the research concept consists of a survey used to identify the experiential characteristics of concrete technological self-service artifacts. It can be used to reveal strengths and weaknesses of the design. As part of the general marketing efforts the overall goal is to create self-service systems for retail use that consciously and subconsciously fascinate the user. These positive experiences manifest through positive emotions and in the active willingness to share and recommend products or services (Mattila, 2005). Customer experience literature proposes various criteria supposed to positively influence the perception of products and services. Applying an explorative factor analysis, Novak et al. (2000) first introduce a valid scale for the construct of customer experience in the Internet context. Their work is based on Csikszentmihalyi's Flow concept, a psychological approach that describes a person's emotional state of being completely merged in a task (Csikszentmihalyi, 1975, 1990). However, a large number of experience concepts (Gentile et al., 2007; Knutson et al., 2006; Mascarenhas et al., 2006; Novak et al., 2000; Schmitt and Mangold, 2004; Verhoef et al., 2009) underpins that there is not one single widely accepted theory. Nevertheless, the excitement criteria proposed by Schmitt and Mangold (2004) serve as a basis for subsequent research and therefore can be regarded a prevailing opinion (Gentile et al., 2007; Mascarenhas et al., 2006; Verhoef et al., 2009). Accordingly, holistic experiences build on a stimulation of sensory, social, behavioral, cognitive as well as affective modules. Based on this assumption, the survey is constructed of items to measure these experiential dimensions. These items (see Table 1) are either adopted from previous research or newly created on basis of research in the respective areas.

Table 1. Experiential Design Survey (including Cronbach's α for both studies)

Affective	Source	Study 1	Study 2
I find the system to be enjoyable.	Davis et al. (1992), also used in	0.723	0.872

The actual process of using the system is pleasant.			
I have fun using the system.			
Using the system is fun for its own sake.	Childers et al. (2001), also used in Kim and Forsythe (2007)		
Using the system makes me feel good.	Childers et al. (2001), also used in Kim (2006)		
Cognitive	**Source**	**Study 1**	**Study 2**
I am satisfied with the product information the system provides.	Chen et al. (2004), based on Daft and Lengel (1986)	0.847	0.868
The system provides product information in a variety of ways (i.e., text, graphic, animation, audio, and video).			
Using the system is interesting.	Childers et al. (2001), also used in Kim and Forsythe (2007)		
Overall, the service quality of the system is high.	Chen et al. (2004), based on Cronin and Taylor (1992)		
The system allows me to make buying decision in a reflected way.	New item, based on Gentile et al. (2007) and Schmitt and Mangold (2004)		
Behavioral	**Source**	**Study 1**	**Study 2**
Using the system would change my shopping behavior.*	New item, based on Gentile et al. (2007), Schmitt and Mangold (2004), and Verhoef et al. (2009)	0.891	0.915
Using the system would influence my shopping behavior.*			
The system shows me alternative ways for buying products.	New item, based on Gentile et al. (2007), Schmitt (1999), Schmitt and Mangold (2004), and Verhoef et al. (2009)		
The system fits to my personal lifestyle.			
Sensorial	**Source**	**Study 1**	**Study 2**
Overall, I think the system looks attractive.	van der Heijden (2003)	0.947	0.806
The system stimulates my senses (visual, auditory, haptic, gustatory or olfactory).	New item, based on Gentile et al. (2007), Schmitt and Mangold (2004), and Verhoef et al. (2009)		
The system stimulates multiple of my senses at once.			
The physical interaction feels appealing.			
Social	**Source**	**Study 1**	**Study 2**
In general, I think the system provides good opportunities for interaction with others.	Liu et al. (2010)	0.813	0.751
The system motivates to use it together with others.	New item, based on Gentile et al. (2007) and Liu et al. (2010)		
My friends would be envious of me having the chance to use the system.	New item, based on Schmitt and Mangold (2004) and Venkatesh and Bala (2008)		
Having had the chance to use the system is like a status symbol.			
*Adaption of the experiential design study to fit the respective field of application (e.g., shopping)			

Schmitt and Mangold (2004) state that these experiential dimensions form one holistic construct. This results in the fact that users discern the effects of these stimuli as one complex and integrated feeling, often not being able to consciously separate the elements (Gentile et al., 2007). Consequently, they form a common, formative "experiential design" construct within the second part of the research concept presented: the service fascination research model (see Figure 2). The goal is to assess interdependencies with other (reflective) constructs influencing the overall satisfaction and service fascination (Zagel et al., 2014).

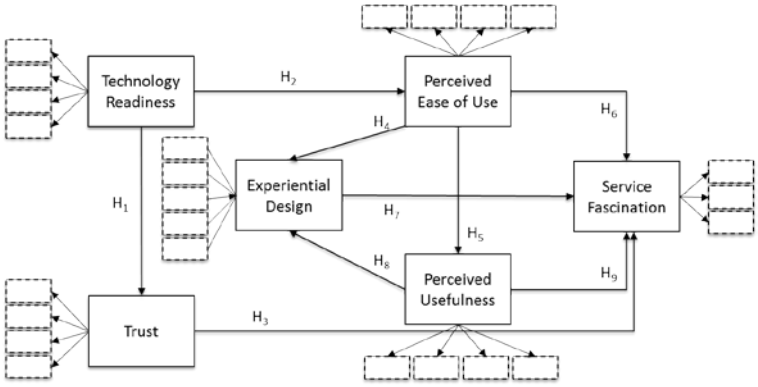

Figure 2. Service Fascination Research Model (based on Zagel et al., 2014)

Table 2 shows the grouping of the items, their origins in literature, as well as the Cronbach values for both studies. While the basic elements (perceived usefulness and perceived ease of use) as well as their relationships (H_5) are adopted from the traditional TAM (Davis, 1989), further extensions are done to integrate the aspects relevant for self-services addressed in previous research.

Table 2. Service Fascination Questionnaire (including Cronbach's α for both studies)

Technology Readiness	**Source**	**Study 1**	**Study 2**
I feel apprehensive about using technology.	Raub (1981), also used in Meuter et al. (2005)	0.719	0.702 (item 2 dropped)
Technical terms sound like confusing jargon to me.			
I have avoided technology because it is unfamiliar to me.			
I hesitate to use most forms of technology for fear of making mistakes I cannot correct.			
Trust	**Source**	**Study 1**	**Study 2**
I am concerned that the system collects too much personal information from me.	Chen et al. (2004), based on Smith et al. (1996)	0.958	0.927
I am concerned that the system will use my personal information for other purposes without my authorization.	Chen et al. (2004), also used in Koch et al. (2011)		
I am concerned that unauthorized people (i.e. hackers) have access to my personal information.			
I am concerned about the security of my personal information during transmission.	Chen et al. (2004), based on Smith et al. (1996)		
Perceived Usefulness	**Source**	**Study 1**	**Study 2**
Using the system improves my performance.	Davis (1989), also used in Davis et al. (1989), Venkatesh and Davis (1996; 2000)	0.891	0.936
Using the system increases my productivity.			
Using the system enhances my effectiveness.			
I find the system to be useful.			
Perceived Ease of Use	**Source**	**Study 1**	**Study 2**
My interaction with the system is clear and understandable.	Davis (1989), also used in Davis et al. (1989), Venkatesh and Davis (1996; 2000)	0.938	0.851
Interacting with the system does not require a lot of my mental effort.			
I find the system to be easy to use.			
I find it easy to get the system to do what I want it to do.			
Service Fascination	**Source**	**Study 1**	**Study 2**
I would share my good experience about using the system.	Maxham (2001), also used in Kim (2006)	0.950	0.919
I would recommend shopping with the system.	Maxham (2001), also used in Kim (2006), Kim et al. (2008)		
Using the system is exciting.	Childers et al. (2001), also used in Kim (2006)		

Next to the element stated before, the aspect of technology readiness is included as a mediating variable, being especially important when assessing innovative technologies. Research has shown that people with higher

technology anxiety are more likely to avoid using self-service technologies (Parasuraman, 2000). Next to that, technology readiness is also found to influence the perceived ease of use when interacting with computers (H_2) (Hackbarth et al., 2003). Finally, if a person is used to and enjoys working with technology he/she is likely to judge potential security issues of a system (H_1). These connections between technology readiness and trust are discussed in recent studies (Liljander et al., 2006). Amongst others, Gefen et al. (2003) as well as Koch et al. (2011) see trust playing a crucial role in technology and service adoption, either supporting or preventing (if usage of a system is too risky) the creation of positive experiences (H_3). As perceived usefulness and perceived ease of use are of experiential nature, providing functional/utilitarian value to the user, they directly influence the experiential design of a system (H_4, H_8). Furthermore, acting as basic elements and being regarded an absolute necessity for the acceptance of technologies, they directly influence the overall service fascination (H_6, H_9). Consumers strive for positive emotions. Schmitt and Mangold (2004) as well as Gentile et al. (2007) showed that a substantial part of the value perceived when interacting with a system is formed by experiences and hedonic elements that may even predominate pure functional aspects (H_7). These correlations lead to the following hypotheses:

- H_1: Technology Readiness affects Trust towards self-service systems.
- H_2: Technology Readiness affects the Perceived Ease of Use towards self-service systems.
- H_3: Trust affects Service Fascination.
- H_4: Perceived Ease of Use affects the perception of the Experiential Design of self-service systems.
- H_5: Perceived Ease of Use affects the Perceived Usefulness of self-service systems.
- H_6: Perceived Ease of Use affects Service Fascination.
- H_7: The Experiential Design of self-services affects Service Fascination.
- H_8: Perceived Usefulness affects the perception of the Experiential Design of self-service systems.
- H_9: Perceived Usefulness affects Service Fascination.

RESEARCH METHODOLOGY AND SELF-SERVICE ARTIFACTS

Study 1 - Interactive Fitting Room

The prototype of an interactive fitting room presented by Zagel and Süßmuth (2013) serves as the first self-service system to validate the proposed model. The system applies innovative technologies in order to generate an exciting retail service for young consumers. Analyses and observations conducted between 2010 and 2013 amongst various companies of the textile industry show that the use of technology is in most cases limited to the optimization of back-end systems (e.g., stocktaking based on Radio Frequency Identification (RFID) Technology) or the presentation of multimedia content via digital signage systems. Especially the areas of intense consumer contact like shopping windows or fitting rooms have hardly been improved during the last decades. In retail shops fitting rooms typically feature identical layouts and designs and currently do not provide a pleasing stay (Dennis-Jones, 2007) even though the goal should be to raise consumer's attention by addressing physical, cognitive, and emotional stimuli (Mayer, 2000). Latest studies prove the economic importance of this consumer touch point as well: A pleasant fitting of clothes in a dressing room leads to 71 % of buying probability (Envisionretail, 2006).

The developed system uses IT-support like RFID, touch interfaces and projection screens to create an immersive, virtual space in a fitting room environment. Focusing on the consumer group of 14 to 19 year olds, the goal is to create an exciting shopping experience by stimulating multiple senses. In addition to detailed product information the system offers recommendation services and access to social networks. When accessing the fitting room, the consumer feels like stepping into another world which reflects the respective context of the product at hand. By automatically detecting the article via RFID, the system triggers for example an animated mountain environment, when entering with an outdoor jacket (see Figure 4). All user interfaces and controls are integrated into the specific virtual world, augmented by additional product information. For the realization of the physical prototype, a dimensionally correct piece of furniture is constructed. Three large projection screens integrated into the walls compose the core of the system. Comparable to a CAVE (Cave Automatic Virtual Environment) they maximize the level of immersion by augmenting reality with virtual content. Cruz-Neira et al. (1993) describe the CAVE as a projection-based virtual reality system in form of a cube, using the walls as display areas. All additional hardware components as well as the projectors are mounted inside of an interior wall. Figure 3 shows the physical prototype.

Figure 3. Interactive Fitting Room - Physical Prototype

Next to displaying general product data like available sizes, colors and detailed material information, it is possible to also show cross- and upselling information. A link to the online world, especially the company's Web store as well as social networking services (SNS) is realized by integrating product reviews and ratings from the website into the fitting room's product experiences and by allowing the consumer to actively share and comment products from within the device. By scanning a QR-code with his personal smartphone, the user is linked to a mobile optimized website (see Figure 4).

Figure 4. Social Media Connection and Immersive Environment

Study 2 – Social Media Mirror

As a second self-service system the so called "Social Media Mirror" is presented. Since 2012, eleven devices are installed in ten fashion stores throughout Germany. As an interactive consumer touch point the device allows users to connect with their friends and other consumers while shopping in the retail store. It provides its users with a fun way to take pictures, record short videos and share their look in combination with a personal comment on favorite social networking platforms. Next to posting the content on private profiles it is also possible to upload the posts to the company's brand sites. Furthermore, sales assistants can use the system to post content in order to promote articles and to engage consumers through social platforms.

The system is realized through a terminal, consisting of a large format screen and a camera mounted behind a one-way mirror as well as a pillar carrying a 15 inch touchscreen display (see Figure 5). The term "Social Media Mirror" is derived from its large, reflective front surface covering the camera as well as the large format screen. This semi-transparent mirror glass is used to make the display and the camera invisible and only reveal the digital content as soon as the display shows other than black colors. When turned on, it is therefore not possible to recognize the technical devices behind the glass and the user gets the impression of standing in front of a standard mirror with interactive elements. The goal is to integrate the technology in an unobtrusive way and to surprise the consumer through messages appearing.

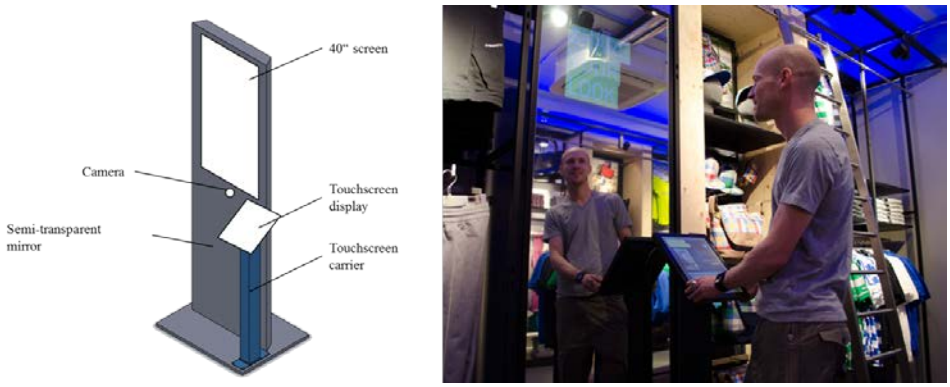

Figure 5. Social Mirror (Left: Hardware Setup; Right: Productive Use)

DATA COLLECTION

Procedure

The described self-service systems serve as appropriate artifacts to validate the proposed model and to identify differences in their individual experiential manifestation. Both systems are evaluated applying the questionnaires introduced above with additional demographic questions about gender and age. The questionnaires are pre-tested on a small number of consumers and a factor analysis is conducted to ensure that the measures are distinct from each other. After the self-service systems are used by the participants, they are asked to provide answers on Likert-type items labeled at the endpoints ("strongly disagree" and "strongly agree"). The constructs "trust" and "technology readiness" are represented by reverse coded items in the questionnaires and translated for further analysis.

While study 1 (interactive fitting room) is evaluated within a laboratory experiment in August 2013 amongst 67 participants (28 female, 39 male, average age 23.6 / std. 4.73), study 2 (social media mirror) is performed in a productive shop environment in December 2013 amongst 68 subjects (55 female, 13 male, average age 20.4 / std. 4.25). Participation in the study is voluntary and without any compensation. The evaluation group for study 1 consists of subjects recruited at the university and on a shopping street, the subjects for study 2 are randomly asked for participation in the store. For the evaluation of both artifacts the subjects are asked to complete the surveys after autonomously interacting with the self-service systems.

Data Analysis

The reliabilities of the constructs used to validate the design artifacts and the theoretical model are calculated using SPSS 20 and presented together with the item groups in Tables 1 and 2. Despite the technology readiness criterion (study 2) and the affective dimension (study 1), all reliabilities exceed Nunnaly's (1978) recommended levels. In order to also reach a Cronbach's α value exceeding the threshold of 0.7, the items without strong contribution are dropped.

The structural model presented in this paper is modeled in SmartPLS 2.0 using the partial least squares method (67 / 68 cases, each with 5000 samples) to test the proposed relationships and to analyze model validity. On a measurement model level, the reflective constructs are validated based on the criteria of indicator reliability, convergence (composite reliability and average variance extracted (AVE)), discriminant validity (Fornell-Larcker criterion and cross loadings), and communality applying Stone Geisser's Q^2. The formative measurement model "experiential design" is validated using the indicator weights of the items and the variance inflation factor (VIF). As for both studies some of the indicator weights do not significantly influence the latent construct, also the loadings are examined, showing high significance. The structural model is validated by testing the hypotheses in form of the respective directional paths and by the variance explained (R^2). Figure 6 shows the results of the analyses for both evaluated systems.

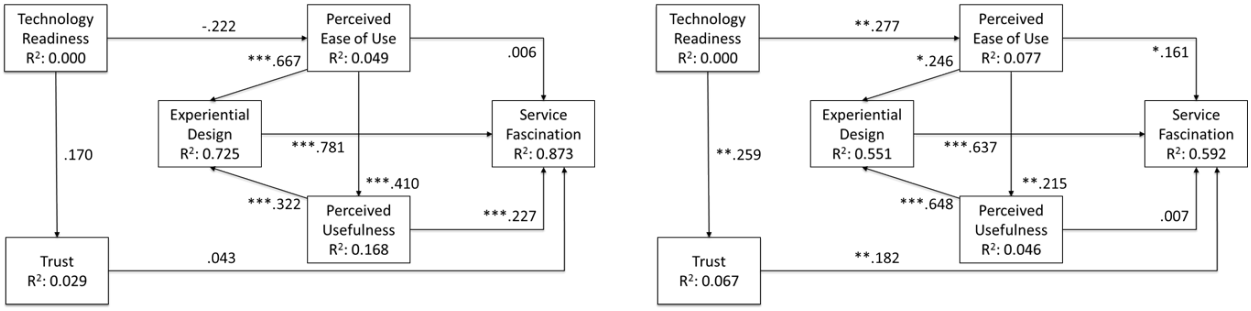

Figure 6. Test Results - Path Coefficients, left = study 1, right = study 2, t-values (*<0.1; **<0.05; ***<0.001)

Table 3 summarizes the hypotheses and the analysis results for both studies. While results differ in several of the hypothesized relationships, the patterns for H_4, H_5, H_7, and H_8 match for both studies. PEOU and PU are found to significantly influence the experiential design. The traditional TAM's robustness is confirmed by the significant relationship of PEOU towards PU. Finally, the experiential design of a self-service system claims a significant relationship towards the overall perceived service fascination. With R^2 values of 0.725 / 0.873 (study 1) and 0.551 / 0.592 (study 2), the model is able to well explain the two main variables "experiential design" and "service fascination" (Chin, 1998).

Table 3. Hypotheses and Results

Hypothesis	Study 1	Study 2
H_1: Technology Readiness -> Trust	Not Supported	**Supported**
H_2: Technology Readiness -> PEOU	Not Supported	**Supported**
H_3: Trust -> Service Fascination	Not Supported	**Supported**
H_4: PEOU -> Experiential Design	**Supported**	**Supported**
H_5: PEOU -> PU	**Supported**	**Supported**
H_6: PEOU -> Service Fascination	Not Supported	**Supported**
H_7: Experiential Design -> Service Fascination	**Supported**	**Supported**
H_8: PU -> Experiential Design	**Supported**	**Supported**
H_9: PU -> Service Fascination	**Supported**	Not Supported

Even though the experiential dimensions are integrated into the common component "experiential design" within the service fascination research model, they can be analyzed separately using the first questionnaire section. The detailed analysis for both self-service artifacts is depicted in Figure 7.

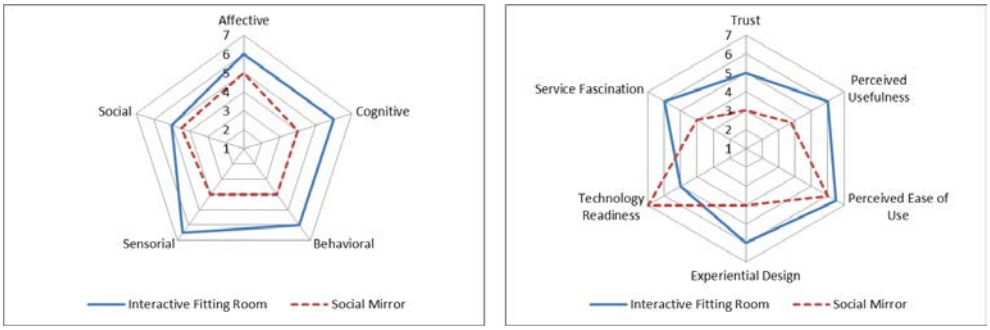

Figure 7. Evaluation Results: Interactive Fitting Room vs. Social Mirror (Medians)

The results clearly show more positive ratings for the interactive fitting room in comparison to the social media mirror across both parts of the survey. All experiential dimensions (the utilitarian and the hedonic factors) are perceived with a higher intensity. The self-service system of study 1 is furthermore accredited more usefulness and a better ease of use, in sum leading to a higher overall service fascination. Nevertheless, the subjects of study 2 considered themselves as being more technology ready than the subjects of study 1. Most noticeable are the differences regarding the sensorial dimension as well as the perceived usefulness of the devices. For deeper analysis the results are broken down into genders (see Figure 8).

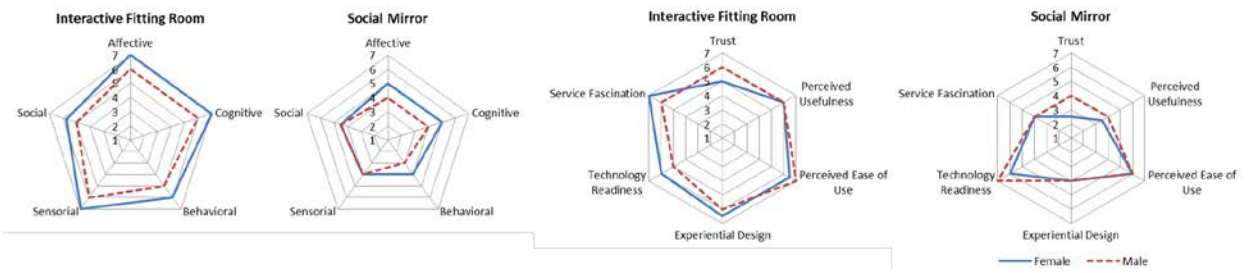

Figure 8. Gender Breakdown: Interactive Fitting Room vs. Social Mirror (Medians)

Discussion and Future Research

There are many aspects influencing a customer's satisfaction with a technology-based self-service system. This study analyzes various effects: service fascination shaped through experiential design, trust, technology readiness, and ease of use as well as the system's usefulness. The data show that the experiential design is strongly related to service fascination and consequently the willingness to use and actively promote a service. It is therefore possible to confirm Gentile et al.'s (2007) statements. While it is possible to reinforce the traditional TAM's robustness in explaining technology adoption through PU and PEOU, both elements are also found to be part of the experiential continuum. In both studies it was possible to confirm their importance as basic elements of electronic self-services, constituting an absolute necessity for system use. The most interesting finding is, that while within both test groups women show less trust in technology, they experience the experiential design dimensions with a higher or at least the same intensity compared to men. This implies high potential for future research. If confirmed in additional use cases, a major chance for improvement lies in the creation of gender-specific self-service experiences, focusing on the experiential elements with highest impact. The position of trust as a rejection dimension for self-service use is only confirmed in study 2, which represents the system with the lower overall service fascination rating. Further research has to be done in this area. Especially trust's relationship to the perceived experience has to be further examined to answer the question: do consumers show a high willingness to take risks for the sake of exciting moments? While both groups of study participants are age-wise comparable, they strongly differ in technology readiness. Additional investigation has to be done to learn, if a higher technology readiness generally leads to an inferior evaluation of the experiential elements.

Limitations of the work presented can provide starting points for continued research in the area of consumer experience management as well as for a better understanding of the adoption and use of technology-based systems. Both studies only focus on self-service systems and are conducted with rather small sample sizes (N=67/68) within the specific focus group of the digital natives. Further investigation needs to be done to prove the validity of the concept and model with higher sample sizes and their applicability to other target audiences. Additional and repeated utilizations across further self-service artifacts will provide knowledge about promising technology combinations and a change in perception over time. Further chances for research lie in evaluating the influence of a system's innovativeness towards how it is perceived, as well as the changes in perception if an innovation becomes commodity.

CONCLUSION AND OUTLOOK

Creating superior experiences is gaining tremendous attention by marketers and retailers. However, authors still demand for research that provides a deeper understanding of the experiential dimensions and their effects, as well as consumer experience in general. This paper presents an approach for assessing consumer experience in technology-based self-service systems in a structured way. A research model is introduced that integrates the constructs trust, technology readiness and experiential design generated through systematic implementation of experiential dimensions. The model is able to confirm findings of existing literature: the specific assessment of the excitement criteria can lead to positive experiences. From a practical standpoint the findings of this research support the future development of attractive services. Retailers and marketing experts are striving for self-service systems that are not only easy to use and provide utilitarian value to their consumers, but specifically include hedonic elements, leading to great experiences. Creating positive emotions, excitement and fascination will per se lead to positive word-of-mouth and to a higher overall value perception. The implementation of these findings in practical use cases and the combination with future research in long term investigations will show, if the economic accrual is able to pay off the additional investments in technology.

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The First Intelligent Store in Brazil

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ABSTRACT

The First Intelligent Store in Brazil was developed since 1993 and since 2011, it was implemented at Billabong Store in Alphaville, São Paulo, Brazil as study case of a PhD. Inside the same space, it was implemented 15 applications that uses RFID, NUI, Mobility, Interactivity, all connected with an ERP that is integrated with Smart Self Checkout, Smart Loss Prevention, Smart Dressing Room, Smart Exhibitor, Smart Inventory, Smart Replenishment, Smart POS, Smart Shelf and other features that allows the store improve the manager and the customer experience. As a result, the store counts with the boost to the store´s traffic, fueled by curiosity about the new solutions that also led to higher sales. For the customers it was very important because the technology helped to reduce queues and improve the shopping experience. For the business it was wonderful because they could improve the receipt, inventory, loss preventions, products locations. The customers can play inside the smart dressing room that recognize the products and suggest others that coordenates with that one that customer bring inside the smart dressing room. It helps to know the habits of consumers and their expectations and it helps to increases the sale of products on impulse. The store is a big success in Brazil, because it was the first one that put everything together at the same place: RFID, NUI, ERP, Mobility, and we could prove the ROI with the technologies working together.

Keywords: (IT) Information Technology. AIDC (Automatic Identification and Data Capture). RFID (Radio Frequency Identification). Barcode. Biometrics. Retail. Loss Prevention. Inventory. Stock. EPC (Electronic Product Code) Processes. EAI (Enterprise Application Integrator).

INTRODUCTION

Customers shopping behavior will change more in the coming years than it did during the last one hundred (UNDERHILL, 1999). According to the author, the new consumer age provides an overwhelming amount of options, so that consumers will surely redefine markets in all sectors, requiring new products, services and sales channels.

Kotler, Hermawan and Iwansetiawan (2010) state that we live in the 3.0 Marketing Era, in which the behavior and attitudes of consumers will influence the business, since consumers will demand more collaborative culturally and spiritually marketing approaches. Highlighting that new technology will facilitate the dissemination of information, ideas and public opinion, which will allow consumers to work together to create value. The authors said that technology drives the rise of the creative market, whose worldview is more spiritual, requiring differentiated products and services.

This "new consumer" is more individualistic, independent and knowledgeable, with a lot of freedom to purchase (anytime, anywhere) besides being increasingly demanding and stressed. They are “omni-channel consumers” and because of it, they wants to use all channels simultaneously and retailers needs to track customers across all channels, not just one or two. He is more awareness about his power and rights and challenge the suppliers to provide him with more pleasant experiences, and he values his shortage of time, attention and confidence, resulting in greater need for convenience, authenticity and credibility, has greater geographic, ethnic and cultural diversity as a result of the increasing globalization of human society. He is concerned with environmental problems and issues of personal and social security. He is driven to acquire new, more complex and urgent knowledge, experiences, attitudes and feelings of self-confidence (Nascimento, 2010).

According to Mattar (2011), some events in the New Economy has brought new features to the Brazilian retail, such as: strong growth in e-commerce, demand for greater privacy by customers, full transparency, mega retailers globalization, neofrugalism, social responsibility, sustainability, efficient management, new store formats, new forms of communication, growth of own brands, growth of direct marketing, etc. Omni-channel consumers impact a lot the traditional retail (brick-and-mortar stores). In the brick-and-mortar channel, digitally-savvy consumers are entering stores already well-informed about a product’s features and prices, and expect store employees to know more than they do (Kilcourse, 2012).

Currently, trends in retail management are aimed at customization, differentiation, innovation, and especially a value added relationship with the customer. This requires the intensive use of technology to offer the customer more than he expects, surprising and captivating him, thus aiming his loyalty. (MATTAR, 2011).

Due to the change in consumer behavior, cheapening of technology resources, the constant search for quality improvement and competitiveness, globalization, new sales channels, it is therefore necessary to study the use of new technologies and IT tools that help enable the retailer to sell more and facilitate consumers purchases (SANTOS, 2006).

With competition just a click away, stores will have to be set up in prime locations with easy access and very good facilities. Fun is also an essential component, since retail and leisure are increasingly integrated. If the store did not have fun, surely it will be replaced by the competitor who has it. Thus, the act of going out shopping will be a leisure activity. The interaction between the product and the seller should be a moment of pleasure, in which the consumer will have the opportunity to get the quality of services according to his needs and technology should support it.

In short, retailers need to rewrite their brands, optimize their activities using technology and systemic intelligence, solve internal constraints especially in regards to people, systems and technology.

OBJECTIVE

The aim of this study is to identify the changes and possible gains in operational processes of the retail self-service stores, impacted by the use of Information Technology (IT) and Automatic Identification and Data Capture (AIDC) in world of omni-channel consumer.

To achieve this goal the key operational processes in a self-service retail store were studied focusing to identifying how AIDC and IT could help improve customer experience, operational performance and deliver business value.

STRUCTURE OF RESEARCH

The work consists of a literature review and rationale for its development, required to conduct the research. In this context, the following issues are addressed: Retail, IT applied to Retail; Automatic Identification and Data Capture (AIDC), Case Study and Conclusion.

RETAIL

To define the requirements of IT and AIDC to retail is essential to understand what is “retail”.

The "retail consists in the business activities involved in selling any product or provide any service to final consumers for use, personal, family and residential consumption" (MATTAR, 2011). Therefore includes: fast food, entertainment, laundry and health services and even furniture, cars and residential services. Being the last end of the chain adds value by including a set of business activities as it is in direct contact with the end consumer.

Marques (2004) points out that the most critical retail processes are: customer service, relationship management, purchasing and negotiating with suppliers, logistics and distribution, demand and inventory, operational efficiency and training of the staff, in addition to safety and loss prevention.

According to Marques (2004), inventory control will be increasingly necessary, so that the consumer finds the desired product exactly when he needs, and AIDC and IT can help a lot in all processes.

Hardgrave (2008) says that the inventory accuracy is one of the most important process at retail. Purchase order are based in inventory information that are lack of accuracy 65% of the time impacting revenues in 10%. Worldwide inventory inaccuracy average is 8% meaning a potentially 3.2% loss for retailers and 2.8% for manufacturers. Increasing inventory accuracy will help improve this issue.

In a world of omni-channel consumer, IT need to help retailers to transform the experience inside brick-and-mortar stores and retailers should use many of IT tools to offer the right product at the right place at the right time integrating all channels and transforming the shopping experience into something enjoyable and unforgettable.

INFORMATION TECHNOLOGY (IT) APPLIED TO RETAIL AND AUTOMATIC IDENTIFICATION AND DATA CAPTURE (AIDC)

The concept of Information Technology - IT - as an area of knowledge management emerged in Brazil around 70/80 and has been considered as one of the most important components of business environment at either strategic and operational level (ALBERTIN, 2005a; LAURINDO, 2002). IT enables retailers to improve their competitiveness and customize their products and services adding value to customers (Siqueira, 2004).

With the expansion of retailing activities, issues such as efficient management and intensive use of advanced information technology begin to play a more important role in the modernization of the distribution system and the Brazilian economy as a way to improve customer service that is more mature and demanding. In addition, an increasing share of income of these consumers has been used in entertainment, tourism and telecommunications, changing their purchasing profile (MATTAR, 2011).

Retail is one of the most important links in the supply chain and makes use of various technologies (MARQUES, 2004). Among them are: point of sale (POS), Enterprise Resource Planning (ERP), Customer Relationship

Management (CRM), system collaboration between suppliers process (as is the case of the ECR - Efficient Consumer Response), the exchange of data between all links of the chain (EDI - Electronic Data Exchange), and information systems for decision support and business intelligence (Marques, 2004).

Information Technology (IT) causes a direct impact on organizational processes. Graeml (2000) identified how organizations generally invest in IT, ie, what are the main organizational objectives, to be achieved with the use of IT in their processes. According to the author, they are: operational efficiency (at this level, IT helps to improve existing processes, focusing on improving its execution); organizational effectiveness (in this case, IT is used to refine processes, products and services); relationship with suppliers (in this regard, IT is used in order to reduce transaction costs and improving collaboration between companies); customer relationship (seeks customer retention, by knowing about them); competitive dynamics (the focus at this level is to add value to products and services and develop new distribution channels so that the competition can't copy quickly, creating barriers to new entrants); marketing support (use IT to help to identify market trends, prospecting new markets in order to increase the efficiency of searches); improvement of products and services (search is mass customization, by reducing the development time of new products); cost reduction in production (aim at increasing productivity, through quality improvement); business innovation (IT can be used to create new opportunities for business).

To Bolwijn and Kumpe (1990), the competitiveness must be analyzed. For the authors, the most important factors affecting the competitiveness are: cost, quality, time, flexibility and innovation. Efficiency refers to the ability of the organization to achieve its goals cost effectively, according to the resources available. Aims to provide quality products and services that meet the specifications and / or requirements in accordance with customer expectations. The time refers to the ability of the organization to respond quickly to new market requirements. Flexibility searches customization to meet the individualized needs of customers, i.e., the ability of mass customization in a wide variety of products and services, to meet the needs of customers on an individual basis. Innovation relates to the ability of the organization to develop products and / or services that are perceived as new by consumers.

According to Albertin (2008), the use of the IT benefits (cost, productivity, quality, flexibility and innovation) in corporate performance will take place by means of processes and strategies that are affected and supported by IT and that will compose this performance and are measured in order to form the structure of benefits of using information technology in the business environment.

In addition to the previously discussed information technology, retail also needs to use tools that streamline data capture, so that the benefits of cost, productivity, quality, flexibility and innovation can be evidenced. Because of this, it is useful to consider major technologies available for retail to enable automatic identification and data capture, or AIDC - Automatic Identification and Data Capture.

The Automatic Identification and Data Capture refers to the family of technologies that allow the automatic insertion of data into a computer or other microprocessor controlled system without using the keyboard, providing data accuracy, reducing human errors, cost of labor and time (GROOVER, 2011). AIDC refers to a category of technologies used to collect information from an individual, object, image or sound, without manual data entry (Agarwal, 2001). The AIDC include bar codes, biometrics, magnetic stripes, computer vision, Optical Character Recognition (OCR), smart cards, voice recognition and Radio Frequency Identification (RFID). The AIDC is also commonly referred to as "Automatic Identification," "Auto-ID," and "Automatic Data Capture." In retail, the Auto-ID systems are use to track products throughout the supply chain, from the manufacturer to the end consumer. In this case, one of the most interesting technology is RFID.

RFID or Radio Frequency Identification uses electromagnetic waves (radio signals) to transmit data stored on a microchip. This is a chip with antenna encapsulated in a label. Each chip stores a special number and a unique product (better known as EPC - Electronic Product Code). The code is read by means of antennas installed in the environment, which are usually integrated with the input and output systems of goods, but can be used in various applications throughout the supply chain. You can read data in labels on any type of element, such as: products, boxes, pallets, containers, assets, vehicles, animals, objects, machines and even people (PEDROSO; ZWICKER; SOUZA, 2009).

The RFID systems are based on three basic layers: (i) a transponder with an encapsulated chip in a physical object that can be identified; (ii) a reader, also known as interrogator, with his antenna which communicate with the transponder, without the need of aiming directly and (iii), a server, equipped with a RFID middleware that manages the device, filtering data and connecting with business applications (WAMBA; Boeck 2008).

According to Loebbecke and Wolfram (2004), the use of RFID technology will impact the entire distribution chain and can be used in pallets, cases and items, depending on the value of the products.

Hardgrave (2008) says that some studies on the application of item-level RFID in the retail fashion and footwear segment were performed, and concluded that the ROI is perfectly measurable. Tests concluded that the ROI is directly related to customer satisfaction, since the main causes of customer dissatisfaction is lack of stock, difficult to locate products and check out delays. Hardgrave (2008) argues that the applied RFID in an item level offers the opportunity to improve those problems.

Another problem for retailers is the location of products that also influences drastically in sales because customers can not find the products they are looking for, leaving the store without buying them. RFID can help find the goods, thus providing better services to customers and increasing sales (Hardgrave, 2008).

In loss prevention, RFID can help trace products and processes, it will improve visibility of all process of the store, such as: employee entrance, boxing disposal, waste, among others. So Hardgrave (2008) concludes that the main uses of RFID are: inventory accuracy, lack of inventory control, product localization and loss prevention, that are very important process to retail.

In summary, the key benefits provided by RFID technology are: (1) cost reduction of labor and time; (2) improvement in all processes which have become more efficient, faster or less complicated; (3) collaborative benefits, since the exchange of data between manufacturers and retailers allowed better visibility and planning; (4) increased accuracy over all processes; (5) interaction between customers and staff which increased the consumer satisfaction and sales due to the fact that they always find what they are looking for, customized services and shopping experience (Loebbecke, 2005).

To understand the impact of Information Technology and Automatic Identification and Data Capture in retail, the case study of Billabong was developed and will be reviewed below.

CASE STUDY: BILLABONG ALPHAVILLE

The first Intelligent Store in Brazil was opened in August 2011 at Iguatemi mall in Alphaville, São Paulo. It was developed and implemented by Vip-Systems Informática that is specialized in new technologies for retail, since 1993.

The Billabong, a sportswear clothing store, has a young clientele with an interest in Innovation, and they values innovations and understand that technology can provide a differentiated shopping experience.

Billabong implemented a total of 15 VIP-Systems applications, all integrated in the store, which carries about 5,000 items on the sales floor. The RFID applications the Vip-Systems developed in the last 12 years, include features such as a ERP integrated with Smart Self Checkout, Smart POS, Smart Loss Prevention, Smart Dressing Room, Smart Logistics, Smart Exhibitor, Smart Inventory, Smart Replenishment and others features that can improve the interactivity and the mobility of customers and employees.

One of the interactivity solutions that was implemented, it is called as an "Interactive Mirror," which allows customers to take pictures of themselves wearing a pair of sunglasses, write messages on a touch screen mounted in a kiosk and send the photos to a social network or e-mail. In the same kiosk, the customers can play with some interactive games and they can ready they're QRCode to check if they earned a discount or a gift. They can either play with augmented reality; all integrated in the same space and kiosk.

The other technology that customers likes a lot is the Intelligent Catalog that can show the products using NUI (Natural User Interface). As they move theirs hands, they can see all the products.

In Billabong's store were used three RFID interrogators, one handheld reader for staff to conduct inventory of its products in the back room and in the sale floor; one fixed reader with multiple antennas for the Smart Dressing Room, Smart Exhibitor and Smart Shelves applications, and one with multiple antennas to read tags at the point of sale and at the front door, for loss preventions that was integrated with cameras.

Once items are received via RFID, the data can then be stored on the store's back-end system. They did the

inventory check of all items in the back room and in the sales floor with the handheld reader by passing the reader past each product. While typically an inventory check of the back room takes staff about six to nine hours, with RFID they did in 45 minutes.

The store is also equipped with Smart Shelves with RFID antennas that reads the ID numbers of tags and store that data to provide a real-time inventory count that indicates where each item is on the sales floor, and whether any items need to be moved because they have been miss shelved. Everything is displayed on an Ipad or other mobile hardware connected in WI-FI.

The Smart Exhibitor system allows customers to learn more about the items they are viewing in the store. When a customer remove an item from the shelf and hold the tag next to a RFID antenna, the systems identify the ID number and shows in an IPAD informations about other products that might best accompany that item, and the place that it is inside the store.

One of the most exciting solution is the Smart Dressing Room. When customers bring garments into the dressing room, an RFID antenna, that is at ceiling captures the ID numbers on tags attached to those items, and shows the informations in a touch screen.

A touch screen on the dressing room mirror then displays products that coordinate with those brought into the room, as well as colors and sizes available in the store. A customer can then press a prompt on the screen to send a text message to the mobile phone of a staff member to request additional items, or can put everything in the cart and finish the shop inside the dressing room.

At the POS System, an RFID antenna installed under the payment place reads tags of items placed on the counter for the purpose of being purchased and sends that information to the software, that reads all tags, shows the picture and product informations, and lets make the payment in various forms (cash, check, card, NFC, etc.). It is also integrated with the store's inventory management system, which then updates sales data by moving the tag's ID number from the "unsold" category, to "sold." An Intelligent Deactivator function also allows a customer to have the tag deactivated by staff, using a kill command to turn off the tag's transmission functionality.

Finally, when the customer exits the store, an RFID antenna captures the tag ID numbers and checks their status in the inventory management system. If, by chance, the system determines that someone leaves with a product not paid for, the system will trigger an audible alarm and will record a video of the incident.

SOME OF RESULTS

The store's director, Marcelo Chiaparini, says the boost to the store's traffic, fueled by curiosity about the technology and how it was being used, also led to higher sales.

For the Ph.D some tests were performed in store. Just to have an idea, the gains in sales processes were amazing. With the bar code, the time used to read 12 items it was 1 minute and 06 seconds, while the same reading with RFID was in 42 seconds, and is therefore 35.22% on average more quickly, which will reduce queues and improve the shopping experience.

The time of receipt of product was also reduced considerably. The average receipt with a barcode was 44 seconds while that with RFID was 1 second for each 12 products received, with an average gain of 97.72% productive.

In the process inventory, tests were conducted using a fixed quantity of products (100). Three surveys were conducted, using one (1) mobile reader Barcode and same collector equipped with RFID reader, ie, the collector had the two technologies and embedded software collection, was also the same.

It was verified that 100 products RFID technology is, on average 23.70 times faster than the barcode.

This difference tends to increase because "the greater the amount of inventory of products, the higher the reading time using bar code." Reading time with RFID may also increase under these conditions, but in a very slow and insignificant compared with the variation of time using bar code readers.

The case study also showed the Billabong critical points for successful implementation of IT and AIDC in retail. Regardless of the type of technology that will be implemented, it was found by the pilot, which will need to consider the following aspects:

PROCESSES

Complete revision of processes, due to the advantages and disadvantages of AIDCs
How to introduce the technology into a new store?
How to introduce the technology in a store in operation?

HARDWARE

What kind of reader to use and where and how to post it?
What kind of antennas are the most suitable for the project?
What and how many connectors should be installed?
Making the integration of peripherals such as: CFTV, Barcode, Mobile Collector, Mobile Phones, Printers, Wireless, Multi touch screens, etc.

SOFTWARE

Making the integration with the legacy system? What points will be impacted?
What should be adapted in the modules of EAI / EDI - to feed the new modules in place and make the management of legacy and new applications?
What drivers, SDKs, DLLs, and others should be installed in the store to make the system work properly?
What customizations are needed to meet business objectives?

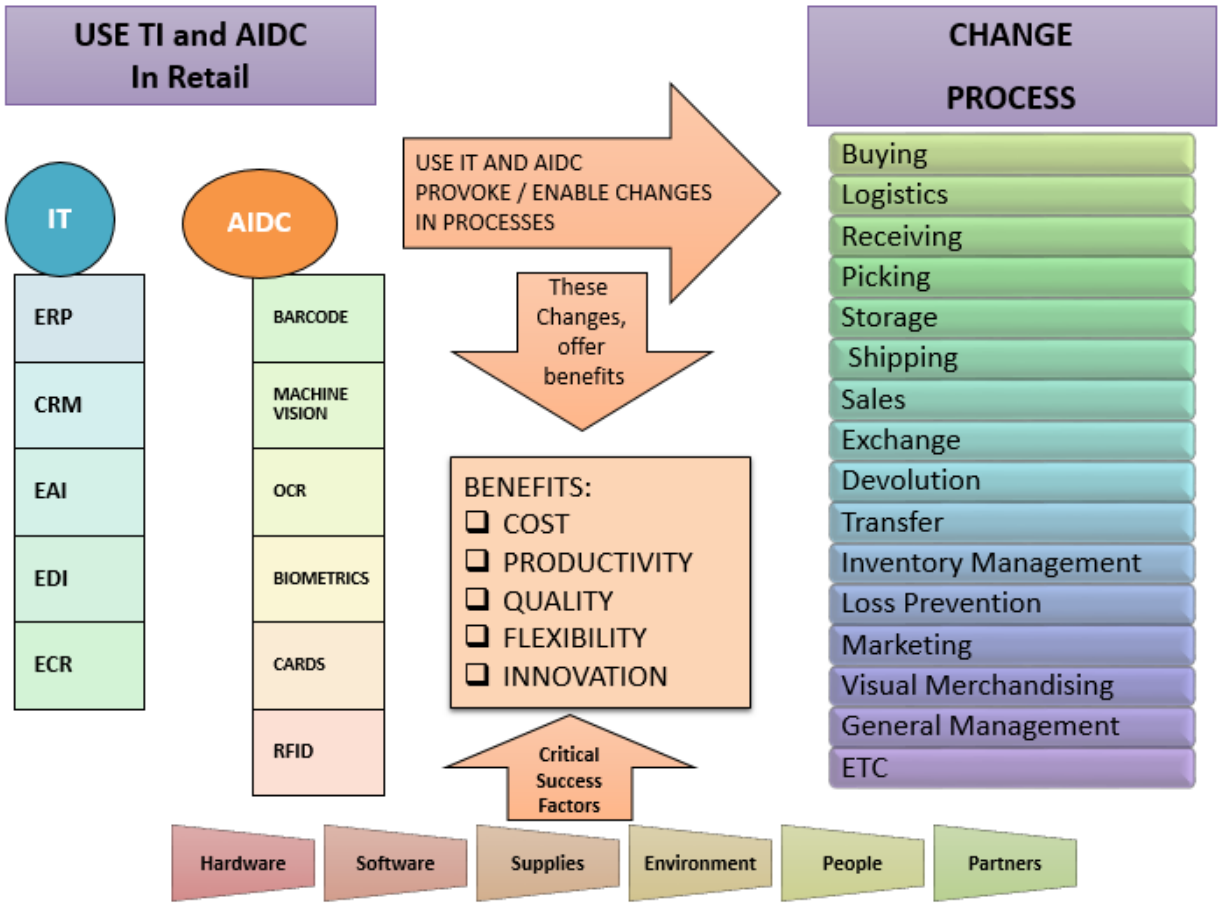
LABELS / SUPPLIES

How to select the best type of encapsulation?
Which vendor?
What is the scope and range of reading that will be needed for the project?
What is the ideal format for each type of label product?
What data should be stored?
What patterns and what kind of key security and encryption is used?
How will the antitheft control?
With respect to pricing, you must set: Who will post?; As will be posted?; When will be posted?; Who will guarantee the quality?; How to ensure that will not be lost?

ENVIRONMENT / INTERFERENCE

What are the types of furniture and objects that will be used in store? What types of materials used in store in terms of floor, walls, furniture and what its possible interference in the reading?
What are the technologies that will run concurrently? What are the possible impacts on RF?
What kind of lighting will be used?
What kind of network (wired or wireless)?

Thus, one of the contributions of this work is to warn the critical success factors experienced throughout this case study and demonstrate that the use of IT and AIDC may impact the business and generate benefits for businesses, since they are regarded as factors hardware, software, people, suppliers, inputs and environment. The Scheme 1, shows the Benefits and Critical Success Factors for the use of AIDC IT and retail:



Scheme 1 - Benefits and Critical Success Factors for the use of AIDC IT and retail.
Source: Romano,2011.

CONCLUSIONS

This work was limited to studying the key operational processes in a self-service retail store with a view to identifying how technologies Identification and Automatic Data Capture and IT can help it improve customer experience and its operating results.

It was possible to study the combination of IT, RFID technology and others AIDC are imposing a new format retail business. Leverage the mobility of consumers with the ease of the Web and with smartphone features, opens new opportunities to boost sales. Knowing the habits of consumers, their preferences, their expectations and have earned their trust, provide the sale of products on impulse.

As a result, the store counts with the boost to the store´s traffic, fueled by curiosity about the new solutions that also led to higher sales. For the customers it was very important because the technology helped to reduce queues and improve the shopping experience. For the business it was wonderful because they could improve the receipt, inventory, loss preventions, products locations. The customers can play inside the smart dressing room that recognize the products and suggest others that combines with that one that customer bring inside the smart dressing room. It helps to know the habits of consumers and their expectations and it helps to increases the sale of products on impulse.

For future works, it will be important to analyze the use of AIDC and IT throughout all processes of the supply chain, not just in the store, since during the research and literature review, it can be seen that we are at the beginning of a significant change on businesses that tend to "collaborative chain", where all the links are mutually help to reduce costs. These technologies can positively impact the development of this new model.

Because it was an innovative project and have a few similar studies in Brazil and other countries, since in a single environment brought together various technologies in an integrated manner in order management, interactivity, entertainment, mobility and convergence of multiple channels (as is the case of the store, internet and social networks), the store attracted the media from different parts of the world!

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Natural Human Interaction - The Future of Social Media

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ABSTRACT

In the future, major social networks will become personal "Social Dashboards", being at the core of people's lives in the global village. Human Relationships will no longer be as physically dependent and we will befriend and hang out with people from all over the world and all walks of life, all ethnicities and all beliefs, creating a worldwide melting pot. All the same, the future is anything but information overload. The future is information customization. There will be no need to search for information. The information will find us. It will be specially tailored to individual interests and needs, saving all a lot of time, effort and energy. There will be no difference between a physical and a digital world. There will be no division between user experience and consumer experience. There will be a human experience. The future of social media is natural human interaction, pure and simple.

Keywords: Human-Computer-Interaction, Ubiquitous Information, Omni-Channel, Big Data, Consumer Experience, Human-Centered Design

INTRODUCTION

The term "internet of things" was coined by the British technology thought leader Kevin Ashton back in 1999 (Ashton, 1999). He considered the question of what would happen if not humans but computers were to produce the majority of data. It was in 2006 when the slogan "data is the new oil" started being used, meaning that gathering information would be the key for future business success (Palmer, 2006). Today, the term "big data" is used to describe the changing importance and fields of application of constantly growing myriads of data – referring to the connections between all types of individual information such as location, buying behavior, social background or motivation. Humans are producing these data with the help of "things" – and today is just the starting point of this development, as the "internet of things" is not expected to become firmly established before the year 2023 (Gartner Inc., 2013).

By the beginning of the third decade of this millennium, the world around us will be dominated by screens of various sizes, allowing us to control online communication and information-seeking at any time in any place – this, at least, is how Microsoft envisages the future (Microsoft Corporation, 2010 and 2013). At the same time, screens are recognized by their viewers as electronic devices, displaying digital content – and therefore are nothing "natural". There are many reasons to believe that the coming years will evolve in a quite different direction than towards a world full of screens. Rather than dealing with a growth in complexity by controlling more and more devices, this article will sketch an alternative path to that of the linear inflation of today's media consumption and communication. With the help of today's and tomorrow's technology, the internet of things, big data and ubiquitous infor-

mation, the future way of living and working will in my opinion become what is here referred to as "Natural Human Interaction" (NHI). The basic message of what NHI is trying to outline is that there will be no sensible difference between digital and non-digital interaction. Taking this thought one step further, there will also be no sensible difference between a human to human and a human to machine interaction. Before describing this thought model in further detail, it's necessary to understand communication and the changing ways of interaction from three aspects: The human, commercial and technology aspect.

CHANGING WAYS OF INTERACTION

Communication Over Time

"Nothing would work in the absence of communication." (Hauser, 1997) At the same time, "you cannot not communicate.*"* (Clevenger, 1991) Seems like a pretty stable situation – so, what is subject to change?

In 1844 the editor of the highly respected New York Herald, James Gordon Bennett, predicted that the telegraph would "blend into one homogenous mass ... the whole population of the republic ... it could do more to guard against disunion than all the most experienced, most sagacious, and the most patriotic government, could accomplish." (Carroll, 2000) After a period of 36 years, 32 million messages had been sent between 12,000 US American telegraph offices. On average that means a number of 24,353 messages per day in North America.

The first telephone was invented by Elisha Grey and Alexander Graham Bell back in the 1870s. 20 years later, Heinrich Hertz, Oliver Lodge, and Guglielmo Marconi succeeded in transforming electric signals into electromagnetic waves – which can be seen as the foundation of our today's digital communication (Ensmenger, 2006).

The speed of adopting new technologies is accelerating with each new innovation: The diffusion of innovation shows the distribution of technology adoption types in a normal curve (Rogers, 2003). While the distribution stays similar over time, the pace accelerates increasingly: To reach a general consumer adoption rate of 50%, it took 70 years for telephones, 28 years for radios, 10 years for the internet (Ingelton et at, 2011) and 6 years for smartphones[1] in major markets (eMarketer Inc., 2013).

Looking at a special event between January and March 2011, the Arabic Spring, the number of messages sent rose to 230,000 daily – counting just those sent through one of many communication channels (Twitter) and specifically relating to Arabic Spring (#algeria, #egypt, #feb14, #morocco, #sidibouzid, #yemen) (Howard et al, 2011). Bennett's above mentioned vision of communication which is not enabled by government therefore became true – if not through telegraphy, so through tweets. Why is the amount of daily sent messages rising? Why is the adoption of new media and communication means increasingly accelerating? The answer lies with the people who are doing so.

Social Media Interaction – The Human Aspect

In earlier times, the internet was accessed by information seekers who looked up information like news, weather and sports and internet communication took place predominantly via email. It slowly evolved into a medium used for entertainment and leisure purposes. With this shift, the digital interaction between people also evolved, moving from communication dominated by mail and instant-messaging towards a multi-connected, social environment. In 2011, webmail usage declined by 31% amongst teenagers and by 34% within the age group of 18-24 year olds (Radwanick and Lipsman, 2012). Today, there is a generation which spends 55 minutes per day on Facebook and more than 15 hours a week actively on the internet with communication. 80% of them base their decision-making on peer recommendations, only 14% on advertisements. This generation is called Generation Y[2]. Unlike previous generations, Generation Y should not be seen as "a uniform group but as an evolving mindset". Focusing on Generation Y has the advantage of getting an impression of future developments as well. It will be the only generation that grows in population – and that by 7% between 2007 and 2016 (Ingelton et at, 2011). Speaking of population, Stephen Wolfram offers a "Personal Analytics" tool for Facebook based on the data from his search engine "Wolfram|Alpha". It

[1] Taking the launch of the first iPhone in 2007 as the starting point of today's era of smartphones.
[2] People born between 1978 and 1989: "They're young, smart, brash. They may wear flip-flops to the office or listen to iPods at their desk. They want to work, but they don't want work to be their life." (Armour, 2005)

generates reports that take the information of millions of Facebook users as a basis to do analysis across a high number of different fields with the newest one being the people's personal lives as exhibited on their Facebook. If you compare this data with US census data, the result reveals that the majority of Facebook users are members of Generation Y (Wolfram, 2013). Social media have also become the means of choice with regards to their communication (TNS Infratest, 2013).

In 2012, the U. S. population using social networking amounts to 171.8 million (Nielsen Company GmbH, 2012). The main argument for them to join is to connect and keep in touch with people who they already know – family, friends and colleagues. In many cases, the communication is "passive", e. g. checking status updates or looking at other peoples pictures (Estes et al, 2012. Of the time spent online, social networking and forums have the highest share with 27% across US, UK and Australia (Experian Information Solutions Inc., 2013). During the time spent on social media, users are not acting aimlessly: The power of social media users is not to be underestimated, as internet memes[3] are showing. Internet memes, which are usually humor- or art-based, like for example "Where the Hell Is Matt Harding? Dancing around the World", "LOLcats" or "Gangnam Style", (Gil, 2014) can spread within hours across the globe (Marshall, 1998). Memes that are spread via the internet can, in contrast to any other media, be initiated by virtually anyone who is connected to the internet and – through social media – very quickly develop a high degree of virality.

Today's social media interaction is not just a question of the way of communication but also of the devices used to do so. On-hand digital mobile communication has become a self-evident means that shapes an integral part of users' lives. The determining differences to other devices are the location and frequency of consumption. There's a term for people, consuming digital content through various and changing channels in their everyday life: The "digital omnivores" (Radwanick and Lipsman, 2012).

Beyond the well-known state of today's social media usage there is a trend to be mentioned in this context: The trend towards self-optimization. It started as self-tracking one's weight, sporting activities, sleep rhythm and nutrition. Through wearable technologies, connected user profiles and sharing achievements via social media, the possibilities have advanced from tracking to self-optimization. This in turn is likely to grow into what is referred to as Human Augmentation, leading to a "Human 2.0" (Gartner Inc. IT Glossary, 2013). Why would someone be interested in that? The reasons are of clear psychological nature as David DeGrazia explains: "Human beings have always been interested in self-improvement. We diet, exercise, color our hair, and modify work habits to bring about changes in ourselves that we consider improvements. Technologies have long played a role in self-improvement projects; diet pills, weight machines, and hair dye are hardly new. Somewhat newer are certain biomedical means to perceived self-improvement – or enhancement, as it's often called today." (DeGrazia, 2005) The human need for betterment and progress is an important factor to help explain the willingness to reveal and share personal information – because only on the basis of available data, benchmarking and improvements are possible.

To sum up, social media plays the key role in today's communication for Generation Y. Updating oneself about friends' day-to-day life via Facebook, re-tweeting messages from idols, connecting to companies hiring managers via LinkedIn, sharing most current experiences visually via Instagram or saving and sharing findings via Pinterest – the social media platform is virtually interchangeable. But all of them serve the same need: The human need for catching up, joining in, listening, telling, sharing – or summarized – the need for recognition and attention in a hazardously fast-moving and increasingly anonymous world.

Consumer Experience – The Commercial Aspect

Around the turn of the millennium, the consumer's engagement took place on a purely transactional level, buying for the most part in department store chains. Though eCommerce began to emerge in 1995, social networks around 2002-2004, and meaningful mobile engagement only after 2010, today's B2C[4] channels are still separated from each other. On the other side of that, today's youngsters are growing up with social media and are therefore self-evidently expecting instant, personalized and convenient communication – including all their other communication channels as well. It has always been natural for them to be personally "known" by a company and they would even feel frustration when not being able to finish a transaction in a store which they've begun online. These "advanced" consumers, the so-called "prosumers", are commercially very interested and post, like, comment, tweet and share information about brands, products and services. They record themselves while unwrapping newly bought technical equipment and upload videos like this or self-recorded tutorials or reviews to YouTube (Ingelton et at, 2011). They

[3] Meme is "an idea, behavior, style, or usage that spreads from person to person within a culture" (Merriam-Webster Inc., 2014)
[4] Business-to-Consumer

also show a different kind of buying behavior: After browsing products on a mobile app while commuting to work and comparing price information at night on their tablet in the living room, they finally purchase next day on their PC at work. While being in a store, prosumers consult their most popular shopping mate – their mobile – to grant them access for example to competitors. The consequences for retailers are to strategically address the customer across devices, channels and touch points. At the same time, the ubiquitous connectivity offers new opportunities for companies to reach their customers (Radwanick and Lipsman, 2012). Generally speaking, it is obvious that companies are no longer in sole control of the communication. Instead it is essential to recognize the shift to a two-way conversation. The key for success is not to just realize but to take advantage of this shift by engaging with consumers (Estes et al, 2012). An opportunity is for example to invite the consumer to participate in the research & development, design and go-to-market phases or to crowd-source customer support. Some companies incentivize the opinion-leading prosumers as multipliers of marketing messages or as authentic support channels to other customers. This again allows the empowered consumer to shape the image of a brand and – through their power in social media conversation – to even create new products. Consequently, the link and the relationship between company and consumer get stronger and more intertwined. Most companies have recognized that, as there are only few that do not have an elaborate CRM[5] and customer loyalty strategy in place. Still, this is in its very early stages, as a true Omni-Channel approach towards a holistic and at the same time consistent and individualized consumer experience is a vision for most companies. Information customization in an Omni-Channel communication is essential in order to be ready for the future. Planning and building a holistic customer experience strategy will be the key to win the battle for successful CRM and customer loyalty. Between 2015 and 2020, the currently still detached touch points between a company and a consumer will need to become more and more interlinked - networks, applications, devices, content and channels will need to be converged in order to create one seamless and meaningful experience (Ingelton et at, 2011).

To bring this thought into comprising relation: As it is of little help to split people's social behavior in physical reality from digital social media interaction, it is also not rewarding to differentiate these from the people's buying behavior and consumption. Instead of speaking of a user experience, a social media experience, a consumer experience, it's important to recognize what they refer to: These experiences belong to the same individual and thereby create one experience – the human experience.

Big Data – The Technology Aspect

By 2020 there will be 50bn internet enabled devices (Telefonaktiebolaget LM Ericsson, 2011). Because these ubiquitous devices are all connected with each other they will make the internet of things become meaningful reality. Whereas in the first decade of this century, only phones came to be smart, now is lamps, scales, fridges, homes, cars, gyms, schools, etc. Through sensors of various kinds, these "things" will produce myriads of data – in addition to all the tracked data produced by people living their day-to-day lives. Google's executive chairman Eric Schmidt brings this amount in relation: "From the dawn of civilization until 2003, humankind generated five exabytes[6] of data. Now we produce five exabytes every two days… and the pace is accelerating." (Marr, 2013). The shrinking costs in data storage and increasing computational performance will not limit the trend to gather, save and consolidate more and more data. Instead of that, the challenge will be to deduct meaningful and instructive information from this huge mountain of data.

So what might be done with this vast amount of data? Here are some examples of what is already being done today with big data: Politicians, such as Barack Obama, build their whole election campaign on a combination of demographic, social media and other data and can hereby anticipate not only which states and cities but which neighborhoods, streets and families can be persuaded by which kind of contact and content (Rutledge, 2013). Another example is the prediction of unexpected and therefore dangerous or surprising traffic situations on the basis of mobile phone GPS data, weather reports, calendar information and major events, such as a football match (Horvitz et al, 2012). Furthermore, day-to-day mobile apps, such as the "personal assistant" Google Now offers its users information based on their current location in connection with their personal internet surfing history, calendar data and other information (Sokolov, 2012). These examples only show a fraction of what awaits us in the future when combining even more intertwined and complex data sources to make even more astonishing calculations and predictions. For good or bad, this will touch virtually every aspect of our lives.

Big Data, Pervasive and Ubiquitous Computing will mark the "third paradigm" of computing after mainframes and the PC era (Weiser, 1996). It has just gone off the starting blocks and will result in extensive consequences for the world's society, above all in the fields of perceived and actual privacy and security: The question is where the free-

[5] Customer-Relationship-Marketing
[6] One exabyte is equal to one billion gigabytes

dom to collect data ends. Interestingly, the attitudes to privacy on the one hand and readiness to publish data on the other differ amongst members of Generation Y: 26% have uninstalled an app by the simple reason that it collects and shares personal information and 51% have even ignored certain apps because of privacy concerns. 46% disable location tracking in apps or their mobile for the same reason (Madden et al, 2013). Next to the privacy aspect, big data security questions will also need to be approached: Who is responsible for security flaws? Who is responsible if a technical system malfunctions? Aspects associated with the mentioned ones are also to be considered, such as conflicts between the freedom of speech and other fundamental rights and the increasingly blurred border between intellectual property and public information. All this might be seen as slowing down the developments and adoption of new technologies but are necessary considerations and nevertheless will not stop progress.

Today, there is more information available through the little device in everybody's pockets than in any encapsulated computer system – no matter whether one is at home or takes a walk in the woods. Computers often times create frustration while a walk in nature is relaxing. Technologies that don't force people to enter an artificial environment but which adapt to the human way of living don't create the feeling of frustration that today's computers do. These technologies will feel natural and will preserve us from information overload (Weiser, 1991). They won't be seen as computer systems but as natural enhancement of human capabilities.

Summary

Communication changed over time, resulting in instant and ubiquitous information, shared globally through diverse channels. The actual interaction in social media is a way for humans to address their needs for betterment and progress, for recognition and attention. Individuals have a new spectrum of impact towards brands and markets and companies need to address this commercial power by human-centered strategies. Information and services need to be customized fully to individual human needs allowing natural interaction between the parties.

But what does natural interaction mean? What is the common thread for interaction in general? In the world as described above, who or what is a meaningful interaction partner?

The next section describes a theoretical framework to put interaction, which is felt as being "natural", and its associated parties into relation to each other.

NATURAL HUMAN INTERACTION (NHI)

"Hundreds of computers in a room could seem intimidating at first, just as hundreds of volts coursing through wires in the walls did at one time. But like the wires in the walls, these hundreds of computers will come to be invisible to common awareness. People will simply use them unconsciously to accomplish everyday tasks." (Weiser, 1991) The internet will instantaneously be fed into the flow of our experiences – without the need to make a conscious request (Rosenfelder, 2013).

The Natural Human Interaction (NHI) model aims to provide an abstracted and simplified framework to explain the merging perception and meaning of three kinds of interaction: Human to human, human to machine and machine to machine.

Definition

Natural Human Interaction (NHI) is defined as:

A mutual or reciprocal action, effect or influence between multiple entities according to their expectations.

The definition is explained as follows, starting with the description of the intended meaning of its components: "Mutual or reciprocal" refers to a direction and reception by each toward the other or to a characteristic which is possessed in common. Consequently, the channel in which the interaction takes place needs to fulfill the criteria of a two-way conversation. "Action" is the state or process of doing something and is triggered by at least one entity and directed towards at least another entity. "Effect" is something that is brought about by a cause and is targeted by at least one entity towards another entity. "Influence" is the power to produce an outcome or to achieve a result and is owned by at least one entity, directed towards another entity. "Multiple" means the involvement of more than one part or individual. The smallest number of entities involved in the interaction is two. No matter whether the action, effect or influence is meaningful to the receiving entity, it needs to be directed towards at least one. "Entities" refers to something that exists as a particular, distinct or self-contained unit and is able to communicate with another, in

this definition referring to humans and machines. "According to their expectations" refers to the state or act of expecting. 'Their' refers to the entities involved in the interaction and includes the specific context, needs and tasks of the entities.

The name of the model itself consists of three parts, which are explained in the following:

- *Natural*: Referring to the expectations of the entities: In accordance with the nature of things. 'Natural' refers to what is seen as normal or to be expected, ordinary and logical, in accordance with human nature. Referring to a dialogue principle of human-computer interaction, 'conformity with user expectations', this can be described as "predictable […] concerns, emerging from the application context and in accordance with generally accepted conventions" (International Organization for Standardization, 2008).
- *Human*: Referring to the entities. The 'Human' aspect of the definition is not to be understood as a reference to Homo sapiens directly. Instead, in this definition, the term 'Human' refers to a measuring factor of an entity to fit into the described kind of interaction: It refers to entities acting in accordance with or not distinguishable from human behavior. Having and showing those aspects of nature and character is regarded as the distinguishing feature between humans and animals.
- *Interaction*: Referring to the mutual or reciprocal action, effect or influence. Triggered, targeted or owned by at least one entity and directed to at least one other entity.

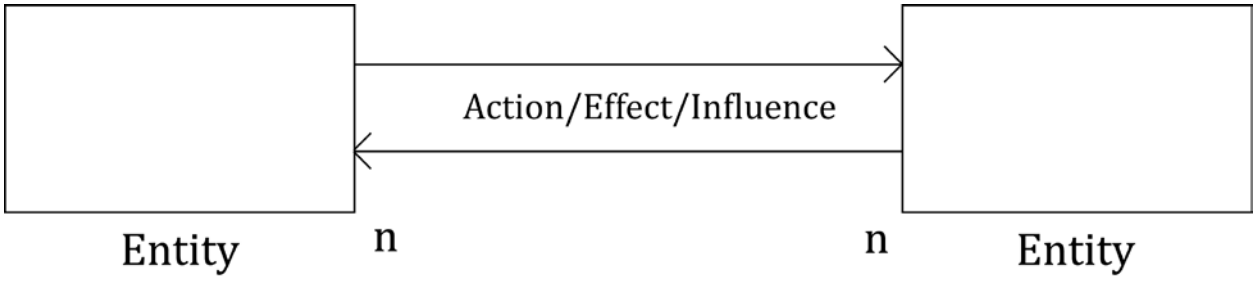

Figure 1. The NHI model

Applicability & Scope

The applicability of the model is extremely broad and relates to any kind of human to human, human to machine (HCI[7]) or machine to machine (M2M[8]) interaction, allowing blended communication in a true Omni-Channel setting. The channel itself is not mentioned in the model as it is interchangeable: The expectations of the entities decide the best channel to use.

Human to Human

The human to human interaction is already natural by definition. There are various models that explain communication in a generic way, e. g. the Shannon-Weaver-Model of communication, which speaks of a source of information that transports a message via a transmitter through a certain channel (which may alter the message and may get disturbed) to a receiver that transports the message to its destination (Hollnagel and Woods, 2005). This amongst many other communication models is usually used to define communication between senders and receivers in an abstracted way. Practically speaking, an interaction between two humans involves various sociologic and emotional aspects that are usually not covered by models like the mentioned ones. Another one, the four-ears-model (Schulz v. Thun, 2014), identifies four dimensions of a message: Factual information, relationship indicator, self-statement and appeal. Factual information refers to what the sender informs about. It can be verified by three aspects: Truth, relevance and sufficiency. The relationship indicator refers to what the sender thinks of the receiver and how she relates to her. Aspects that influence the relationship are phrasing, intonation, facial expression, gestures and body posture. Self-statement is what the sender shows of herself by sending the message. The receiver therefore experiences the sender in a certain way: What is she like? What mood is she in? What is she thinking? And the appeal reveals what the sender wants to do. It is about desires, suggestions and instructions. The factors which influence each of the four

[7] Human-Computer Interaction
[8] Machine-to-Machine interaction

layers are hard to measure and are – by definition – of subjective nature for both the sender and receiver.

All this is not new – as it is 'natural'. In the NHI model, this kind of communication is set as expectation baseline towards a human to machine interaction that is perceived as being 'natural'.

Human to Machine

The human to machine and machine to human interactions are objects of research in the HCI field. HCI is defined as "a discipline concerned with the design, evaluation, and implementation of interactive computing systems for human use and with the study of the major phenomenon [sic] surrounding them" (Hewett et al, 1996). The discipline is linked to information technology, psychology, design, ergonomics, cognitive science and labor studies – amongst others. Aspects that research focuses on are computers, humans, interaction between human and computer, special usage and special user groups.

To fit human to machine interaction into the NHI model, it is necessary to apply the same "quality standards" as for a human to human interaction. These quality standards follow the above mentioned four-ears-model with its aspects being subjective – as in a human to human interaction. In basic terms: As soon as a human to machine interaction feels 'natural', it is an interaction according to the definition of NHI.

Machine to Machine

The emphasis is laid on the similarity of human to human and human to machine interaction. The similarities with M2M interactions are briefly touched in the following as the above definition speaks of entities, regardless of whether they represent humans or machines. The reason for that definition is that the point in time is near when the behavior displayed by a machine is equal to or indiscernible from human behavior. One way to measure that ability of a machine is the Turing test. It tests whether a human judge, who witnesses a conversation between a human and a machine, cannot reliably recognize differences from a human to human conversation (Turing, 1950). The futurist Ray Kurzweil predicted that machines, which pass the Turing test, will be produced by the year 2029 (Kurzweil, 2005). According to his prediction, machines will be in a position to optimize themselves by the year 2050. After that, general progress will no longer depend on humans and their ability to deal with rising complexity (Reißmann, 2013). Asked or not, machines will provide us with ideas and associations – which basically is the good old job of the brain (Rosenfelder, 2013). In this scenario, machines that are reasoning and acting in a similar way as humans do, will also have similar expectations towards interaction.

Summary

To sum up, there will be no difference in quality standards between the interaction of a human to a human, a human to a machine or a machine to a machine. The interaction needs to follow the expectations of the interaction partners (entities).

NHI in Practice

An interaction following the NHI model does not include anything in addition to the elements as described in the model. Any supplement which is perceived as artificial or as detouring from the actual interaction would result in a non-natural interaction. Only that kind of interaction which is in line with the expectations of the entities, which show human aspects of nature and character, is defined as NHI.

For example NFC[9], which is supposed to offer the most simple wireless payment service, is as, Jack Dorsey explains, just "another thing you have to do. It's another action you have to take. And it's not the most human action to wave a device around another device and wait for a beep. It just doesn't feel right." (Dorsey, 2012)

Another example: A smartphone has a user interface (UI) that is needed to allow the activity of speaking to someone. What the smartphone user wants to do is to speak to someone else who is physically not present but instead of just speaking, she first has to 1) take her smartphone from her pocket, 2) unlock it, 3) access the 'phone' functionality, 4) look for the person she wants to call, 5) select this person and to 6) wait for the connection to be provided. An approach for simplifying this, is through a "Natural User Interface" (NUI), which "relies on a user being able to carry out relatively natural motions, movements or gestures that they quickly discover control the computer application or manipulate the digital content." (NUI Group, 2014) As this explicitly speaks of a computer application, which is

[9] Near-Field-Communication: A wireless communication technology used in close proximity between two mobile devices to exchange data, e. g. for payment transactions.

recognized as such, the "No UI" approach takes this thought even further: "The real problem with the interface is that it is an interface. Interfaces get in the way." (Laurel, 1990) Instead, the user wants to focus on the job and does not want to think how to use a machine. In this example, the smartphone itself is the user interface which is also recognized as such. Even if the graphical user interface would work in the most simplistic way, the device itself is still very present and forces the human to artificial steps needed to do the job. A NHI in this context would not allow a device like a smartphone. Instead, it would use non-invasive or in other words imperceptible technology and would thus allow to satisfy the need in the simplest way: The human – as basic as it sounds – would start talking. The quality standard for this NHI is that it feels to be as natural as a conversation from fact-to-face, including all necessary sensory impressions.

Designing a NHI requires to simplify to the maximum. It is not sufficient to know how things are currently being done and to find a better way of doing the same. But it is also not the idea to reduce the complexity of an existing user interface to a less complex one. Instead of that, various design methods do exist when it comes to designing a ubiquitous information system. Janzen, Kowatsch and Maaß analyzed various methods and created a new "Methodology for Content-Centered Design of Ambient Environments" (Janzen et at, 2010). Although this methodology describes various interesting approaches, the necessary activities to design a NHI follow something which is defined as ISO standard: Human Centered Design (HCD) (International Organization for Standardization, 2010). Designing a NHI requires the following human-centered activities:

Firstly, analyzing the context in which the current interaction takes place. The outcome of this activity is the identification of true human needs – beyond the consciously expressed wishes and ideas from one of the interaction partners. Secondly, specifying the human requirements for natural interaction. This means to take the needs and to derive certain requirements from them. The derivation is one of the most crucial activities in the design of NHI as in this step the solution is already being shaped. Thirdly, creating the design solution based on requirements. This results in a prototypic realization of the interaction by describing or visualizing the interaction steps in detail. The fourth activity is the evaluation of the created design solution. The prototype is tested with the interaction partners. Depending on the results, the previous activities are iterated until the evaluation proves the interaction to be seamless, meaningful and natural.

The following example explains the above in practice: Textual communication between two interaction partners in transit resulted in the use of a mobile phone firstly by sending SMS[10] text messages with a numeric keypad, then in a Blackberry mobile with QWERTY[11] keypad and later in smartphones with the SwiftKey[12] system. The evolving solutions are trying to make the interaction less painful and reduce the complexity of the user interface. In the NHI model, the task would be to analyze, why the interaction partners communicate textually while underway. Is it the need for communicating to someone and the textual aspect is only a workaround? Or is it the need for asynchronous, more sophisticated or less emotional communication? Having analyzed that, the derived requirements will be very different than if the task would be "to improve the keyboard". It might result in completely new approaches to communication which will be evaluated by the help of prototypes to find out whether the solution really fits the needs. Iterating and thus optimizing the solution might result in something really disruptive. As following the design approach of NHI is not about getting at the core of a problem but at the core of a human need, this is the basis for truly game changing innovation.

CONCLUSION

It is time to take a step back from inventing constantly improved solutions. Instead, the focus on the true human motivation drivers and needs, such as self-betterment, recognition and attention, helps us to understand the potential for innovation. In order to understand them, it is essential to know about the various aspects of communication. Furthermore technological developments in the fields of mobile devices, social media, big data, sensors and location-based services will converge into something changing the way we live today (Israel, 2013). This also gives us an

[10] SMS: Short Message Service
[11] QWERTY: A keyboard, with keys for each letter of the alphabet. The abbreviation refers to the order of letter keys on the keyboard, in this case the US American layout.
[12] SwiftKey: Allows the user to write phrases without lifting the finger from the touchscreen and uses a prediction engine to predict the next word.

idea how similar a human to machine interaction will need to be, compared to a human to human interaction. The digitization of everything is a step change even greater than the invention and adoption of the internet, primarily because of its scale and pace of change (Ingelton et at, 2011). The Natural Human Interaction model describes a digital world merged seamlessly with the rest of the world: There is no perceptible split between digital and non-digital experiences.

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Me, Myself & Data - Principles for the Design of Self-Tracking Services

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ABSTRACT

In this paper, we will explore how applying principles of design research to the design of self-tracking services can lead to a more human and delightful user experience, and thus more desirable services. Design research has always aimed at helping design human-centered products and services. To do so, researchers follow various guidelines to ensure that the conducted research is relevant, ethical and inspiring. The rise of new technologies for the self-tracking of personal data has blurred the distinction between users and researchers as devices for self-tracking have become more mobile, wearable, and affordable for the mainstream, allowing users to become researchers of their own lives. Yet, having access to more data does not automatically mean people will understand this information, or know how to apply it. The main challenge, therefore, lies in interpreting the data and acting upon the information gained. We have conducted a series of interviews and analyzed concrete examples of self-tracking services, and based on our observations have defined five principles of design research. We believe that when applied to the design process, these principles will ultimately result in self-tracking data that brings more value to users.

Keywords: Self-tracking, Design Research, Human-Centered Design, Quantified Self

INTRODUCTION

Research for Human-Centered Design and New Challenges Around Data

Researchers for human-centered design collect and interpret data to uncover needs and inspire design solutions to better serve people's future needs, a process which always begins with considering the people for whom we are designing. Traditionally, human-centered design focuses on qualitative data, based on the belief that observing people in context and having in-depth conversations will lead to a better understanding of their latent needs – to inspire the next instead of just describing the now (Seemann, 2012). Lately, digital technologies have had a huge impact on how we do research (Berry, 2011), primarily because of the ever increasing amount of data produced in modern society. This omnipresent accessibility of data has added more variety to data collection methods. It is easier than ever to derive information from huge quantities of data that users have produced themselves, a circumstance that has added an interesting additional source of information to our work. While this has led to a new set of questions and challenges, our general guidelines of how we understand data and make it useable have remained the same. At its core, research for human-centered design is not just about analysis of objective evidence, but rather it is a way of informing our intuition – synthesis of evidence, recognition of emerging patterns, empathic connection to people's motivations and behaviors and intuitive interpretation of information from multiple sources (Fulton Suri, 2008).

Self-tracking of Personal Data

The human behavior of tracking personal data is nothing new. For a long time humans have collected information about themselves: qualitative information, as with a journal, but also quantitative information, like weight tracked on a scale or a financial balance tracked with a bank account (Wolf, 2010). What has changed is not the need to understand more about ourselves, but rather the technologies supporting data collection: electronic sensors becoming smaller and better, devices to track personal data becoming wearable, accessibility and affordability for the mainstream. A vast number of new products and services has appeared in the market, giving rise to new opportunities for people to collect and interpret their own personal data, with users have become researchers themselves. A term often used in the context of self-tracking is the Quantified Self, coined by Gary Wolf and Kevin Kelly of Wired Magazine in 2007. With the goal of connecting users and makers of self-tracking tools, and helping people get more meaning out of their personal data, they founded the California-based company, Quantified Self Labs, which regularly organizes international meetings and conferences. The topic of self-tracking and Quantified Self has been widely discussed in regards to technology, as well as research, with early adopters of self-tracking services often referred to as 'geeky' or even narcissistic (Kelly, 2011). According to Genevieve Bell (as cited in Simonite, 2013), an anthropologist and director of Intel's user experience research, this is partly due to the fact that with many of the early self-tracking services it was not completely clear how their technical features could actually enhance people's lives. The focus when talking about self-tracking services is too often on what they can do, the 'task' piece of it, rather than on how one can make sense of the information provided (2013). Another challenge discussed in the context of self-tracking is the lack of ways to help users act upon the data they collect. As Adam Tinworth, blogger for NEXT Berlin, asserts "the Quantified Self needs more actionable data," for only when we have more compelling examples of how data from self-tracking services can make a powerful difference in people's life, will the Quantified Self movement really move from the data enthusiasts to the mainstream (2013).

How Can We Make Self-tracking Services More Human-centered?

For design researchers the development of users tracking their personal data leads to various fascinating questions: What can we learn from users' behavior of tracking themselves? What can we learn from the data produced through self-tracking? While these questions continue to inspire and challenge us, we focus here specifically on one question: How can we design more human-centered self-tracking services and help users become better researchers of their own lives? As already stated above, two core questions in this context are the *purpose* of self-tracking – which human need does the service address – and the *outcome* of self-tracking – how does it enable users to act upon what they have learned. We discussed these questions in conversations with users and in interviews with colleagues, designers and scientists involved in the creation of self-tracking services. The broader basis for our conversations were the following three provocations:

More data – more value? New technologies have made it easier for people to track their personal data. Yet, the fact that people are able to track data does not necessarily mean the resulting knowledge is actually beneficial. We are convinced that the design of every self-tracking service has to start with understanding which existing or emerging need the service addresses, which problem it can solve or which behavior it can ease in the future. In addition, the value of a self-tracking service hardly lies in the data it provides, but rather in the insight that can be derived from this data. *How can the design of a self-tracking service benefit the user by moving beyond data towards actionable insights?*

More data – more 'truth'? Smart devices seem to do the math for us. By counting, measuring and providing numbers, they evoke the impression that all is objective and accurate. Yet self-tracking of personal data is, in itself, a very subjective matter. Data is never purely objective and interpretation of data is always as much an evaluation of oneself as of the data itself (Evgeniou, 2013). Even though a large part of the data tracked is quantitative by nature, the results produced are not necessarily 'facts', as the data is tracked and interpreted based on subjective observations and choices (Boyd & Crawford, 2011). As design researchers we believe that data cannot make decisions for us, but rather enable us to make better choices by informing our intuition (Fulton Suri, 2008). *How can a self-tracking service encourage users to draw upon their intuitive and interpretative skills?*

My data – my responsibility? Knowing more about themselves can potentially enable users to make better choices, more independently. For example, many self-tracking services exist in the realm of health and disease-management, potentially producing data that helps users take better care of themselves. Such data can lead to a new independence from doctors and hospitals, in turn giving users a new form of responsibility. However, this responsibility comes not without ethical implications, for who really owns the data? Who is responsible for interpreting and making decisions

based on the data? Taking these questions into consideration is also an important design challenge for self-tracking services. *How can a self-tracking service make users aware of and deal with the new risks and responsibilities it generates?*

LOOKING INTO EXAMPLES OF SELF-TRACKING SERVICES

Over the last year we have immersed ourselves in the world of new and emerging self-tracking services and related literature, and had many conversations with users about their motivations, habits, beliefs and and questions concerning the self-tracking of personal data. We interviewed several representatives from existing self-tracking services about their work: Arye Barnehama and Laura Michelle Berman, founders of Melon, a headband and mobile app that measures focus; Andrea Mallard, Chief Brand Officer at Omada Health, a service that inspires lifestyle change through evidence-based digital health programs, and Ethan Fassett, VP of Product at Basis, a health- tracking service that seeks to help users become fitter, sleep better and be less stressed. In addition we interviewed our colleagues Dirk Ahlgrim, Timothy McGee and Mitch Sinclair, of IDEO Boston, who, in the last year, have been involved in the design of several self-tracking services that are not yet on the market.

* Melon: Barnehama and Berman, the founders of Melon, set out to help consumers improve their focus to help them become more mindful, confident and productive. They developed a technology that enables people to better understand their own minds and transform their behaviors accordingly, resulting in a headband that measures brain activity and tracks mental focus. In 2013, Barnehama and Berman spent four months with a team of IDEO designers as part of IDEO Boston's Startup-in-Residence program, during which time they developed their user experience and prepared a Kickstarter campaign that nearly tripled the project's fundraising goal (IDEO, 2013).

* Prevent, Omada Health: Omada Health is a digital healthcare company focusing on preventable, chronic disease, that for the first time in history are killing more people than infectious diseases (CDC, 2011). Omada seeks to combine human-centered design with behavioral medical research to build programs that are enjoyable, social, and effective (Omada Health, 2014). Prevent, Omada Health's first product, aims at preventing type 2 diabetes. Sean Duffy, Omada's CEO, feels that most tech companies focus on making a service that consumers would love and not so much on clinical effectiveness, while medical companies focus on medical research but produce services that are not engaging enough to encourage usage. Omada's goal, in contrast, is to design a service that people would like to use and is also proven to work (as cited in Bradley, 2013).

* Basis: The self-tracking service Basis consists of a wrist-based health tracker and online personal dashboard to help people incorporate healthier habits into their daily routines. The Basis band continuously measures motion, perspiration and skin temperature and captures heart rate patterns throughout the day and night (Basis, 2014). "Every year, in their quest to become healthier, millions of people join a gym, start a new health program or download a fitness app," says Jef Holove, CEO of Basis, "often these approaches are too rigid to accommodate life's ups and downs, require us to log our lives manually, or can be too time-consuming to fit into our busy schedules. Basis solves these problems to help people build lasting healthy habits," (as cited in Chan, 2012).

Based on what we have observed in our daily work as design researchers, and from our conversations with users and the aforementioned experts, we have devised five principles that we believe are fundamental to our work as human-centered design researchers, as well as to the design of self-tracking devices: (a) ask the right questions, (b) move from data to insight, (c) move from insight to action, (d) tell a human story and, (e) ensure an ethical use of data. In the following section we will discuss these principles in the context of existing research and provide examples of how they apply to existing self-tracking services.

PRINCIPLES FOR THE DESIGN OF SELF-TRACKING SERVICES

Ask the Right Questions

It is tempting to get enthusiastic about the possibilities that technology offers for tracking personal data. The appeal of novelty can lead companies to design a service with an unclear goal in mind, and lead users to track personal data

'just because they can'. But this is often no more than an initial curiosity and not a sustainable motive for users to keep tracking in the long run. Benjamin and David, two passionate runners with whom we spoke, both discussed how they began tracking everything related to their runs, but soon got bored with it and finally ceased tracking altogether when it began to seem like too much hassle for what they got out of it. "When my current tracking device breaks, I won't bother to buy the next one," says David. As design researchers we believe that good research needs a clear purpose: What need are we trying to address? What problem are we about to solve? "Good design asks the right question", says IDEO's CEO Tim Brown (2009), every behavior change – exercising more, learning a language, changing job – always begins with asking the right question first (Brown, 2014).

The design of a good self-tracking service must start with the right questions. It should address a real need and it should enable users to ask the right questions themselves, while becoming increasingly aware of their answers. Melon's founders, for example, had a clear goal in mind when they started developing their technology: to empower people to know more about their own mind. "We want to help you focus better", says Arye Barnehama (personal communication, February 19, 2014). Further, "how could we transform the way we work? Improve the way we meditate? Find a new way to be creative?" (Melon, 2013). Melon is not about measuring brain activity, but about focus, feeling in control and feeling good about it, with the technology merely serving as a means of fulfilling this human need.

Understanding *why* people are tracking information about themselves is a central question that is not always so easy to answer. Besides very tactical motivations like losing weight or managing a chronic disease, there are also harder-to-grasp motivations, among them an almost philosophical desire to get a better sense-of-self, or a deeper understanding of oneself in relation to others. As Sinclair states, "self-tracking helps me to better understand who I am" (personal communication, February 14, 2014). By self-tracking, users might also want to tell a personal story about themselves. Bell (2013) discusses how wearable technology has a symbolic function in sending a message about ourselves and acting as a sign of belonging to a specific group, engaging in a specific activity or having specific beliefs. For the design of a good self-tracking service it is necessary to understand people's motivations before one can properly address them. In addition, what we learned from David and Benjamin's example of decreasing curiosity in their running data, is that motivations also change. The 'right question' in the beginning might be replaced by another 'right question' with time. As Ahlgrim, McGee and Sinclair describe it, "the perfect self-tracking device grows with you, as the engagement changes over time" (personal communication, February 14, 2014).

Move From Data to Insight

"People are not interested in getting more and more data, they want to understand what's going on. They are interested in the message," says Ahlgrim (personal communication, February 14, 2014). The value of a self-tracking service lies not in the data it collects, but in the insight it provides. Ethan Fassett, VP of Product at Basis, states that self-tracking services in general have to become better at confidently generating insights based on the data generated (personal communication, February 21, 2014). As design researchers we move from data to insight by synthesizing the information we have collected. We do this by cross-validating, contextualizing, filtering and interpreting the information. A well-designed self-tracking service should enable the user to make sense of the information by moving beyond the raw numbers and distinguish between important and irrelevant bits of information. Christian, early self-tracking adopter and self-proclaimed data enthusiast says, "in order to make sense of my data, I need to be able to put it into context," and criticizes that many self-tracking services lack the ability to connect and combine different sources of data.

Melon, for example, combines contextual information, such as current activity or environment, with data about brain activity measured by the headband, moving from data to insight and understanding about what factors affect our focus. According to Barnehama and Berman, "at Melon we are really interested in the idea of Understood Self, which we are trying to add to the movement of Quantified Self" (Melon, 2013), with the term 'Understood Self' describing the layer of insights on top of the numbers and scores. While many self-tracking devices leave it to the user to interpret the data and make decisions based on that information, Melon is specifically designed to interact with the user and provide messages about their focus based on the data collected (Treuhaft, 2013). Barnehama says "we didn't create a Quantified Self service. We are not just printing numbers. We believe Understood Self services are the Generation 2.0 of Quantified Self." He strongly believes that users don't want to "sit and look at data" (personal communication, February 19, 2014). And self-tracker Christian confirms, "I'm not interested in the numbers, I want to see what it means for myself, how it compares to my own personal record."

The health-tracking service, Basis, automatically tracks and combines data from multiple sources and relies on the smart combination of different biosensors to provide better insight. Fassett says the continuous tracking of the users' heart rate, instead of just collecting data from an accelerometer, is a key factor in providing insights about what is really going on with the users' body (personal communication, February 21, 2014). Omada Health's service, Prevent, uses yet another approach to get from data to insight. Instead of relying on an algorithm to make sense of the data, a real coach does the work of interpreting, including not just the data obtained from self-tracking, but additional background information about the user, to provide more meaningful and relevant results (Mallard, personal communication, February 20, 2014).

Move From Insight to Action

As design researchers we believe that a good insight invites action, and should be inspiring, not simply descriptive. A well designed self-tracking service, therefore, should enable users to move not only from data to insight, but also from insight to action. Andrea Mallard, from Omada Health's service Prevent, states "we ultimately use the tracking to prompt a behavior rather than to accumulate data," (personal communication, February 20, 2014). When talking to users of self-tracking services, we asked them what they have learned from self-tracking and what impact it has had on their life. Aleksandra, a young biotech-scientist and passionate self-tracker, admits that although she loves self-tracking because she loves graphs and likes putting everything in a system to see the order of it, she did not really gain a lot of new information, nor did it really have much impact on her life. While there will always be users like Aleksandra, who like "self-tracking in itself," we believe Tinworth has a point when he says that self-tracking will only move from data enthusiasts to the mainstream when there is more actionable data that makes a real difference in people's lives (Tinworth, 2013).

Going beyond data by providing actionable insights is one of Melon's most important goals (Pugh, 2013). Melon learns, together with the user, what helps and what hurts one's focus and gives personalized recommendations when focus dips too low (Melon, 2013). For Melon, making data actionable is all about giving great real time feedback (Barnehama, personal communication, February 19, 2014). For example, the Melon app shows increases in concentration after performing certain tasks, with the user interface transforming from shades of red to shades of blue to help users determine an optimal study environment, or gauge when they have been working too long and need to take a break. The service not only helps users learn what affects their focus, but it also offers tips for improving focus and offers a game to help train your mental powers (IDEO, 2013).

Real time feedback about one's own body acts as a powerful tool in learning how specific actions lead to specific outcomes. As Nafus and Sherman state, "in situ awareness surfaces threads of other associations – what was eaten, the environment, the associated social dynamics, and so on. This gives a fuller experience of what changes in data, such as rising glucose levels, might physically feel like. One learns how to feel one's body through the data (Nafus & Sherman, 2014). Runner and self-tracker David, for example, reports that he learned through self-tracking how tired he would feel at a specific heart rate. And, Melon's Arye Barnehama tells a powerful story of how a child with attention deficit disorder (ADD) learned, through the use of Melon, to focus better by receiving feedback about how feeling focused is supposed to feel (personal communication, February 19, 2014). The direct feedback, in this case, acting as a trigger and positive reinforcement to lead to the desired behavior.

Short feedback-loops and personal recommendations based on real time data are huge opportunities for self-tracking services to move from data to action. As Ahlgrim states, by getting regular feedback users see and understand the impact of behavior change in real time, becoming aware of ways to improve their health by little changes in their everyday life (personal communication, February 14, 2014). It is exactly these little changes in everyday life that Basis is about. Basis wants to help users move to action by setting very specific and rather modest goals, like sitting less or having more consistent sleep times, and then use a gaming system and positive reinforcement to motivate those users to keep at it (Fassett, personal communication, February 21, 2014). Melon's Barnehama believes that timing is important and that embedding feedback and recommendations into people's day-to-day activities is integral, "a good service should give feedback in the moments that count." In the case of sleep-tracking, for example, users might get a score about their quality of sleep in the morning when they wake up, but then go through a full 12-hour day, doing all sorts of things that affect their sleep without getting feedback about those activities (personal communication, February 19, 2014). Omada Health's Andrea Mallard adds, that behavior change is not always dependent on the actual data, but rather about the awareness that self-tracking induces, "people who track what they eat or weigh themselves every morning, will automatically eat less" (personal communication, February 20, 2014).

Tell a Human Story

Researcher Brenè Brown states in her TED talk "maybe stories are just data with a soul" (2010). As design researchers we embed stories into data (Seemann, 2012) to keep data human and the user at the center of our attention. When self-trackers track data they are creating a very personal story about themselves. As Gary Wolf (2010) describes it, "the goal isn't to figure out something about human beings in general but to discover something about yourself – the validity might be narrow, but it is beautifully relevant." In his 2010 TED talk, Wolf spoke about how data derived from self-tracking should not be exclusively seen as a 'window' that allows outside institutions to look into peoples' lives, but rather as a 'mirror' that allows self-discovery and self-awareness. Nafus and Sherman also discuss how the self-tracking of personal data is one of the few areas of big data collection in which the individual is not a resource whose data is aggregated and abstracted by a distant machine for the sake of advertising or controlling the behaviors of others, but instead is a meaningful reflection of oneself (2014).

Self-trackers have their own notion of analytics and represent a profoundly different way of knowing what data is and why it is important (Nafus & Sherman, 2014). "The relationship that people engage in with their self-tracking service is often very personal", says Ahlgrim (personal communication, February 14, 2014). Basis-user Cristina, for example, reports how the service feels like a friend telling her "this is how you feel, it's ok, just take a couple of breaths and calm down" (Basis, 2014). This personal nature of self-tracking should certainly be taken into account when designing a new service. Instead of applying a numbers-focused and abstract tone of voice, a good self-tracking service should address the fact that the data has been generated 'by myself, for myself' by adding a human layer to the data, allowing for subjective, intuitive interpretation. As Ahlgrim states, "a good self-tracking service acts as a translation tool, it enables natural conversations based on the data generated," (personal communication, February 14, 2014). Human subjectivity informs such natural conversations, and IDEO's Sinclair reports the frequent use of humor in the language of a self-tracking service to make it feel more human (personal communication, February 14, 2014).

At Melon there was conscious decision not to use numbers on a scale to communicate focus level, but to translate the data into something that users could understand on an emotional level, "Melon is about taking invisible information – in this case from your brain – turning it into something visible," says Barnehama (2013). Thus, they created a language with their users, resulting in the gradient on the app that turns from shades of red (stress, caution) to shades of blue (calm, refreshed) as the focus level improves (Barnehama, personal communication, February 19, 2014). Visual communication is often a good way to allow for more intuitive interpretation of data. Self-tracker Christian says "I would rather see the quality of my sleep in a circle or something, the numbers are just too abstract for me to interact with it." Dave Dickinson, former CEO of sleep-tracking service Zeo, strongly believes presentation matters, "some data charts and graphs simply have no chance to capture our fear or to engage our competitiveness," (2013). Health-tracking service Prevent also keeps data human by including real human interaction in their service. Calling it 'high tech meets high touch' Mallard describes the service as one part digital, and one part real life interaction with a health coach, who validates the data with meaningful stories (personal communication, February 20, 2014).

Ensure an Ethical Use of Data

Ethics around data are most often considered when the people analyzing and using the data differ from the ones producing it. The immense accessibility of data has given rise to much discussion about the ethical use of user provided information, with many suggesting that just because people publicly share information, it is not automatically ethical for others to make use of it (Boyd & Crawford, 2011). Ethical considerations are, of course, just as relevant when users track data for themselves. In this paper we have focused on the personal relevance of data and therefore have limited ourselves to ethical concerns related to the hypothesis of users becoming researchers of their own lives. Questions around security and confidentiality of data collected through self-tracking need to be answered on a societal, governmental and legislative level. It is imperative, however, that service providers ensure users are aware of how their data is stored and what it could be used for.

Our main goal here is to examine how self-tracking leads to new personal risks and responsibilities for the user. Self-tracking tools can empower users in many ways: to learn more about themselves, ask better questions and make better decisions, more independently. Especially in the health domain can self-tracking lead to exciting opportunities: a more democratic distribution of knowledge, more independence from experts, patients who have more knowledge about their bodies, take better care of themselves and lead a healthier lifestyle that helps not just in managing diseases but also preventing them. At the same time questions of responsibility and liability are also more

pressing in the field of health-tracking. As roles and responsibilities between different stakeholders are changing, we have to ask ourselves: who owns the data and who is responsible for interpreting it and making decisions based on it? Does the expertise lie with the service, with the user or with some external institution making sense of the data? With Omada Health's service Prevent, for example, the interpretation of data is not left up to the user, as they are often subject to biases, with seemingly 'neutral' self-tracking services often supporting those user biases (Mallard, personal communication, February 20, 2014). Instead, data from self-tracking is supplemented by the expertise of a real human health-coach, and decisions are based on conversations between the user and the coach. As Mallard states, "we don't rely on a program or an algorithm or even the user to do the work of interpreting all the data that comes in," (personal communication, February 20, 2014). Additionally, Wolf believes that the fact that electronic trackers are emotionally neutral, "makes them powerful mirrors of our own values and judgements," and further, "I got nothing from my tracking system until I used it as a source of critical perspective, not on my performance but on my assumptions about what was important to track," (2010). Thus, helping users become better researchers of their own lives through self-tracking also means making them aware of their new responsibilities, their biases and implicit judgments.

CONCLUSIONS

In this paper we have proposed five principles, derived from our work as design researchers, that should be kept in mind when designing new services for users to track personal data:

First, the design of a human-centered self-tracking service must start with *asking the right questions* and should continue to reframe those questions as the engagement with the service might change over time. Having the right questions in mind leads, as we have seen in the case of Basis, for example, to an outcome of more tailored feedback.

Next, a well designed self-tracking service should help users *move from data to insight* and *from insight to action.* Melon, as we have seen, uses contextual information to help the user learn more about what helps and hurts their focus and translates those into easy-to-grasp insights. By giving real-time feedback, Melon helps users not only receive valuable information to help develop a better understanding of their brain activity, but also helps them move to action and change behaviors based on their new understanding.

Throughout this process of moving from the right questions to relevant insights and desired actions, a human-centered self-tracking service should also *tell a human story* instead of merely focusing on abstract numbers and charts. We have seen services apply a humorous and playful language or use visual communication to enable natural conversations with the user based on the data collected, and encourage users to draw more upon their intuitive skills.

Lastly, self-tracking services need to *ensure an ethical use of data.* As stated above we primarily focused on understanding new risks and responsibilities that self-tracking implies for a user on a personal level. Knowing more about oneself does potentially lead to more independence in decision making, but also to more responsibility when it comes to interpreting data and acting upon the knowledge gained. We believe Omada Health has found an interesting way around this dilemma with Prevent. Instead of keeping the service purely digital, Prevent uses the data to inform conversations between the user and a real human health-coach. Interpretation and decision making happen in these conversations, building on additional personal information about the user.

As the market matures, we hope to see more examples of self-tracking services that will incorporate our five principles, leading to better designed services and more value for the user. From a design research perspective we are keen to see how self- tracking services will develop in the future. Will self-tracking become more pervasive? Will self-tracking devices become invisible or even implantable? Self-tracking technology is changing the way we conduct our research as users take on the role of researchers, becoming collectors of their own data. Our role as researchers increasingly changes from passive observers to active collaborators, working together with users to collect and interpret data. We look forward to the additional learning opportunities gained as users increasingly interact with their personal data as researchers of their own lives.

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Section 13

Innovation in Healthcare Intelligence and Smart Communities

Risk Prediction Methods Based on Electronic Medical Records and Social Surveys for Improving Patient Outcomes and Enabling Targeted Care Services[1]

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ABSTRACT

This paper focuses on effectiveness of methods for improving patient quality (e.g. improving treatment adherence, reducing adverse events) outcomes and targeted interventions based on psychosocial and clinical risk factors embedded structured and unstructured elements in medical records. Current methods on outcomes analysis such as adherence to treatment regimen largely rely on survey instruments, and provide lagging indicators that inhibits timely intervention and care services. In this paper we present a novel early-warning method that can predict patients at risk of non-adherence based on clinical rules, natural language processing techniques and predictive algorithms applied to risk factor information embedded in electronic medical records. We conducted studies on the effectiveness of our risk estimation methods across 2.5 million patient-visit records from a community cancer clinic that spans a 14 year time-horizon. We identified 2 distinct patient groups, between 26 and 38 (mean risk score, r=0.77, s=0.22), and 75 and 90 (r=0.81, s=0.19) years of age respectively, who exhibited a strong likelihood of non-adherence to treatment regimen. We obtained a reasonably high C-statistic (> 0.77) on predicting outcomes based on the risk factors. The dominant risk-factors, not surprisingly, included psychosocial (e.g. depression and lack of support), medical (e.g. side-effects) and financial (e.g. co-pay). We finally discuss the effectiveness of the methods for targeted and improved health care services.

Keywords: Electronic Medical Records, Medical Adherence, Cancer, Predictive Analytics, Text Mining

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INTRODUCTION

At least one in five cancer patients fails to adhere to a recommended treatment plan of care or medication regimen. For specific cancers this proportion can be substantially higher. These non-adherence leads to higher costs through unplanned hospitalizations, adverse outcomes, and increased risk of preventable death. Early warning of risk of patient non-adherence can provide clinicians with useful information for attempting suitable and targeted interventions. Understanding the factors that drive medical non-adherence is a long standing research effort (DiMatteo, 2004).

We utilize a retroactive dataset of cancer patient visitation information at an outpatient clinic, the Moncrief Institute at University of Texas Southwestern, to create a rich information model based on attributes cleaned from the unstructured fields in electronic medical records. This was achieved through the use of data dictionaries and text mining techniques. These factors are combined with structured information from medical systems are used in calculating the risk of non-adherence using predictive modeling. The models are evaluated and validated through a combination of blinded validation datasets and ultimately by clinical evaluation and validation conducted by clinical staff.

STUDY DESIGN

Predicting patients at risk of non-adherence to their hospital administered treatment plan through canceling and no-shows of their scheduled visits to the hospital. Specifically our models will attempt to score whether the patient will be a no-show or cancel her next treatment visit. These risk scores will help guide the provision of additional resources towards patients with high-risk profiles of non-adherence in order to maintain their treatment plans and avoid potentially life-threatening situations.

A retrospective study is conducted on past cancer patients who were participants with the UTSW Cancer Institute with patient cases and treatment visits ranging from the end of 1978 through 2012. The focus of the study is on three main categories of cancer, namely breast, colon, and lung cancers as well as an overall one. We utilize two types of model features; first a set of features based on structured information which include frequency and recency of events within different time horizons, medical condition of the patient, prior treatment history, presence of comorbidities, adverse effects; secondly a set of features extracted from medical clinical records utilizing text-mining, clinical rules, and natural language processing which include social factors, financial factors, domestic issues, emotional issues and related concepts (Christiansen and Ehlers, 2002). The design of these text-mining algorithms utilizing dictionaries is described in (Sairamesh 2009a, 2009b).

A critical step in our approach is to validate the terms and variations of terms and phrases in the risk factor dictionary. The validation is done using the frequency and distance vector methods of terms and phrases used by clinicians in various records. We measure error rates between the text in the new records and risk factor terms in the dictionary. A crucial next step is to validate the risk algorithms by estimating the risk based on the risk factor dictionary and verifying with the help of a clinician if the patients projected to be at risk are indeed the patients who are at risk. This process requires comparing the actual versus the computed value of risk.

- First, the algorithms are trained on a large enough training set from the retrospective data. We considered a variety of risk factors (e.g. treatment cycle, side effects, costs, social status and others) and patient attributes (e.g. age, genetics code, vital signs and others) for validation.
- Once trained, the algorithms are then tested on a “testing set” consisting of patient records different from the training set to verify that the risk factors extracted are indeed the dominant factors for patient non-compliance. 10-fold cross-validation is also used to better assess the prediction error.
- A third set of patient records, called the validation set, is then chosen from the newly created patient records for further validation and correction.
- Finally a clinical validation study is contacted to compare the results of the algorithmic models with the results skilled clinicians would identify and compare the two. Models that predict close to the results of the clinical staff are in general better.

RISK MODELING

The risk modeling component of this study involved the use of different predictive methodologies to predict the risk of non-compliance. The study was done in two parts. One part involved utilizing text-mining features alone and the second part involved the generation of a more extensive set of features utilizing structured information and coupling it with the text-based risk factors. Prior predictive model efforts include adjuvant treatments studies for women with primary breast cancer (Partridge et al, 2003)(McGowan, 2008), and Anastrazol (Partridge et al, 2010) but without utilizing text-mined risk factors.

Risk Models using Text-Based Risk Factors

We conducted studies on the effectiveness of our risk estimation methods across 2.5 million patient-visit records from a community cancer clinic that spans a 14 year time-horizon. Multiple modeling techniques were utilized and evaluated. Bayesian, Neutral Networks, and nearest neighbor techniques were utilized against the text-based risk factors as well as some basic demographics to predict no-shows and cancellations.

These models allowed us to identify 2 distinct patient groups, between 26 and 38 (mean risk score, r=0.77, s=0.22), and 75 and 90 (r=0.81, s=0.19) years of age respectively, who exhibited a strong likelihood of non-adherence to treatment regimen. We obtained a reasonably high C-statistic (> 0.77) on predicting outcomes based on the risk factors. The dominant risk-factors, not surprisingly, included psychosocial (e.g. depression and lack of support), medical (e.g. side-effects) and financial (e.g. co-pay).

Risk Models using Combined Features

A subset of the visit data based on type of cancer was used in this modeling effort. We utilized two predictive modeling methodologies namely regularized logistic regression and boosted decision trees to building prediction models. We evaluate both methodologies utilizing performance metrics. We utilized 10-fold cross validation as a way of calculating performance metrics. Models are built for colon, breast, lung and combined (for all three).

Table 1: Population Characteristics of Prediction Models

		Breast	Colon	Lung	Combined
Patients	Patients since onset of cancer	3,735	945	1,904	6,584
	Total patient visits since onset	262,681	64,505	123,206	450,392
Adherence	% of visits non-adherent	8.3%	7.5%	5.9%	
	% of patients non-adherent	81.8%	79.1%	70.7%	
Gender	Female	3,702	452	864	5,018
	Men	23	492	1,036	1,551
	Unknown	10	1	4	15
Age at onset	65-	2,543	492	939	3,974
	65+	1,192	453	965	2,610
Survival Rate		90%	80%	62%	81%

The C-Statistic for each of the boosted tree versions of the models are over 0.77 with the most prominent features being the length of time between the last visit and current visit, days since the treatment plan began, stage of cancer, and prior incompletions of treatment visits. The most prominent text-based features were fatigue, nutrition, emotional, and domestic issues.

CLINICAL VALIDATION STUDY

We aimed to study the risk factors computationally gleaned from clinical notes that predict for administrative noncompliance and overall risk of deviation from a treatment plan as measured by appointment keeping. All datasets and study protocols were submitted to the UT Southwestern Institutional Review Board (IRB) for approval and certification of the study protocol, its human subjects protections and provisions, and aims. Such approval was obtained prior to the project commencement.

Patients who had a confirmed diagnosis of Breast Cancer and Colorectal Cancer as indicated by ICD-9 code were included. We excluded male breast cancer patients because of the different course and indications for therapy. Further, charts of patient who were not living, not receiving therapy (e.g. in survivorship), or participating in a clinical trial during the course of the study period, 2008-2009, were excluded from the sample. This enrollment yielded 3,400 breast cancer patients and 1,879 colorectal cancer patients. This subset was then randomly sampled for three groups of breast (n=125), lung colorectal (n=125) cancer patients that underwent both computational risk scoring and manual, human risk scoring. Specifically 125 patients from each of the three cancer areas were randomly selected from the population of patients within each category provided that the following criteria were in effect: The patient age at point of cancer diagnosis was 65 and above; the patient visit information included a treatment plan, diagnosis, visits, and visit notes; and the patient was diagnosed with either a breast, colon, or lung cancer.

These patients' records and visit notes were made available to clinical staff for evaluation solely through the use of clinical notes. These are retroactive evaluations for patient visit activity as the clinicians were provided the visit note history for each patient and asked to evaluate whether a particular set of risk factors was present.

Clinical Validation Results

We have contacted a quick analysis to determine the risk factors that are possibly driving the decision of a clinician to assess the level of risk that a patient would have given their medical record information. In our particular study we utilized two expert clinicians for validations to expedite the processing of records. This approach necessitated checking the inter-rater reliability between the two clinicians.

Inter-rater Reliability

Items such as clinical record evaluations and conclusions with regards to the overall diagnosis often rely on some degree of subjective interpretation by clinicians. Studies that measure the agreement between two or more clinicians should include a statistic that takes into account the fact that observers will sometimes agree or disagree simply by chance. Since the data we have are ordinal in nature (there is an ordering in the categories) we are making use of Cohen's Kappa [2]and Krippendorff's alpha[3]. In both case a value of 1 denotes complete agreement. No agreement between the raters unless by chance when the value is close to 0. Negative values denote disagreement that is worse than random.

What we observe is that over certain areas the two raters had higher agreement namely with factors that pertain to their expertise, namely behavioral health, pain, fatigue, mobility, non compliance and missed appointments, nutrition, depression and anxiety as well as employment. There was disagreement on issues of self image. Overall however the two raters are fairly consistent.

Clinician Model

We have contacted a CART based model to evaluate the different levels of risk of non-adherence assessments against evaluated risk factors and get some insight into the factors that seem to be affecting the clinician's evaluation on whether the patient is Low (1), Medium (2), or High(3) risk. We achieved this by aggregating the evaluations with the highest agreement between the clinicians.

We run a CART model on the assessments generated by the clinicians using their identification of risk factors and their overall assessment at the end on a per patient basis. The model demonstrates that once the clinician has identified patient information regarding mobility, transportation, nutrition, companionship, pain, and prior missed

[2] http://en.wikipedia.org/wiki/Cohen%27s_kappa
[3] http://en.wikipedia.org/wiki/Krippendorff's_alpha

appointments, ability to pay, anxiety and depression then a determination is assessed on the risk of non-adherence. The most important features as extracted by model are mobility, transportation, nutrition, companionship and pain management.

Comparisons with Prediction Model

The clinical study was conducted using all visit information while the prediction models are scored on a per visit basis. As such a particular logic needed to be implemented to translate the clinical per-patient assessments to the per-patient-visit prediction scores.

For each patient identified to have one or more of the risk factors by the clinicians should be compared with all the patient visits (encounters) you have our prediction models gleaned from the .

- If the risk factors identified by the model and the risk score for a single patient across all encounters is over 60% matched with risk factors identified by the clinicians for a patient then we call this a match.
- If the risk factors are very different and match less than 60% then we don't have a match on the risk factors. However is the risk prediction score shows that a patient is likely to be non-adherent, and the clinicians say the same then it is a match.

Comparing the prediction results of the overall boosted tree model against the evaluation provided by the clinicians we observe that applying the logic above the text extraction and models have at least 67% overlap between what the clinicians identified and what the text tool and models predicted.

CONCLUSIONS

We proposed a novel, real-time risk estimation method that uses data-mining and text processing of unstructured text embedded in electronic medical records to detect whether patients are at risk of non-adherence to treatment regimens. Our results indicated that over 30% of the patients were likely to drop off treatment based on several risk factors. We validated the predictions of these models against blinded datasets as well as clinical validation with clinicians with a fairly high overlap in their assessments. We also showed that two distinct patient groups (ages less than 40 and over 75) were at a high risk of non-adherence compared to other age groups. Further work needs to be done in leveraging the gleaned risk-factors to target interventions over multiple patient groups for improving adherence, care and quality of life for the patients. These risk scores can now be integrated into early-warning systems for clinicians to use. They allow them to identify the high risk of non-adherence patients and implement proactive protocols to reduce non-adherence through better understanding of the risks posed by the patient and through the improvement of overall care.

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A Game Theoretic Approach for Managing Multi-Modal Urban Mobility Systems

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ABSTRACT

Collective adaptive systems provide secure and robust collaboration between heterogeneous entities such as humans and computer systems. Such entities have potentially conflicting goals that attempt to satisfy by interacting with each other. Understanding and analyzing their behavior and evolution requires technical, social and economic aspects of modeling. In this paper, we develop a new design principle to describe an integrated and multimodal urban mobility system and model the interactions of various entities by means of game theoretic techniques.

Keywords: Collective Adaptive Systems, Commuting, Game Theory

INTRODUCTION

Emerging large-scale collective adaptive systems (CASs) such as urban transportation systems, national electric power markets and grids, ad hoc communication and computing systems, public health and others provide secure and robust collaboration between heterogeneous entities such as humans and computer systems (Kernbach, Schmickl, Timmis, 2011). As each entity is autonomous and preserves individuality, it still forms collectives for collaboration to accomplish collective tasks. Dynamic changes in the environment in which a CAS evolves, affect its operation and have to be properly handled by adapting system configuration and entities' behavior. Understanding and analyzing this behavior requires technical, social and economic aspects of modeling. Concepts that characterize and describe CASs have been studied in various domains like, for example, Swarm Intelligence (Levi, Kernbach, 2010), autonomic computing (Lewis, Platzner, Yao, 2012), or service-based systems (Marconi, Pistore, Traverso, 2008). Little research, however, addresses the problem of predicting the evolution of such systems.

In this paper, we use a new design principle based on cells and ensembles (Andrikopoulos et al., 2014) to develop an economic model that describes the strategic interactions in an integrated and multimodal urban mobility system. According to this approach, a CAS comprises of multiple entities that are physical or virtual organizational units. Each entity has a context (a set of properties) and a set of goals that it attempts to fulfill. Each entity aggregates a set of cells and participates in one or more ensembles. Cells represent concrete functionalities of the

system that need to be executed in order to satisfy a goal or interact with other cells (of the same or different entity) through pre-defined protocols. Ensembles are collections of cells provided by different entities that collaborate with each other to accomplish a certain goal. In this context, entities have a set of preferences that affect its perceived utility derived by participating in an ensemble. The concept of ensembles challenges current research on developing methodologies for the evolution of cells and ensembles to meet entity goals and improve the utility of the system under changing conditions. This work was carried out as part of the EU funded project "ALLOW ENSEMBLES[1]".

We consider an urban mobility system that includes various means of transport such as regular buses, flexible buses and car pooling (Andrikopoulos et al., 2013). The FlexiBus is a special bus that operates a flexible route set by passenger needs. The FlexiBus company is represented by a FlexiBus system, which is responsible for optimally creating different routes in the area of interest and guarantees that each route satisfies passengers' preferences. This new mode of transportation promises a decrease in travel cost but probably an increase in travel time. A passenger has to decide whether to process a request to one of the predefined destinations, while the FlexiBus system has to make a choice to accept or not a new request that arrives after the beginning of the bus, checking for availability and time constraints.

In this paper, we model the decisions of different kinds of entities in the above scenario as a dynamic non-cooperative game of complete information. At the lifecycle of a FlexiBus route, arrivals of new request trigger a new game comprising of a set of players (potential passengers, FlexiBus system, bus driver, payment manager) that negotiate for achieving an optimal travel time. The outcome of each game adjusts the decisions taken by the various entities of the system so that a passenger maximizes his utility (minimizing his desired travel time) and the FlexiBus system maximizes the probability of fulfilling each commuter's time constraint within promised boundaries.

LITERATURE REVIEW

An efficient transportation system utilizes mass transit alternatives to the automobile in order to reduce congestion and support ecological solutions. Travelers make decisions based on timing, cost, comfort, safety and mode of trips, while planners face policy questions such as frequency of routes, itineraries, size, cost and so on. Several studies have been conducted for modeling commuting time and analyzing congestion management strategies including travelers' departure time choice, route choice, or mode choice.

In (Lam, Small, 2001), a method to value travel time and its reliability is proposed. The method is based on collecting data on travel behavior. People had to choose between two parallel routes, one free but congested and the other with time-varying tolls by maximizing a utility function (a function of travel time, variability in travel time, cost, characteristics such as time-of-day and car occupancy, and a random component). Then, the value of time for a traveler is defined to be the rate of change in utility with respect to travel time over the rate of change in utility with respect to cost. Similarly, the value of reliability for a traveler is defined to be the rate of change in utility with respect to variability in travel time over the rate of change in utility with respect to cost. Estimates of value of time and reliability have been compared under various versions of the model (taking into account route only or, route and time of day, route and mode, route and transponder).

In (Johansson et al., 2003), the labor market commuter behavior is analyzed taking into account the observation that the willingness of an individual to commute is different for short, medium and long time distances. The paper introduces a utility function of wage level and commuting time in which time-sensitivity parameters for local, regional and interregional interactions are included. The paper examines the hypothesis that time sensitivity is lower for intra-municipal compared to intra-regional commuting. In addition, jobs inside the municipality are preferred to jobs in the rest of the region.

In (Li, Huang, 2005), the reliability of morning commuting in congested and uncertain transport networks is investigated. A model for studying commuting behavior in a stochastic and time-dependent network is proposed. The commuters make their choices on departure time and route in terms of the minimal perceived travel disutility. The route travel disutility, expresses the travel cost for a specific trip and is defined as a function of travel time, value of time, schedule delay cost of early or late arrival and a lateness penalty. The perceived disutility is the expected travel disutility added by a component that represents the random error of perceiving the expected travel

[1] ALLOW Ensembles: http://www.allow-ensembles.eu

disutility.

Other studies analyze the interactions that take part between commuters and planners or transport managers and examine how commuters choose their optimal routes and trip modes using non-cooperative games. In (Sun, Gao, 2007), a non-cooperative, perfect information, static game is formulated to describe how travelers adjust their route choices and trip modes. This paper analyzes the game between travelers and discusses the equilibrium of transit market. Every traveler's strategy set is the combination of all routes that link his origin and destination and all the trip modes provided by different operators. The utility function of each traveler is defined as his satisfaction degree which is a function of travel time, travel cost, environment, comfort and safety. The model of operators is examined independently of that of the travelers. It formulates the decisions taken by operators as a profit maximizing problem. The solution to this problem is the number of travelers attracted by the operator given a price vector.

In (Anas, Berliant, 2010), the authors consider a commuting network consisting of a finite set of nodes at which the commuters live or to which they commute or through which they commute and a finite set of transport links between the nodes (there exists only one mode of transportation). A non-cooperative game is formulated consisting of a set of commuters who compete for routes. The route choice is modeled using two different models. In the static model, the commuter chooses a route (this is his strategy) in order to minimize the time cost (pay-off). There is no choice of time of departure or arrival (it is not part of his strategy). If a link of the selected route operates below capacity then the time cost is constant, otherwise the time cost increases in proportion to the excess of commuters above capacity. It is proved that there is a Nash equilibrium in pure strategies. It is also proved that an optimum exists (social welfare is maximized) which is generally different from the Nash equilibrium. The dynamic model considers that departure time is part of the strategy of a commuter (in addition to the route). It is proved that Nash equilibria in the dynamic model are completely different from those of the static model.

In this paper, we investigate a dual problem facing both the commuters and the transportation authority; the commuters choose their trip mode, while at the same time the transportation company that provides a bus for example, makes decisions on accepting or not travel requests dynamically.

AN URBAN MOBILITY SYSTEM

Supporting citizens' mobility within the urban environment is a priority for municipalities worldwide. Although a network of multi-modal transport systems (e.g., buses, trains, metro), services (e.g., car sharing, bike sharing, car pooling), and smart technologies (e.g., sensors for parking availability, smart traffic lights, integrated transport pass) are necessary to better manage mobility, they are not sufficient. Citizens must be offered accurate travel information and ability to exploit related services on the go (e.g., ticket purchase, car pooling reservation, etc.). In order to deliver ``smart services'' to citizens, available systems should be interconnected in a synergic manner constituting a system of systems. In the context of the motivating scenario for this paper, we consider an *Urban Mobility System (UMS)* that integrates three means of transport: regular bus (*RegBus*), flexible bus (*FlexiBus*) and car pooling (*CarPool*) (Andrikopoulos et al., 2013) (see Figure 1).

Regular bus is a conventional system of predefined routes and timetables that is supported by a number of buses.

FlexiBus is a modern transportation service that combines the features of taxi and regular bus service. A FlexiBus system defines a network of pickup points and provides to passengers transportation between any of these points on demand. In other words, a passenger can request transportation between any two points at given time. Trips are served by small buses and each bus can serve more than one request at a time. The cornerstone idea of the service is to organize bus routes in such a way that all requests are served with minimal number of buses/routes. As a result, passengers are provided with a ``trip on demand'' service that is more convenient than regular buses but less expensive than taxi.

Car Pooling provides integration between independent drivers and passengers. Each driver can submit her itinerary with timetable, and other passengers can apply for a lift by this driver, once their origin and destination fit the itinerary.

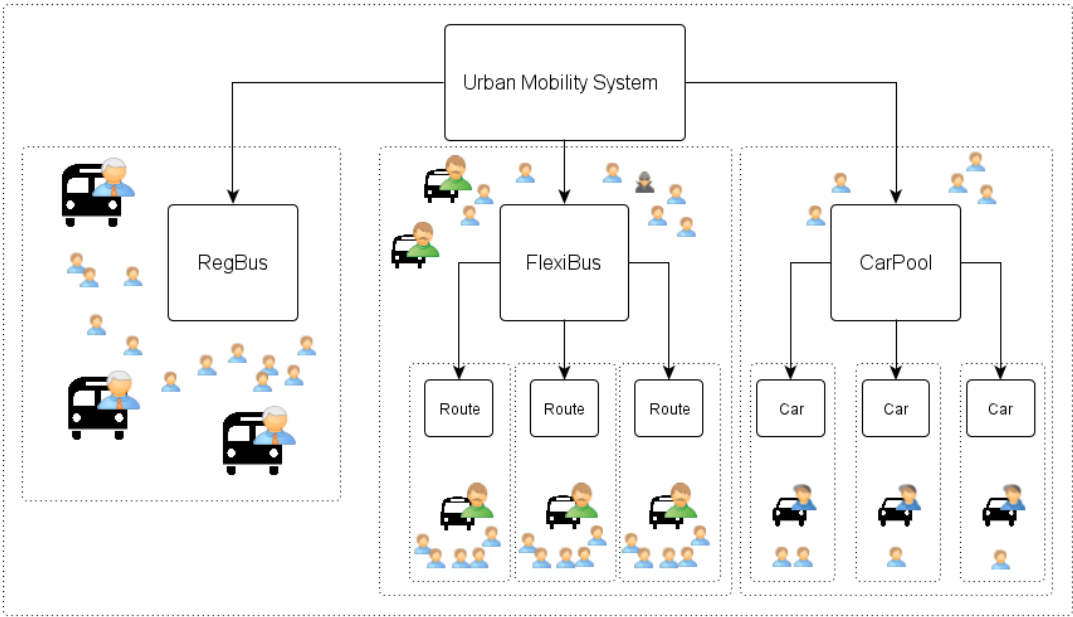

Figure 1. The Hierarchy of the Urban Mobility System

The goal of the urban mobility system is to provide seamless integration of the above services to the passengers. Within the current scenario we can distinguish the following set of entities:

- *Passenger*: this entity has the goal to reach its destination at certain time and with certain preferences (e.g., payment by cash, trip with a luggage, trip with a wheelchair);
- *RegBus Driver*: this entity has the goal to perform a predefined route and respect the timetable. It communicates to the RegBus system and may report bus delay, bus damage, traffic difficulties as well as receive updates (e.g., about the traffic situation);
- *FlexiBus Driver*: this entity has the goal to perform routes and respect passenger's needs (e.g., timing, preferences). It needs to keep in touch both with the FlexiBus system (to get route updates) and passengers it serves (e.g., in case of delay);
- *CarPool Driver*: this entity submits trip details into a system and has to reply to passenger applications by either accepting or rejecting them. The CarPool driver may also need to communicate with the passengers (e.g., in case of delay);
- *RegBus System*: provides passengers with the trip planning service and notifications about route status (delays, cancellations). It may also circulate information about traffic jams or road accidents to bus drivers;
- *FlexiBus System*: has the goal to organize optimal routes (e.g., a route serves more passenger requests at lower expenses). It guarantees that each route satisfies preferences of its passengers (e.g., origin and destination, temporal aspects, special requirements etc.), and other utility functions (reduction of the number of routes, optimal traffic planning, CO2 emissions, congestion, etc.). To find the set of possible routes it may communicate with the other services to get additional information (e.g., traffic, closed roads etc.), available resources (i.e., available buses), and generate alternative routes;
- *CarPool System*: aggregates propositions from drivers and supplies them to passengers on demand. It may also provide some kind of communication and notification system.
- *Urban Mobility System (UMS)*: supervises the three means of transportation and provides their integration. In particular, it provides the passengers with a universal tool for planning complex trips involving more than one means. It also creates integrated notification and support system (e.g., where car accident information reported by a regular bus driver can be propagated to FlexiBus and CarPool drivers, or where a

damage of a regular bus can be addressed using minibuses of the FlexiBus system). Finally, UMS can provide single payment for a complex trip;

- *Ticket Manager* is the entity that processes trip payments.

The way urban mobility is organized in real life reflects all the challenges of a collective adaptive system. Indeed, within the urban mobility domain we have multiple entities (passengers, buses, transportation systems, ticket machine, cars and others) that are *autonomous* in their goals and operation but need collaborate with other entities around them thus bringing up the concept of *collectiveness*. For example, in order to travel to a destination with a FlexiBus, the passenger must interact with the FlexiBus system, the Ticket Manager and maybe with the bus driver (in case of cancellation or delay). Inter-entity interaction/collaboration may be more complex and include more than one participant. Such group of participants with related intentions can be considered as a temporary collective of entities operating in coordination with each other. One example of such a complex collective is a particular FlexiBus route that groups the bus driver operating the route and the passengers served by this route. A more complex collective might be the whole FlexiBus system that includes all passengers, bus drivers and routes. Although the participants of such collective are not always explicitly connected, such connections might emerge spontaneously (e.g., a passenger may ``switch'' from one route to another).

It is quite clear that entities in our scenario have to operate in a *dynamic environment*. For example, for a given passenger, the surrounding world evolves autonomously: the buses keep on moving, the management system keeps on accepting new requests, the other passengers keep on conducting their trips and so on. Moreover, external factors may cause unpredictable situations: the road may get closed and the bus may get damaged. All this forms a *dynamic context* that, even though not fully controlled by the passenger, may affect the way he operates. Another important aspect is *dynamic partners*. The set of entities with whom the given entity can interact is dynamic. This is determined by the openness of the system (entities can enter and exit the scenario) and by the fact that some partners are only reachable/useful in certain point in time and space. For example, FlexiBus system may temporarily cease to operate due to technical problems (i.e., become temporarily unavailable to passengers).

Entity operation is closely connected to the environment (e.g., the passenger may change her travel plans if the bus is going to be late). It means that actors must properly react to critical environmental changes and *adapt* their behavior to such changes. As we mentioned, collective adaptation may be way more complex and imply changes to the behavior of multiple participants. For example, if a FlexiBus route is treated as a collective of a bus and passengers, in case of bus damage, the bus driver might need to contact the repair service and trigger reimbursement to the passenger. As an option, alternative solutions could be proposed to the passengers (alternatively, the FlexiBus system might negotiate with the passengers and, upon agreement, request urgent bus replacement). This is an example of collective adaptation.

Finally, the scenario demonstrates the *hierarchical* organization of entities into collectives. For example, 1) a FlexiBus route is a collective of a bus and passengers, 2) a FlexiBus system is a collective of routes (and maybe unassigned passengers and buses), 3) the Urban Mobility System is a collective of RegBus, FlexiBus, CarPool systems etc.

The Allow Ensembles Model

The urban mobility system previously described is modeled as a complex service system enabling an evolving interaction of multiple actors towards achieving their individual goals in a certain context. As previously presented in (Andrikopoulos et al., 2013), such actors are modeled as *entities*, which aggregate a set of different functionalities offered or required by an entity as reusable *cells*. Collaborative interactions between entities arise from the interaction of their cells in the scope of an *ensemble*, which is dynamically created in order to fulfill specific goals initiated by the entities. Focusing on the previously presented scenario, the FlexiBus system of UMS aggregates a set of cells, e.g. the trip booking cell and the route assignment cell. The trip booking cell interacts with the passenger's cell towards guiding the passenger through the ticket booking process, while the route assignment cell assigns a specific route to a bus driver.

The existence of entities having individual selfish interests leads to the existence of conflicting goals that entities aim to satisfy by establishing collaborations among them. For example, the FlexiBus system aims to maximize the overlapping routes in the city towards reducing the CO_2 emission. However, passengers' preferences, e.g. arrival time, are distinct, and in occasions can be adverse to FlexiBus system's goals. Therefore, entities cooperate towards

increasing their individual and collective satisfaction, which can be expressed in utility terms. Consequently, in the scope of our work we aim to model the economic perspective of systems of ensembles, and consider that entities participate in games according to multiple criteria towards achieving a set of objectives. *Non-cooperative games* can be considered when focusing on the achievement of individual objectives when potential interests exists within a system (Osborne and Rubinstein, 1994), while the interaction of entities towards achieving a common task and objective can be modeled as a *cooperative game* (Wiese, 2010).

In order to incorporate the means to analyze and evaluate properties and desired goals of the entities, we investigate the economic models that assign utility to individual entities, and therefore provide a measured value of their satisfaction. The usage of a utility function as a mean to quantify utility allows the assignment of numerical values to every choice and its ordering based on the entity's preference (Andrikopoulos et al., 2014). Cells interact in the scope of an ensemble towards achieving an entity's objective and contributing to improve its utility. Therefore, each entity takes into consideration the criterion of *utility maximization* when selecting an ensemble to participate in, while also considering the behavior and actions of the other entities. When an ensemble is being executed, the utility values from each entity participating in such ensemble are aggregated to a *collective utility*.

The modeling of the economic behavior in the proposed system is approached by defining the concept of meta-cells (Andrikopoulos et al., 2014). *Meta-cells* represent the economic characteristics of functional cells. More specifically, by collecting and measuring data, these cells measure the utility of every entity and ensemble, and communicate with other cells in order to compute strategies and make decisions. In addition, meta-cells facilitate the ensemble performance improvement by running optimization algorithms. Simultaneously to the creation of ensembles due to the interaction of entities' functional cells, strategic utility-based interactions of different entities' meta-cells trigger the creation of the *strategic ensemble* (see Figure 2). The strategic ensemble is constituted by the interaction of one or more meta-cells and handles the decision making at the level of interactions between entities. The capabilities provided by the strategic ensemble are related to: 1) reducing the entities' choices by imposing constraints derived from the entities' goals, 2) the evaluation from the point of view of an entity for participating in one ensemble, and 3) the assignment of utility to each entity in an ensemble in order to manage the negotiation between entities.

The strategic ensemble execution and life-cycle is closely related to the execution ensemble. More specifically, the strategic ensemble is created previous to the execution ensemble. Decision-making interactions between the meta-cells concerning the selection of the most beneficial execution ensemble trigger the creation of the strategic ensemble. During the execution phase of the execution ensemble, the strategic ensemble runs in parallel, as the operations of the execution ensemble are directly affected by the ones executed in the strategic ensemble.

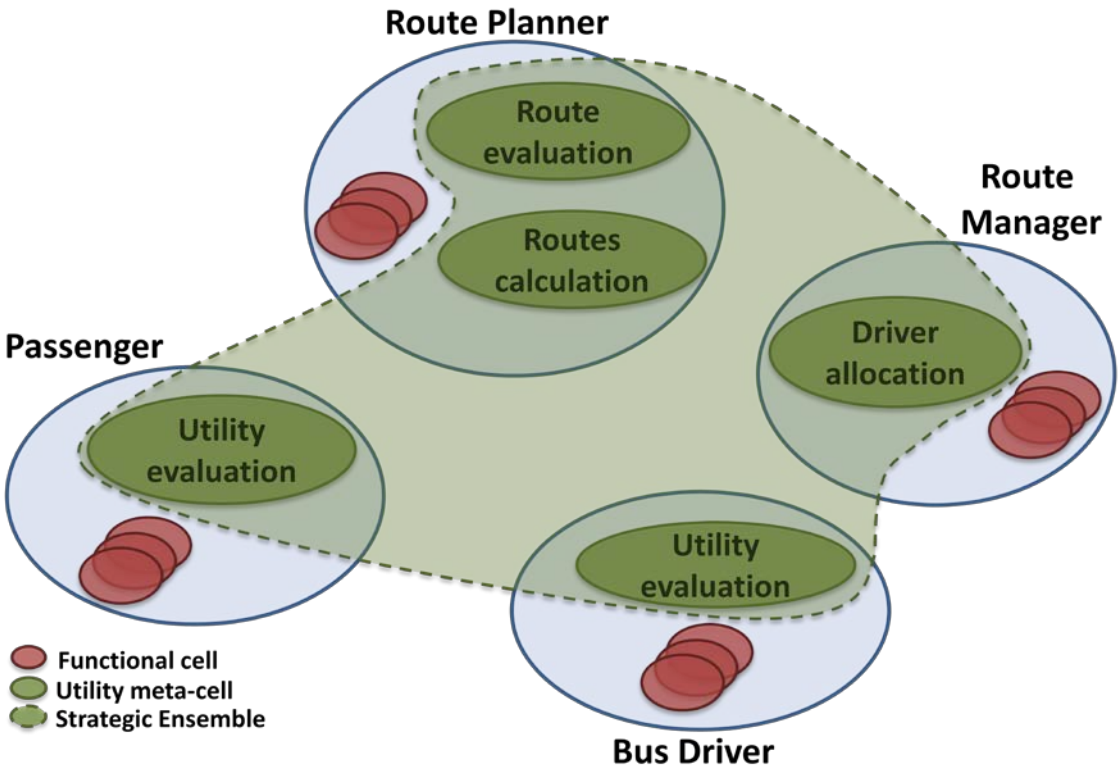

Figure 2. A strategic Ensemble in the FlexiBus Scenario

A GAME THEORETIC APPROACH TO MODEL ENTITY INTERACTIONS

We introduce a simplification of the urban mobility system described previously and apply our ideas to formulate the economic model that describes the actors, their actions and the problems they need to solve when they participate to set up and use a single FlexiBus route. We investigate a dual problem facing both the passengers and the transportation authority; the passengers choose their trip mode, while at the same time the FlexiBus system makes decisions on accepting or not travel requests dynamically.

Scenario

We consider the ensemble described by a scheduled route operated by a FlexiBus company and a set of passengers that have already booked for using this route for a common destination. We consider the urban mobility system consisting of the passengers, the FlexiBus system, the ticket manager and the FlexiBus driver. The route consists of M pickup points that are executed according to passenger requests. Passengers are able to pre-book for a pickup point. The route is postponed if the number of pre-booking requests is less than a pre-defined threshold. A passenger may send a request after the departure of the FlexiBus for a subsequent pickup point.

Let T_A be the time that pre-booking for the route is initiated. If the number of requests does not reach the threshold n_0 by time T_B ($T_A < T_B$) the route is postponed. The requests that arrive before T_B are conditionally accepted by the system provided that the route will finally be executed. Once the route is being executed we consider time slots $t_1, \dots, t_M$. At t_1 the bus departs from the starting point. At time t_2 the bus arrives at the second pickup point (the bus will not stop if no request for this pickup point is active) and so on.

The entities of our urban mobility system make decisions according to their own utilities. We consider that each new passenger chooses between two modes of transportation according to his money and time constraints: taking the regular bus or taking the FlexiBus. Given that the route is being executed, the FlexiBus system has to make a choice to accept or reject a new request that arrives before or after the departure of the bus, checking for availability and time constraints. We consider that the passengers that have already chosen to use the specific route do not alter their decisions (taken in a previous time instant), that is, no negotiation between them and the FlexiBus system takes place for the new conditions of the route (increased number of pickup points resulting in longer travel time). The FlexiBus system has to take into account that any violation of its past commitments will affect negatively its utility.

When a new request enters the system, at time t, a negotiation phase between the passenger and the system has to take place. A passenger request R is defined as a vector $R = (tr, m)$ where tr is the desired travel time and m is the pickup point. A new request arrives either in the pre-booking phase or the execution phase of the route. We describe the negotiation phase as follows: upon a new request R, the FlexiBus system processes the request and replies sending a message to the passenger defined as $MES = (status, \bar{t})$ where status is 0 (if not accepted) or 1 (if accepted) and $\bar{t}$ is the remaining expected travel time. The estimate of the remaining travel time depends on the number of current passengers of the route, the number of future accepted requests till the termination of the route and a stochastic component related to congestion.

The passenger then decides to enter the route (ensemble) if the expected utility he accrues by choosing the FlexiBus is higher than the expected utility obtained using the regular bus. The utility of a passenger reflects his benefit from travelling and is a function of the travel cost and travel time. The utility of the FlexiBus system denotes the revenues it gets from one execution of the route. Thus, it is to its own benefit to tempt (a good estimation of travel time is necessary) as many passengers as possible to take the bus. Note that the above utilities cannot be calculated before the execution of the route, since travel time and the total number of passengers of the route are not known beforehand (stochastic component). Instead we can estimate those variables during the route and provide expected utilities.

Utility functions

The utility u_1 of a passenger for participating in the specific ensemble (route) reflects his benefit from travelling and is a function of the travel cost c and the actual travel time T. An example of a utility of this kind is given as follows:

$$u_1(c, T) = \frac{e^{tr-T}}{e^{|tr-T|+c}}.$$

If $tr - T > 0$ the bus has arrived earlier than desired is constant with respect to T. If $tr - T < 0$ the bus arrived late and passenger's utility decreases as T increases.

The utility u_2 of the FlexiBus system for initiating and executing the specific ensemble denotes the revenues it gets from one execution of the route:

$$u_2(\underline{c}) = c_1 + c_2 + \cdots + c_n$$

where $\underline{c} = (c_1, \ldots, c_n)$ is the cost vector for the n passengers of one route.

At decision time t, (during the negotiation), T and n are random variables, thus entities calculate expected utilities $\bar{u}_1$ and $\bar{u}_2$. Examples of these utilities are given below:

$$\bar{u}_1(c, \bar{t}) = \frac{e^{tr-\bar{t}}}{e^{|tr-\bar{t}|+c}},$$

$$\bar{u}_2(\bar{c}, \bar{t}) = c_1 + c_2 + \cdots + c_{n_t} + n_{exp}(\bar{t})\bar{c},$$

where n_t is the number of passengers (already using or having booked for the route) at time t, $\bar{c}$ is the mean cost for future passengers and n_{exp} is the expected number of future passengers as a function of $\bar{t}$. The function n_{exp} is increasing in $\bar{t}$ and takes a maximum value equal to the remaining seats of the bus, say K. An example is given by:

$$n_{exp}(\bar{t}) = \frac{K(e^{\bar{t}}-1)}{e^{\bar{t}}}.$$

Game Formulation

We model the above scenario as a non-cooperative dynamic game where decisions are to be taken each time a new request arrives at the system. At each such time instant the game consists of two players (the new passenger and the FlexiBus system) who compete for the desired travel time. The passenger's strategy is to ask for as short as possible trip while the system's strategy is to promise as long as possible trip. The outcome of the game is a pair of travel times; a desired and a promised one. If the passenger reveals the real desired travel time, he increases the probability of being accepted to the cost of increasing the probability of being late if the actual travel time is significantly larger than the expected travel time. On the other hand, the FlexiBus system has to balance the benefit it accrues from accepting a new request and the potential benefit of future requests. The objective is to find the optimal outcome such that the players have no incentive to deviate from.

We consider a game of *complete information*, since:

- The FlexiBus system provides private information of current passengers to the new passenger.
- The utility functions of all entities are common knowledge.

We also consider a *dynamic mechanism* in which the decision points are request arrivals. New strategies have to be derived each time a new request arrives (thus a new game is formulated). All these games across the route have to be synchronized in order to derive optimal profits for the FlexiBus company and the passengers. We also consider that each such game is sequential:

- Step 1: The new passenger makes a request.
- Step 2: The FlexiBus system calculates its strategy (accept or reject) based on the request.
- Step 3: The new passenger calculates his strategy based on system's strategy.

Let a new request arrive at time t. The game consists of two players; the new passenger and the FlexiBus system. The strategy profile of the players is given by $s = (tr, \bar{t})$ where tr is the desired travel time of the passenger and $\bar{t}$ is the expected travel time specified by the FlexiBus system. The payoff p_1 of the new passenger is given by:

$$p_1(s) = \begin{cases} G, & tr < \bar{t} \\ u_1(c, \bar{t}) - f(tr), & tr \geq \bar{t} \end{cases}$$

where G is the payoff gained by the passenger's alternative solution and f is a function that incorporates the risk of adding future passengers. Accordingly, the payoff p_2 of the FlexiBus system is given by:

$$p_2(s) = u_2(\bar{c}, \bar{t}) - g(\bar{t})$$

where g is a function that incorporates the risk of losing future passengers.

We consider that decisions of the passengers or the system at time t are taken according to the following rules:

- A new passenger decides to enter the route at time t_i, if the expected utility he accrues by choosing the FlexiBus ($\bar{u}_1 = (c, \bar{t})$) is higher than the expected utility obtained using the regular bus ($G = \bar{u}_1(c_{reg}, t_{reg})$).
- The FlexiBus system decides to accept a passenger request, if there are available seats and the current expected travel time is less than the promised travel time to the current passengers ($\bar{t} < \bar{t}_{old}$).

The above game describes the interactions of entities and reveals some rather interesting aspects of the decision making process inside an ensemble:

- Even though the various entities have similar goals (reaching a destination), their strategies are rather conflicting (estimated travel time changes to the benefit of some passengers and at the

same time at a cost for others).
- In equilibrium, entities that participate in the ensemble collaborate with each other and share the payoff created by the execution of the ensemble.
- The evolution of the ensemble is based on the synchronization of entities' decisions during the execution of the ensemble.

CONCLUSIONS

Various utility models have been considered in predicting the behaviour of passengers as parts of transportation systems. Travel time is an important factor that affects the satisfaction of passengers and thus their utility. Models for estimating the value of travel time have also been defined. Non-cooperative games have been proposed to model passengers' decisions in terms of mode choice, route choice and time-of-day travel choice.

In this paper, we aim to develop a methodology using games and utility functions in order to exploit two aspects of transportation systems that have not yet been considered. First, the passengers interact with each other but also with the trip operators/managers/planners in order to take decisions. We consider thus an urban mobility system in which every member has his own selfish goals that are better achieved through a mobility management system. Non-cooperative games are appropriate models for modelling such situations. Second, entities have a utility that expresses their benefits from using the services of the urban mobility system (in the traditional way) but new performance metrics (analogous to utility) have to be defined in order to evaluate the operation of cells and ensembles seen as components of a complex system.

Derivation of equilibrium strategies in the game described in this paper as well as extensions of the scenario to include different destinations for various passengers, perform repeated negotiations between UMS and current passengers, consider flexible routes that add or remove pickup points upon requests, are directions for future work.

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Section 14

System Innovations: A New Perspective in Servitization

A Multi-Criteria and Multi-Actor Perspective for the Evaluation of Sustainability Services

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ABSTRACT

The purpose of this paper is to study the challenge of the evaluation in the context of the services. Because of their specific nature the traditional evaluation methods and measures are not able to capture neither the diversity of the innovations nor the multifaceted dimensions of performance. This paper aims to contribute to the need for a more diverse evaluation approach. We focus on the context of service innovation in the environmental sector, in which we develop further multi-criteria and multi-actor perspectives. The multi-criteria framework describes the impacts of sustainability services and the multi-actor framework aims at analyzing the impacts from the perspective of various actors involved. Thus, our study provides a two dimensional approach to assess the impacts of services. The focus is on understanding the dynamics of service creation in the environmental sector, and on using new evaluation methods and indicators in that sector.

Keywords: Sustainable services, service innovation, multi-criteria evaluation, multi-agent framework

INTRODUCTION

Systematic evaluation is an activity that has been an essential part of strategic thinking for decades. It has been linked both to the general development of organizations and to more specific functions. It has played a particularly important role in the context of innovation and R&D. In public interventions – often carried out in the form of policy programs – evaluation has been an embedded practice whose purpose has been to support decision making (Rip, 2003). Since the early days of evaluation, impact assessment has been a typical way to implement evaluation, which has meant that evaluation has been understood in terms of performance-related steering and monitoring (Chelimsky, 1997; Rip, 2003). The primary idea has been to produce indicator based information to prove accountability and to legitimate the role and existence of individual organizations and policy instruments.

This kind of an approach to evaluation includes several problems. First, it is backward looking and does not work well as a guiding instrument in the current society that is characterized by rapid changes (Todd and Wolpin, 2010; Weijermars and Wesemann, 2013). Second, the approach is "atomistic": it focuses on individual organizations or policies and overlooks the fact that impacts are co-produced by several actors and emerge in a broader context (Rip, 2003). Third, the indicator based assessment simplifies phenomena that emerge in cyclic, complex and long-term processes. Indicators assume a simple causal relationship between intervention and impacts, which is incompatible with the modern view about the emergence of innovations (Hansson, 2006; Van der Knaap, 2006; Cozzens and Melkers, 1997). Summarizing, the linear input-output-outcome -thinking included in the traditional evaluation does not correspond to the complex development processes and the multiple relationships between the contributing actors (Arnold, 2004; Patton, 2011).

As an answer to these problems, researchers have suggested a more versatile view: "plurality of methods" (Dyehouse et al., 2009; Williams and Imam, 2007). Systems thinking have often been applied hand in hand with this

view. It means highlighting interrelationships and feedbacks between the whole, its parts and the environment they are interacting with (Cabrera et al., 2008).

Recently, the increasing "servitization" of society has put pressure to develop a more advanced approach to evaluation. Here, an additional problem linked to the traditional impact assessment has become apparent: the indicators have been one-sidedly technologically focused (Toivonen, 2010; Rubalcaba et al., 2013). These kinds of indicators do not capture the immaterial and interactive aspects that are central characteristics of services. Today services are also increasingly forming systemic wholes – especially the most urgent problems in the present society cannot be solved via the development of individual services, but service systems. The issues of sustainability are an illustrative example of this development. The current evaluation methods are unable to tackle the challenge of the systemic nature of innovation and service creation (Smith, 2000; Edqvist, 2005; Ahrweiler, 2010).

This paper aims to contribute to the above described need for a more diverse evaluation approach. We focus on the context of service innovation, in which we develop further a multi-criteria and multi-actor perspective for evaluation. Our starting points are the multi-criteria framework developed by Djellal and Gallouj (2010), and the multi-actor framework developed by Windrum and Garcia-Goñi (2008). The former strives for better visibility of the multi-faceted dimensions of service innovation and highlights the importance of quality and social value. The impacts of innovation are analyzed using the concept of performance which is also interpreted broadly. The purpose is to diminish the "double innovation and performance gap" that derives from a narrow view on these concepts and has resulted in a difference between the reality and the ability of the traditional measures to perceive it (Djellal and Gallouj, 2010, 2013). The latter framework – the multi-actor analysis – is built on the characteristics-based view on service innovation (Gallouj and Weinstein, 1997). It focuses on understanding the dynamics and impacts of service innovation from the perspective of the different actor groups participating in the service development.

In the conceptual part of our paper we open the "innovation and performance gap" in the service context and review the opportunities for new kinds of evaluation approaches. Then we discuss and concretize the multi-criteria and multi-actor frameworks by applying them in services that are emerging to support the strivings for sustainability. More specifically, we analyze service innovations and their assessment in the context of sustainable energy production. The multi-criteria framework that we develop further utilizes the categorization of different "worlds of services" – equating to different sets of justificatory criteria (Gadrey, 2005; Djellal and Gallouj, 2012). Empirical data has been collected in Finland in the context of public-private development programs in the area of environmental sustainability. The following research questions are guiding our work:

- *How and by what means should the outcomes and impacts of environmental services be evaluated in order to take into account the complex and integrative nature that characterizes innovation in these services?*

- *What are the impacts of environmental service innovations from the perspectives of different societal fields and of different actors?*

The results of our study provide a two dimensional approach to assess the impacts of services by combining the multi-criteria and multi-actor frameworks. The focus is on understanding the dynamics of service creation in the environmental sector and the use of evaluation methods and indicators in that sector. At a more detailed level, our study provides analytical material about the complementarities and contradictions between different actors and indicators in service development. Because the links between services and environmental issues have been scarcely studied, our study also contributes to narrowing the gap between these two fields – a point whose importance has been emphasized recently (Rubalcaba et al., 2012; Djellal and Gallouj, 2010; Gadrey, 2010).

The paper is divided into six sections. The second section after this introduction is based on literature and discusses the challenges of measurement and evaluation, particularly in the context of services. The third section presents the two main frameworks that we apply in our study to evaluate the outputs and impacts of services: the multi-criteria and multi-agent frameworks. In the fourth section, our case-study context and methodology are described. The fifth section analyzes the results of the application of the frameworks in the assessment of environmental services. Concluding remarks ends up the paper.

MEASUREMENT CHALLENGE IN SERVICE INNOVATION AND PERFORMANCE

The importance of invisible innovation and performance

For two decades, service studies and specifically the studies on service innovation have argued that the traditional tools, indicators and measures do not capture the performance, innovativeness and impacts in services (Sundbo, 1998; Metcalfe & Miles 2000). A central background reason for the existence of the gap is the "assimilation" perspective adopted in the early service research (Coombs and Miles 2000; Gallouj, 1994). This perspective analyzed services innovation as an imitation of technological and manufacturing innovations, i.e. it did not recognize independent innovation possibilities in services. The perspective was based on the traditional definition of innovation as an invention which results from an R&D project (Howells, 2004). The linear, stage-gate model of an innovation process, which was raised to the position of a norm and marketed as a prerequisite for success (e.g. Cooper and de Brentani, 1991), increased the bias.

These arguments and perspectives have been developed in the context of service innovations. However, they are strongly rooted in general innovation theories basing on the Schumpeter's definition of innovation that has afterwards been regenerated to "the neo-Schumpeterian" theory of innovation or "the broad view of innovation" (Lundvall, 2007). These traditions are interlinked by several common aspects that affect both the definition of innovations and evaluation of their effects and impacts. Important cornerstones are complexity and uncertainty of innovation process, intangible nature of innovation (focus in new solutions and processes) and systemic view of innovation encompassing multiple sources and actors taking part into the innovation process. (Kline and Rosenberg, 1986; Dosi,1988; Lundvall, 1992; Freeman, 1991; Nelson and Rosenberg 1993). Also from the perspective of general innovation literature conclusion has been parallel: current practices in defining innovation and evaluating them do still follow the mainstream linear innovation thinking which simplifies too much the innovation process as well as the complex dynamics between actors contributing innovation (e.g. Arnold 2004, Patton 2011). Thus, it does not take into account the systemic view of innovation (e.g. Smith, 2000; Edqvist, 2005; Ahrweiler, 2010) and does not capture the multifaceted and diversified performance of innovations (e.g. dealing with societal issues such as health, education, sustainable development) (see e.g. Freeman & Soete, 2009).

A broader view on innovation has increasingly gained ground, but the assimilationist origin of the perspective on innovation and services is still influential. In particular, the measurement and indicators of innovation and performance are still largely based on the industrialist and technologist definitions (e.g. Smith, 2000; Edqvist, 2005; Smits and Kuhlmann, 2004; Djellal & Gallouj, 2010, 2013). In addition to the narrow view on innovation, the dominating view on performance is also mechanical and narrow. It is usually linked to the concept of productivity which refers to the linear and mechanistic input-output function (e.g. Djellal and Gallouj, 2010, 2013; Kellog foundation, 2004; Patton 2011). Its' traditional definition is unable to recognize the "hidden performance" concerning the societal aspects of services and innovations like equality, ecological sustainability and societal well-being. It also often excludes the aspect of social innovation. (e.g. Rubalcaba et al., 2012)

Djellal and Gallouj (2010) have described the interaction between performance and innovation by referring to the visible vs. invisible nature of these phenomena. Whereas technology-based innovations are visible, non-technological innovations are invisible. As regards performance, the authors link the visible-invisible dichotomy to short-term vs. long-term influences. Both in scientific and the managerial discussions, short-term influences of performance are often analyzed in terms of productivity and growth. Longer-term influences are increasingly analyzed in terms of environmental or social sustainability. There are four possibilities in the relationship between innovation and performance as Figure 1 illustrates (ibid., 668). The most apparent relation is between visible innovation and visible performance, but visible innovation may also lead to invisible performance by promoting the long term ecological sustainability or societal well-being. Correspondingly, invisible innovation may be a source of visible performance, i.e. growth and productivity, or promote sustainability.

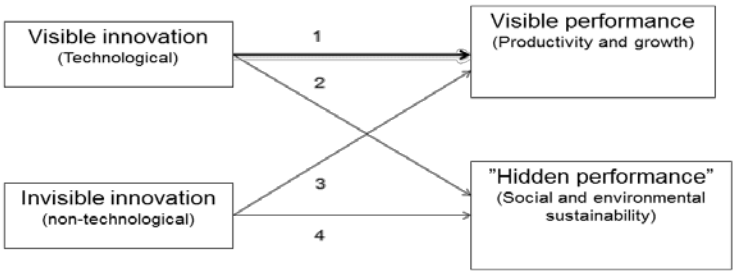

Figure 1. Innovation and performance gap in measurement of services (source Djellal and Gallouj 2010)

Opening the specific characteristics of service innovation and performance

After the realization of the narrowness of the assimilation view, two alternatives have gained ground. The first is the differentiation perspective – also known as the demarcation perspective (Coombs and Miles, 2000; Gallouj 1994, 1998). It focuses on the *specific characteristics* of service innovation and has highlighted the difficulty of recognizing "newness" and its creator in the service context (Preissl, 2000). The second alternative is an integrative or synthesis perspective (Cooms and Miles, 2000; Gallouj 2002) which has become increasingly relevant due to the blurring lines between goods and services. It highlights the production and consumption that focus on integrated solutions and systems.

Recently, these approaches have also been applied when searching better indicators for innovation and performance in services. The peculiar characteristics of services that specifically have been pointed out in this context are *intangibility and the central role of interaction*; the latter refers to the central role of co-production between the provider, customers and partners. An important implication of intangibility is the difficulty of defining the "unit of output" and differentiating the product from the process. These aspects challenge the definition of innovation and quality improvements in it (ibid.). Interactivity increases the complexity of the development of services innovations (Gallouj et al. 2013). Ignoring these complex and dynamic relationships (cf. Arnold 2004) is often linked to the traditional technologic measures and the linear innovation model (Smith, 2000; Edqvist, 2005; Ahrweiler, 2010). It may lead to the oversimplification of the reality and to the biased understanding – not only of the impacts of services and innovations – but also of their drivers and dynamics (Arnold, 2004).

New aspects in the analysis are inclusion of *the time factor* and *the social nature of services* (Djellal and Gallouj, 2013). Time highlights the dynamic nature of services, focusing to their evolution over time. Considering time as a dynamic factor leads to the differentiation of short-term outputs from medium and long-term effects. The social nature of services derives from the fact that the value and benefit of services is always defined by users. This means that different actors have different values, and *it is just this multiplicity of values which makes it necessary to include various criteria in evaluation*. In addition to immediate users, it is important to take into account the multiple values of indirect users as well as those of different actors participating in the development, (Djellal and Gallouj, 2010, 2013). Thus, in service innovation boundary lines are blurring – not only between products and processes – but also organizations often change simultaneously (Preissl, 2000). These kinds of combinatory innovations and their broader socio-economic impacts cannot be tackled on the basis of the traditional linear and industrialist models.

The double gap has been noticed to cause significant implications to public policies, which are still very technologist oriented and do not take into account the innovation and performance gap included. Thus, the invisible innovation and performance remain invisible in the policy making, causing problems – not only in the performance measurement as such – but also in target setting, and in steering and policy planning. In order to improve the situation, both the visible and invisible aspects in innovation and performance has to be included in an integrative way (Djellal and Gallouj, 2010).

However, the analysis above does not mean that all existing innovation and performance measures and indicators should be abandoned. Instead of that, the need for a more diversified, multi-criteria framework can be identified. The framework should also be flexible, and besides the traditional economic measures (such as productivity and

performance), focus on analyzing the aspects relating to social innovation and use value linked to the performance. This kind of an approach also prefers the concept "evaluation" over the concept of "measurement" (Djellal and Gallouj, 2010, 2013).

A NEW FRAMEWORK FOR EVALUATION

Multi-criteria approach to diversify the perspectives of evaluation

These above described challenges in measurement and evaluation of services intend to assess the performance and impacts on the basis of a multidimensional approach which takes into account the special characteristics of services as well as their aspects of quality and social value (Djellal and Gallouj, 2010, 2013; Rubalcaba et al., 2013). Like Djellal and Gallouj (2010, 2013) have argued one potential and diversified way of analyzing the various purposes and outcomes of services is to link to them to the idea of different "worlds", which are *the industrial and technological word, the market and financial world, the relational and domestic world, the civic world, the world of innovation and the word of reputation.* Referring to the initial description of worlds (deriving for the economic tradition; Boltanski and Thévenot, 1991; Gallouj, 2002) aim is in giving an insight to different justificatory aspects in the society considering their different principles and values.

In that model the outcomes are evaluated from the perspective of different goals or target areas, encompassing both the traditional measures arising from the industrial and technical as well as market and financial world and the modern evaluation criteria taking into account the needs of knowledge society (e.g. relational aspects such as trust and aspects relating to the responsibility and societal wellbeing). In addition to the different target areas the model focuses on the long time-scale in the generation of impacts by dividing outcomes into the direct, short-term outputs and indirect, long term-outcomes.

We have made some modifications to the original model. Our changes concern especially the aspect of "the civic world" that originally was focused to social relations characterized by the ethical issues such as equal treatment and fairness. In this analysis we suggest to integrate the concept of societal value and responsibility into the idea of civic world and also rename it *"responsible world"*. Our aim is to better take into the account the aspects of social innovations, environmental sustainability and societal well-being (see Rubalcaba et al., 2012, Djellal and Gallouj, 2013). In the original model also the word of innovation is differentiated. Because in study focuses is on innovations the perspective of innovation world is excluded as a vertical dimension. Instead we clarify the different elements of innovation horizontally by analyzing the core aspect of innovation in the light of each world.

In our study innovations are analyzed based on the following different worlds given the specific justification criteria related to the each of the worlds: *Industrial and technical world (Volumes, flows and technical operations); Market and financial world (Value and monetary and financial transactions); Relational world (Interpersonal and organizational relations, trust, quality of relationship); Responsible world (Values like sustainable development, responsibility, equal treatment and justice), Reputational world (Brand and image).* The different impact criteria described in the analysis are interlinked and dynamic in their nature, thus they me reinforcing and contradicting each other.

Multi-actor perspective to analyze the impacts of multiple actors involved in services creation

The interactive and subjective nature of services (and their implications to the evaluation) leads to emphasize the multi-actor nature of services. In the recent literature the multi-actor perspective has been proposed as an analytical framework to better understand the complex interaction between policy makers (society), public and private service providers as well as users of the services and to help to evaluate the benefits of the services from the different perspectives (Gallouj et al., 2013). By integrating the actors' perspective to the evaluation we aim to emphasize the subjective nature of evaluation; evaluation criteria are always dependent on actors' specific values and interests in a specific situation. In addition we aim to pay attention to the interaction of various actors and their values creating an evaluation situation (cf. Giddens, 1987).

Interaction may be operationalized based on the multi-agent framework that has been developed specifically to the context of public and private innovation networks to develop innovations and services (Windrum, 2013).The central idea in the framework is to study and understand the complex interactions between multiple actors in concerning

service innovations. Framework is based on the former work of (Windrum and Garcia-Goñi, 2008; Gallouj and Weinstein, 1997). When the primary work focuses to analyze services based on their characteristics in the later work the core is in actors. Particularly important are the characteristics and preferences of the actors. One of the values of this dimension is that it puts particular emphasis on the public sector's role in the innovation process. Typically innovation research has been focused on the private sector innovation without putting too much effort to understand the role of public sector in creation of innovations. However, according to Windrum (2013), both political organizations and non-governmental organizations play an important role in innovation generation and dissemination and needs to be considered. Compared to the former model the value added in the recent one is in the recognition of public sector actors and thus the interaction between economic, social and political spheres (ibid.).

In our study we are analyzing the impacts from the perspective of multiple different actors taking part to the service and innovation development. In the analysis the preferences and thus the benefits are emphasized from the viewpoint of society (represented by policy makers), public sector service providers, private sector service providers and end users.

CASE CONTEXT AND METHODOLOGY

In our empirical analysis the focus is in the complex combinatory services in the area of environmental analysis and measurement. Paper studies outputs and outcomes from the viewpoint of different worlds and different actors focusing to the *Environmental data platform* that aims to be a comprehensive platform to support continuous data gathering and real-time environmental monitoring, analysis and reporting. Innovation has been developed in research and development program built on public-private innovation network that aim to promote systemic change in the field of environment in Finland.

We have applied the case study methodology and qualitative approach in our study. The main method in data gathering in our study was face-to-face interviews (30 in total). The main topics focused on the manifestations of new innovative solutions within the programs, factors that promote or slow down their generalization, impacts of the innovations and their evaluation. The interviews were gathered between February and June 2013. The final sample represented actors in the area of environment in a versatile way. It consisted of representatives of private companies (e.g. companies developing environmental and industrial measurement), and universities and other public research organizations.

To analyze and interpret empirical data we applied the modified multi-criteria and multi-actor frameworks. To start we analyzed what are the impacts of innovation in a short and long term from the perspective of different worlds. In the analysis we reflect impacts both from the traditional and modern perspectives. From the industrialist viewpoint typical evaluation criteria are for example technical operations and volumes. Similarly market world uses criteria like value (in financial terms), market share and business transaction. Relational and responsible worlds aim to broaden the focus to take into account the societal value as well as intangible, interactive, social and systemic nature of services. Moreover, world of reputation analyzes innovation from the perspective of brand and image effect. Finally we illustrate in very general level how the impacts vary from the perspective of different actors participating into the innovation creation. In the analysis the role of policymakers, public service providers, private service providers and end-users are taken into account.

RESEARCH RESULTS

Multi-criteria perspective for the analysis of new sustainable services

Environmental data platform (table 1) is from an industrial perspective a prototype platform to gather and share environmental data. As a short term output it integrates real-time data sources (e.g. measured data of water quality and satellite data concerning environment and atmosphere) and provides visualized maps based on the data. In a long-term goal is to integrate multiple data sources in it and provide "cloud-based comprehensive solution" to

Table 1. A multi-criteria framework to analyse the impacts of environmental data platform

	Industrial and technological	**Market and financial**	**Relational**	**Responsible**	**Reputation**
Innovation/Input	A prototype platform for environmental data gathering and sharing (integrating real-time data sources & data storage)	Free access to public sector data	Connectivity via one mediator to multiple data sources and end-users	Open and equal access to public sector data	Image as an innovation to enhance sustainability
Output (direct, short term)	Varied measured and satellite data concerning environment and atmosphere (e.g Weather radar visualised on the map)	Economical of free access to multiple environmental data sources	New connections and actor networks created (via new solution)	Transparency of public data; Easy access	Short term image
Performance related to output	Ability to process increasing amount of environmental data more quickly and more effectively	Reduced cost of sharing data Reduced cost of providing data	Increased connectivity between multiple actors	Increased transparency of public data Increased availability and better use of public data	Improvement/change in reputation and image
Outcome (indirect, longterm)	"Cloud-based comprehensive solution" for producing and sharing environmental data Architecture for real time environmental monitoring, analysing and reporting, bid data New end-user applications created New start-ups crated; new jobs	New market opening based on environmental monitoring New opening export possibilities	Integrating citizens and citizens' requirements to the data provision "Users as a data providers" (*Social innovation*) Personalised environmental data Trust	Equality in sharing information (data) Quality controlled data Platforms applied e.g. in education: environmental education and awareness	Long-term reputation and image
Performance related to outcome	Improvements in weather forecasts, environmental information and warnings Increased quality and reliability of environmental data Increasing number of business start-ups based on environmental data; Increasing number of new jobs	Improvements in the generation of various types of revenues based on environmental data	Increased usability of environmental data /knowledge Increased trust	Increased awareness of environmental issues Increased responsibility in decision making (individual, firm and policy level)	Long-term improvement/change of reputation and image

produce and share environmental data. Cloud-based solution would make the access to big data possible. In addition the architecture for real-time monitoring, analyzing and reporting will be created to improve the quality and reliability of environmental information, weather forecasts and warnings. New architecture helps in developing new end-user applications and thus accelerates business start-ups generation. Our respondents highlighted that services are in the central role in the development of comprehensive solution and new information architecture.

In the market world the main characteristic of the innovation is free access to the multiple data sources and especially to public sectors data. According to our interviewees free access to data is considered to be an important social goal and as a starting point for the development of data platform. In a long term goal is in opening new markets based on environmental analysis and in creation of new export possibilities.

Preferences and valuation principles in the relational world highlight the interaction between multiple actors and a role of end users is the development and use of service. Central innovative aspect here is the connectivity via one mediator to multiple data sources. As output goal trust in the public-private innovation networks is enhanced. From the performance viewpoint, that enhances actors' connectivity and consolidates the networks. Long-term goal is to integrate citizens to the data provision, to better take into account the specific users' needs and requirements and hence provide personalized environmental data. In a long term users will be integrated part of the environmental data generation. That development removes the clear distinction between the production and use of data (citizens are becoming data producers), which has been considered as a prerequisite for a systemic change in the sector.

From the perspective of responsible world overall sustainability is highlighted as a central value in development of new solution. The other value based aspects highlighted are transparency and the citizens' equal rights to participate to the data provision. Innovative aspect relates to the open and equal access to public sector data. As a short term goal platform enhances transparency, availability and multifaceted us of public data. As a long-term goal respondents have considered the possibilities to apply new end-user applications for example to the game and school worlds to support the environmental education and thus increase the awareness of environmental issues from the early age. From the performance viewpoint that may increase responsibility as a value in decision making in individual, firm and policy level.

Finally in the world of reputation innovation is analyzed from the perspective of brand and image effect. From a short and long term the aim is in analyzing how the innovation impact to the attractiveness of different actors. The aspects concerning the image and brand needs to be analyzed from the perspective of specific actors and are thus analyzed in details in the following sub-chapter.

To summarize the central findings from the perspective of different type of evaluation criteria following aspects have been recognized. According to our interviews services have important role in renewing the environment sector. To solve the most urgent societal problems, like sustainability, there is need to develop technologies and services as systemic wholes instead of individual technologies or services. The emergence of comprehensive service solutions in renewing the environment and energy technologies can be perceived by traditional measures. However, the focus from the perspective of industrial and financial world is in technical characteristics of the concepts and solutions, not so much in their social and systemic nature.

To capture the interactive and social nature of service development as well as its' interlinks to the social goals and system level changes the other criteria are needed. Like our example show, relational and responsible worlds are particularly important to make these aspects visible. Like our respondents highlighted the changing roles of data users and producers ("from user to producer") plays a central role in the renewal and a system level change in a sector. That can be perceived only from the perspective of relational world. In addition our example shows that impacts generated in the different worlds are often interdependent and complementary to each other. Some factors in relational and responsible worlds can be seen as a prerequisite to effects generated from the viewpoint of technical and financial worlds. For example for the development of environmental data platform the transparency and open access to public sector data is seen as a precondition.

Multi-actor perspective in the analysis of new sustainable services

In the following discussion and table (2) we exemplify the impacts from the perspective of multiple actors. Central actors taking part into the service innovation development are society (policy makers setting the societal goals and

Table 2. A multi-actor framework to analyse the impacts from the perspective of different actors

	Industrial and technical	**Market and financial**	**Relational**	**Responsible**	**Reputation**
Private service provider	Knowledge transfer: Better use of academic knowledge as a business opportunity Use of multiple data sources to create new business Variety of commercial applications	New revenues Access to international markets Export incomes	Mutual trust and co-creation between multiple partners Opportunity for new roles and responsibilities (intermediator)	Sustainable business Awareness: corporate social responsibility in firm level decision making Predictive information of environmental changes (managing risks)	Image as a successful and international start-up company Socially responsible company (as a competitive advantage); corporate social responsibility
Public service provider	Access to the big data Knowledge transfer between multiple partners New profound and multifaceted knowledge of environment and atmosphere New public services	New (research)markets based on multifaceted environmental data	Mutual trust and co-creation between multiple partners Opportunity for new roles and responsibilities (enabler, intermediator)	Predictive information of environmental changes Respond to the social needs Safety, security and health benefits	Internationally high level environmental knowledge (publications) Responsible public organisation
End user	Access of to the multiple data sources and big data Receive and provide real-time environmental data (e.g. via smart phone) Better (measures) health Job opportunities	Free access to public data Expenditures (applications, new devices)	Change in role: users as data providers Influence; ability to participate Personalised environmental information based on your location)	Usability of environmental information Awareness and sensitivity to ecological issues Empowered citizen Better health (experienced)	Role as an active and empowered citizen Influential citizen
Society (Policy makers)	New environmental knowledge New start-ups created New jobs created; employment rate Growth of services, “servitization” , service society New business ecosystems created	Tax revenues (new companies, new taxpayers) Investments; public expenditures (e.g. renewed educational infra) Export share of GDP Market share of services (%) Economical growth and productivity	Trust in innovative networks consolidates the innovation networks	Creation of innovative, creative and entrepreneurial culture Environmental education Transparency in society Social impacts e.g. health, living conditions Quality of societal services	Responsibility in decision making Innovation system: enabler for creativity, services and innovations Democratic society

preferences for the development), public service providers, private service providers and end-users. By integrating the actors' perspective to the evaluation we aim to emphasize the subjective nature of evaluation; evaluation criteria are always dependent on actors' specific values and preferences in a specific situation. In the analysis we zoom environmental data platform from the perspective of *longer term outcome* to exemplify the diversity of the impacts based on the values and preferences of different actors.

Based on the preferences and values of the *private service providers* it is natural the benefits of the innovation relates to the knowledge transfer, the development of new commercial applications and thus in the creation of new business opportunities. From the financial perspective, that brings new revenues and opens up the access to the international markets. New evaluation criteria enrich the analysis by highlighting the importance of mutual trust between multiple partners, which has been highlighted as a core aspect in development of new innovations and services. In addition it relational world makes visible the opportunity for the new and changing roles and responsibilities when developing and offering new services. Moreover sustainability as a value and as a competitive advantage is has also been highlighted from the perspective of private service providers: a reputation as a responsible company is a competitive advantage for the contemporary companies which may boost their success in international market.

A long term outcome for the *public service providers* relates primarily to the access and new opening opportunities based on big data. That creates opportunity for the profound and multifaceted knowledge production which enhances more quality environmental data production and based on that creation of new public services. From the perspective of public sector service providers the opening the new markets and research opportunities were highlighted. And like the private sector companies they also found that knowing new actors and creating the mutual trust between the multiple partners for deepening the collaboration are in the part of the main benefits from the process. In the other words, trust can be characterized as an enabling factor in the co-creation of innovation. From the responsibility viewpoint provision of predictive information of weather and environmental changes helps to manage potential environmental risks. Because of the specific role of public sector service providers this perspective is highlighted here. Capacity to provide environmental (e.g. safety environment) and societal impact (e.g. citizens health and good living conditions) belongs to the roles and functions of public service providers.

From the viewpoint of *end-users* receiving personalized real-time environmental data is the most self-evident benefit of the innovation. The data personalized to your own needs and received via you own mobile phone based on your location may – for example real-time pollen reports for the allergic and asthmatic person – helps people to predict the pollen risks and thus have important health impacts. In a longer term the citizens' ability to provide data and act as an active and equal data provider and empowered citizen was examined as an important impact. From the relational viewpoint the change in end-users role was recognized as an important impact from individual but also societal point of view: their active and equal role as an environmental data provider creates preconditions for the new innovative and service oriented culture as well as demonstrates the potential for the systemic change in the sector.

Society is serving the multiple actors thus the impacts described here is combination of everything we have represented above. In enabling the creation of new business ecosystems society's preference is to enhance the emergence of start-ups, help them to internationalize (export share of GDP) and to create the jobs. From the financial viewpoint that brings new revenues for the society and helps in developing societal services (which in turn causes impact in health and living conditions). In addition society has a role to promote and consider more soft and social aspects in the society. For example create new 'programs' (meaning devices and educational programs) for the environmental education and thus raising the awareness and responsibility of citizens are the most important impacts from the viewpoint of responsible world. In addition transparency of the society relating to the openness of public data is a self-evident goal for the society.

To summarize, like our analysis show experience of impacts and benefits are strongly related to the preferences and values of actors. Both their goal and motivation to take part into co-creation is different and thus are the experienced impacts. From that perspective it is evident that there are contradictions regarding the benefits of different actors. However, different goals and preferences are in the most cases seen as complementaries which enhances the co-creation. When considering the impacts crosswise from the perspective of multiple actors and different worlds we create more diversified and analytical picture of the generated or potential impacts. In addition analysis makes

visible that in many cases the impacts are strongly interlinked and are systemic in nature.

CONCLUDING REMARKS

The purpose of this paper is to study the challenge of the evaluation in the context of the services. Because of their specific nature the traditional evaluation methods and measures are not able to capture neither the diversity of the innovations nor the multifaceted dimensions of performance in the sector. This paper aims to contribute to the need for a more diverse evaluation approach. We focus on the context of service innovation in the sector on environment and energy, in which we develop further multi-criteria and multi-actor perspectives. Multi-criteria framework describes the impacts of new sustainable services and multi-actor framework aims in analyzing the impacts from the perspective of multiple actors taking part into the service and innovation development.

As a result we identified that services have an important role in renewing the energy and environment sector. The emergence of comprehensive service solutions in renewing the environmental sector can be perceived partially the by traditional measures. However the focus from that angle is in technical and measurable characteristics of the concepts and solutions. From the traditional perspective their interactive nature and multifaceted performance (including the social and value based aspects) cannot be captured. To perceive and make visible the societal goals of the service innovations as well as their interactive nature relational and responsible worlds are particularly important. Moreover, our analysis also shows that impacts generated in the different worlds are often interdependent and complementary to each other. Some factors in relational and responsible worlds can be seen as a prerequisite to effects generated from the viewpoint of technical and financial worlds. In other words relational and responsible aspects are needed to generate long-term technological and economic impacts.

From the multi-actors perspective impacts and benefits are strongly related to the preferences and values of actors. Analysis make visible that there are evident (value and motivation based) contradictions between different actors. However, when there is a mutual trust these are seen as complementaries which enhances the co-creation. When considering the impacts crosswise from the perspective of multiple actors and different worlds we create more diversified and analytical picture of the generated or potential impacts. In addition analysis makes visible that in many cases the impacts are strongly interlinked and are systemic in nature.

Regarding to the further studies more studies would be useful to test the generalizability of our results. Furthermore to go deeper to the dynamic relations (systemic nature) of the different actors and impacts the application of systemic modelling methods could be the next step. In addition generating indicators based on these findings would be both interesting and useful.

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Revealing the Complexities of Health Care Renewal: a System Dynamics Approach

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ABSTRACT

Health care systems are under significant development pressure due to the ageing of population and the problems of public financing. As an answer, a new model of chronic care, and integrated care programs based on it, has been applied in several countries. These renewals have a systemic focus: they aim at simultaneously developing organizations, technologies, services, and partner relationships. Empowerment of citizens and multidisciplinary collaboration among professionals play central roles in them. This paper examines the challenge of combining the system view with the multiple operational improvements that are needed at the practical level when the chronic care model is implemented. Using an empirical case from Finland and the method of system dynamics modeling, we show that established routines are not easy to break down even though the organization is committed to change, set clear goals and concretized their content. Paying attention to the complex causal relations and feedback s typical of human systems is necessary in order to make the multiple changes to strengthen each other. Recognizing the most crucial points that foster either "a vicious or a virtuous circle" in care processes, and analyzing them in terms of influential factors, supports the raising of awareness and facilitates changes.

Keywords: Healthcare Service, System of Primary Care, Chronic Care Model, Integrated Care, Patient Empowerment, System Dynamics Approach

INTRODUCTION

The health care sector in Western countries is facing significant challenges. Along with the ageing of population, there is a growing demand for health services while the public resources to maintain and develop these services are diminishing (Dunston et al., 2009). On the other hand, the development of technologies provides new opportunities, not only for the solution of medical issues, but also for the introduction of new collaboration practices that increase the efficiency and effectiveness in healthcare, i.e. reduce the costs and improve the results. These practices include both the professional – patient interaction and the inter-organizational and cross-functional interaction among service providers.

In addition to the changes in population structure and the advancements of technology, two other factors drive the development in healthcare. One is the discourse on the role of professions and the other is the paradigm which forms the framework for the public service provision. These two factors are interrelated in the current strivings for the renewal of healthcare. The paradigm behind public services is important because in most countries the state and local authorities are more or less the organizers and funders of healthcare. The role of professions has traditionally been very strong in healthcare: interaction has been based on knowledge asymmetry highlighting the position of doctors (and to some extent nurses) over patients (Alvesson, 2004; Löwendahl et al., 2001). Also the renewal of healthcare was for long understood as the adoption of new medical tools and drugs (Djellal and Gallouj, 2008). These views, together with the paradigm that understood public sector in terms of top-down policy activities, were dominant until the so-called 'New Public Management (NPM)' gained influence in the 1980s (Hartley, 2005; Hess

and Adams, 2007; Windrum, 2008). NPM has introduced market mechanisms to the public context: business-type management, lean processes, performance focus, and contracting-out. One of the most important ideas has been handling the patients as customers who have the right to require high service quality (Langergaard, 2011).

The benefits of NPM are indisputable compared to the earlier bureaucratic view that provided users with very restricted opportunities of influencing. On the other hand, the limits of NPM have become apparent along with the development towards increasingly complex issues, multiple actors and need for open dialogue (Sørensen, 2002). Consequently, while NPM is still the dominant public paradigm, there is a new paradigm emerging: so-called *'network governance'*. It highlights relationships and partnerships, and co-production as the service model (Newman and Clarke, 2009). For the professional practice in public services, it means additional challenges because efficient in-house processes are no more sufficient but the crucial issue is the empowerment of citizens.

Within the health care sector, the current renewal of chronic care reflects a transition from NPM to network governance. So-called *integrated care programs* have brought to the fore patient support and education, combined with structured clinical follow-up and case management; a multidisciplinary patient care team; multidisciplinary clinical pathways and feedback, reminders, and education for professionals (Ouwens et al., 2005).These programs, carried out in various countries, are based on *the chronic care model (CCM)* developed to improve the management of chronic illnesses through six cornerstones: utilizing community resources, developing health organizations, investing in self-management support, redesigning service delivery, employing decision support for professionals and utilizing clinical information systems. Segmenting the chronic patients according to the intensity of care needs is a part of the model. A three-group division – so-called Kaiser Permanente Triangle – is typical and consists of patients with multiple diseases, patients with high risks, and patients with a self-manageable disease (Bodenheimer et al., 2002).

CCM, together with the integrated care programs based on it, differs in several respects from the models of acute care and the expert -led health systems that have been dominant earlier: they are patient-centered (not sickness-centered), their focus is on planned, proactive care (not only on the acute, reactive care) and they provide support to the patient (not only diagnostic information). Patients are empowered by treating them as experts of their own health and as partners in healthcare, and this is eventually expected to ease economic constrains in the health care sector (Coulter, 1999). An important insight in the circumstances of ageing population is that the quality of life can be high even when a person has a chronic disease. Health does not only mean the absence of disease, but it includes capability to cope and function with everyday physical, emotional and social challenges (Huber et al., 2011).

Based on the above-described views, several studies have examined how the health systems could be rebalanced from addressing the treatment of acute illness to promoting health, and how the citizens themselves could be engaged in the latter task. Traditionally, studies on health services have focused on hospitals and specialized care, but the new integrated care programs have stimulated interest in the *systems of primary care* (Dunston et al., 2009). There is also active research focusing on the micro-level interactions in healthcare: service encounters and prerequisites for success in them. However, these two approaches have usually developed apart from each other. Systemic renewals are analyzed at quite a general level and their practical implementation as a series of individual improvements without a link to the whole. Thus, we have recognized *a need for research that would integrate the system level and practice level analyses in the healthcare renewal – more specifically, in the adoption of CCM and the new integrated programs*. We aim to contribute to the fulfillment of this need in the present paper.

From the theoretical standpoint, our approach requires a combination of innovation theories, system views and a framework on service development. We apply the central arguments and findings of *social innovation* which is closely linked to the idea of *system innovation*. For a more detailed understanding of the activities and relationships in healthcare, we apply the propositions of *service-dominant logic (SDL)*. This framework is particularly suitable to our purposes because it highlights the role of customer as the co-creator of value and takes into account the broader actor network surrounding the provider-customer dyad (Vargo and Lusch, 2011). In the empirical part of the paper, we examine the application of the chronic care model in a middle-sized city in Finland. The context of transformation is the whole primary care system in this city. The methodology with which we examine the implementation of the transformation is *system dynamics modelling*.

We have structured our paper as follows. In the second section, we discuss the theoretical frameworks that form the starting point in our study: social and system innovations, and service-dominant logic (SDL). The third section presents our empirical research context and the methods of data collection; here we also describe the dynamic modelling technique. The fourth section summarizes the results and the final section includes concluding discussion.

THEORETICAL BACKGROUND

System innovations as answers to broad social problems

In the introduction, we argued that the new chronic care model and the integrated care programs reflect a broader paradigmatic change: transition towards Network Governance. This new paradigm highlights the growing role of self-organizing networks that involve different stakeholders from private, public and voluntary sectors. Partnerships and networks – which can also involve individual citizens – are increasingly the locus for innovation, because they provide evolutionary advantages for learning in a complex and changing environment (Hartley, 2005; Langergaard, 2011). These arguments are very near to the ideas of the nature of social innovation, which is a new topic gaining ground in service innovation literature.

In this context, the concept 'social' includes two aspects. First, *complex economic and social problems* form the starting point for innovation endeavors (Rubalcaba et al., 2013). Social innovations are sought for a wide range of issues in different realms of society: community infrastructures, housing, healthcare, education etc. (Moulaert et al. 2005). The outcomes usually include service innovations, but the sources, goals, actors and activities extend outside the provider-customer dyad. New ways of interacting are an important ingredient in the novelties created (Harrison et al., 2010). The second aspect of 'social' is *the participatory processes* which are necessary for the creation of innovations in a multi-agent environment. Social innovations may emerge at the grassroots level among users and employees; be produced by private, public and third sector organizations; or be initiated by policy and regulatory bodies. In all cases, it is essential to *integrate bottom-up and top-down processes* (Rubalcaba et al., 2013).

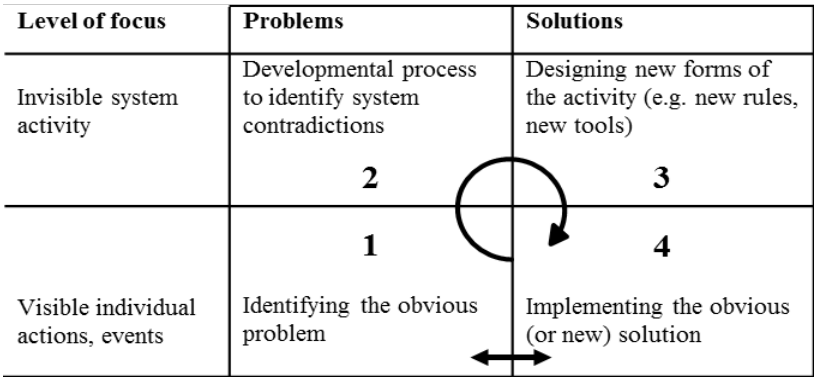
Bottom-up grassroots activities constitute an 'engine of social innovations' and are linked to user-driven and employee-driven approaches in innovation (cf. Sundbo and Toivonen, 2011). The creation and implementation of social innovations highlights *empowerment*: citizens are not passive recipients, but active co-developers (Harrison et al., 2010). On the other hand, also top-down activities are necessary for the materialization and dissemination of social innovations. They are needed both at the organizational and community levels and at the level of policies and regulations. Decision makers and managers have to support and organize bottom-up processes in order to make ideas implementable and scalable (Høyrup, 2010).

Social innovations are often systemic in nature. *A system innovation is based on the simultaneous development of organizations, technologies, services, and multiple network and partner relationships.* Systemic problems cannot be identified directly because systems involve several characteristics that make them counter-intuitive. The following features are important to take into account in particular (Sterman, 2001):

- Systems are tightly coupled, i.e. the actors interact with another and with the outside world. Feedback is a central characteristic of systems: decisions of the actors trigger others to act, which again alters the next decisions of the original actors.
- The central position of feedback makes systems history-dependent: taking one path precludes many others.
- Systems are non-linear, i.e. effect is not proportional to cause. It is also difficult to identify immediate cause-effect relationships – instead of that cause and effect are often distant in space and time.
- Systems are constantly changing at many scales that interact. They are also self-organizing and adapting: small, random perturbations are often amplified by feedback, and capabilities of actors change as a result of learning.
- Systems are policy-resistant: the complexity makes it difficult to understand the system and as a result many seemingly obvious solutions to problems fail. Time delays in feedback often mean that long-run response of the system is different from the short-run.

Even though systemic problems cannot be observed directly, they manifest themselves in various practical problems that can be analyzed in order to understand the underlying dynamic complexities. Figure 1 illustrates how the interaction between practical and conceptual levels can be used in the search for solutions to systemic problems. The first task is to identify obvious problems (quadrant 1), and then to move to the conceptual level in order to uncover the invisible systemic contradictions that give rise to the problems (quadrant 2). Thereafter new forms of activities can be designed at the conceptual level (quadrant 3), and finally they can be tested and implemented in the form of new concrete actions (quadrant 4).

Figure 1: Solving systemic problems via the interaction between practical and conceptual levels (source: Hill et al., 2007; adapted from Seppänen, 2000; Botha et al., 2002)



This kind of a renewal process requires – in addition to awareness raising – efficient analysis tools with which the complex issues can be illustrated holistically enough (Kivisaari et al., 2013). Before presenting the methodology of system dynamics modelling, which we believe to be a suitable tool in this context, we briefly explain why we consider it important to supplement the systemic view with the basic principles of service-dominant logic (SDL).

Service-dominant logic as an approach to highlight the co-creation of value

The need for moving from observable problems to the conceptual, systemic contradictions is increasingly accepted today. The way in which the transfer is carried out in practice depends, however, on the basic assumptions concerning the nature of the system. In the healthcare context, this means that we have to make explicit our theoretical understanding about the nature of service relationships and service processes. In this paper, we argue that a service system applying the principles of network governance and integrated care can be most successfully developed on the basis of service-dominant logic (SDL). This approach developed by Vargo and Lusch (2004, 2011) defines 'service' as the process of using one's competences (knowledge and skills) for the benefit of another party. Individual services, as well goods, are conveyors of competences, i.e. vehicles for service provision. They represent temporal cross-sections in more complex and timeless value-creation that is a core phenomenon in society.

SDL highlights that *value is collaboratively co-created* between the provider and the beneficiary (user). It is not inherent in goods and individual services – not created by the provider and distributed to users. The active role of users comes clearly out when the necessity of *resource integration* is brought to the fore. Before value can be realized, the input from a single provider has to be integrated with other resources, some of which are obtained through the market and others based on private or public sources. The importance of this integration extends the conceptualization of value creation from the focal actors – the provider and the user – to the broader context of actor network (Vargo, 2009).

SDL includes several implications for the development of healthcare systems. The reciprocal nature of the interaction between providers and users implies that *patients are not targets* but function as active agents and a resource in service provision. A central task of the provider is to support the users in their own value-creation process (resource integration). This process does not take place in isolation, but the social context plays an important role in the determination of service value. The phenomenological side of value is essential: actors make sense and determine the value experientially and the experience is holistic in nature: the service and its tangible elements together create the overall experience.

Co-creation of value is linked to *co-production* that has been a common observation among service researchers and refers to the customer's participation in the production process of a service through the conduct of some specific tasks (e.g. Sundbo and Gallouj, 2000). Co-production is also an important phenomenon, but is more optional and depends on the conditions of the provider and the customer. Deviating from that, value co-creation is ubiquitous: the user is always involved through resource integration and contextual experience. It is important to point out that the value focus does not mean the neglect of the design of individual services (Ramaswamy, 2011) – as mentioned before, even the broad social and system innovations usually manifest themselves as new or improved services.

CONTEXT, SCOPE AND METHODOLOGY OF THE STUDY

Context and scope of the study

The empirical study analyzed in this paper has been carried out in Finland, where the biggest provider of health services is the public sector (the private sector accounts for roughly 10% of these services). Primary services are provided by health care centers owned by municipalities and specialized services by regional hospital districts owned by municipality associations. The public system is guided by laws. (Kivisaari et al., 2013)

Our study focuses on the renewal of primary health care system in a middle-sized city of approximately 67 000 inhabitants. The renewal has been going on since 2010 and is linked to a broader national exercise for social welfare and health care. However, the city's health organization has been exceptionally active in learning about the newest developments of the CCM model and integrated care programs and in testing them in practice. Table 1 summarizes the way in which the central elements of CCM have been applied and concretized in this city.

Table 1: The application of CCM in our case (CCM based on Bodenheimer et al., 2002 and Ouwens et al., 2005)

Central elements of CCM	**Contents of the element in CCM and in the integrated care programs**	**Application of the element in the case city**
Renewal of health care organization	Ensuring that the health organization is committed to take care of patients with lifestyle and chronic illnesses and structured its activities accordingly.	Renewal of the entire operational model: setting the management of chronic illnesses as the main goal. Creating *new service-oriented positions*: service managers, service superiors and service coordinators.
Identification of patient subgroups	Making a division between patients with multiple illnesses, patients with high risks and patients with self-manageable long-term illnesses.	Extraction of patients with chronic illnesses and multiple diseases from patients requiring acute care. Creation of *care "channels"* for these two sub-groups and plans for a more versatile segmentation in the future.
Self-management support and patient education	Helping patients to acquire skills to manage their own illnesses.	Investment in services supporting self-management: *group services* arranged for educating patients about their illnesses and about the prevention of further problems.
Follow-ups	Monitoring the patient on a regular base, e.g. by utilizing phone calls.	Empowerment of patients with *target-oriented phone calls* by nurses to see how the care is proceeding. Focusing on *a coaching approach* to support patients in achieving goals.
Case management	Allocating care to a small team who takes responsibility for the guidance of the patient in the care processes.	Assignment of *a responsible professional/professional group* with whom the patient interacts directly regarding the issues concerning the treatment.
Multi-disciplinary care team	A care team composed of different professions who collaborate in the care of defined patient or patient group.	Diminishing professional hierarchy; establishing *multi-disciplinary teams* to collaborate with patients; supporting *holistic care* - not focusing on one disease at a time.
Multi-disciplinary clinical pathway	Structured multi-disciplinary care plans for professionals with detailed steps in the care of patients.	Creating a systematic *health plan* in mutual collaboration between the professional and the patient *according to goals set by the patient*.
Professional education	Education provided to professionals about the appropriate care for patients	Arrangement of *workshops for the professionals* about the re-organizing of care and new operation models around specific topics. Encouraging dialogue between professionals.
Supportive information systems	Registry's for patient information and treatment plans.	Utilizing *eHealth for the communication between patients and professionals*: allowing patients to see their test results, treatments and health plans, and to transfer the measurements that they make themselves (e.g. blood pressure).
Community resources	Creating linkages with community-based resources to support care.	*Collaboration with patient organizations*; providing information, advocacy, peer support, training, rehabilitation and social events for patients.

The table shows that our case city is applying the idea of interaction between practical and system levels in their renewal exercise (cf. Figure 1). After the identification of the visible problems of the long queues, multiple patient visits, dispersed information and high costs, they have moved to analyze the systemic contradictions included. In line with the background problems identified in CCM, they have found out that also their own operational model has been characterized by the reactive way of working, sickness-centered view and the lack of cross-professional interaction. Based on this observation, they have started to develop a new conceptual model that relies on integrated care programs applied in other countries. Three goals for the transformation have been set: 1) improving the availability of services to citizens, 2) providing better health impact, and 3) improving productivity by reducing resources used per patient. These goals guide the change of the operational model: the organization, the delivery of services, the management model, ICT systems and partner relationships. In the implementation, central focus is on the empowerment of citizens and on the replacement of hierarchical processes with user-based service practices. As the table shows, our case organization has been able to concretize their goals in a way, which not only reflects the basic ideas of CCM, but also includes new creative applications.

Data collection and analysis – system dynamics modelling

Our empirical material has been gathered via three methods: observation, action research and interviews. The observations and action research took place in the meetings of two management teams responsible for the renewal. Three researchers working in pairs observed these meetings weekly between February and June 2013. The meetings lasted for three hours. During the first two months, observation was conducted without any participatory actions to get an overall view of the on-going process. Thereafter an action research approach was adopted: the researchers participated in the teams' conversations and asked specifying questions related to the systemic change and to the search for solutions (cf. Berg, 2004). The material was further supported by thematic face-to-face interviews with the team members; these interviews (16 in total) were conducted in June and July 2013. The interviews were recorded and transcribed, whereas the observations were collected in hand-written field notes.

In the analysis of data, we first used traditional qualitative methodologies to sum up our central findings. Thereafter we moved to system dynamics modeling, and it is this part of our analysis which we report in the present paper. System dynamics models are formal and structural models, which incorporate hypotheses about causal connections between phenomena. The behavior of a particular system is explained endogenously as a manifestation of the structure of the system. The emphasis is on understanding the dynamics of the system (behavior over time) that results from interactions between the parts of the system – including reinforcing and balancing feedback loops. In November 2013, we presented the modeling method to the representatives of our case city and discussed about a suitable focus for its application. Instead of trying to model the entire renewal process, we decided to start from more specific questions. A crucial question identified together with our case representatives was how the work practices in the system influence patient flows, i.e. how the long queues can be shortened and the availability of services improved in practice. Thus, we set two research questions for the modeling:

1) What kinds of systemic problems do the reactive and expert-centered work practices cause in a primary health care system regarding the aim to foster efficient and effective patient flows?
2) What factors promote and prevent the adoption of interactive and empowering work practices in critical points of the service system?

In December we organized a modelling workshop with the case organization (about 20 participants). Because of the tight schedule in the workshop, we used as the starting point a preliminary stock and flow model that was prepared in advance with a smaller group (three people) of the organization. The results of the modeling workshop were summarized in a model workbook (Vennix, 1996). Three further workshops within a smaller group were held in January and February 2014, which focused on specific questions identified in the modeling workshop.

RESEARCH RESULTS

Our case organization has recognized that moving away from the traditional expert-led health system and creating a system that supports the empowerment of patients is a necessity. It has adopted the principles of CCM and integrated care and concretized them at the practical level. However, the advancement has not been straightforward. *The most central problem is the slow generalization of planned care that also includes new types of solutions.*

Guiding the patients to visit a doctor still dominate. The patients usually ask for an appointment and because there is constant hurry, the personnel very often react as before: fix a visit date without considering whether this is the service that answers the need of the patient in the best possible way. This means that waiting times in the queue before the appointment continue to be quite long. Further, because the number of appointments does not diminish, the time devoted to an individual patient in the face-to-face contact is too short to allow planned care that could take into account the patient's situation holistically enough. As a result, the problems of patients recur and many patients even contact the system again during the waiting time, i.e. *the same basic group of patients circulates in the system*.

Our case organization is well aware of these problems and has implemented several concrete practices aiming to cut down "the vicious circle". The first contact to the health center usually takes place via phone call and in order to manage the high number of calls and reduce the patient's waiting time on the phone, *a call center and the "call-back" system* have been adopted. However, these centralized systems do not mean routinizing the contacts with patients, but the purpose is to *assess the patient's care needs systematically* (this assessment is also carried out when a patient comes to the reception). If the assessment is successful, a considerable part of patients should find their way to lighter service forms: self-management supported with eHealth and target-oriented phone calls from professionals, and/or group services. Adopting this approach has begun, but it is not yet an established way of working. Also the systematic use of health plans on the basis of goals set by the patient is at an early stage.

Figure 2 illustrates the above described problems with a system dynamics model. The model depicts the flow of patients and shows different feedback loops in the system: the longer the appointment queues are, the more pressure there is to shorten the average length of appointments (balancing feedback B1). However, shortening the appointment time affects negatively the quality of care, and patients may develop new symptoms faster after the appointment (reinforcing feedback R2). Shortening appointment lengths also affects negatively the degree of planning of follow-up care. Due to this, too few patients are guided to lighter services after the appointments and more are given a traditional appointment time (reinforcing feedback R2).

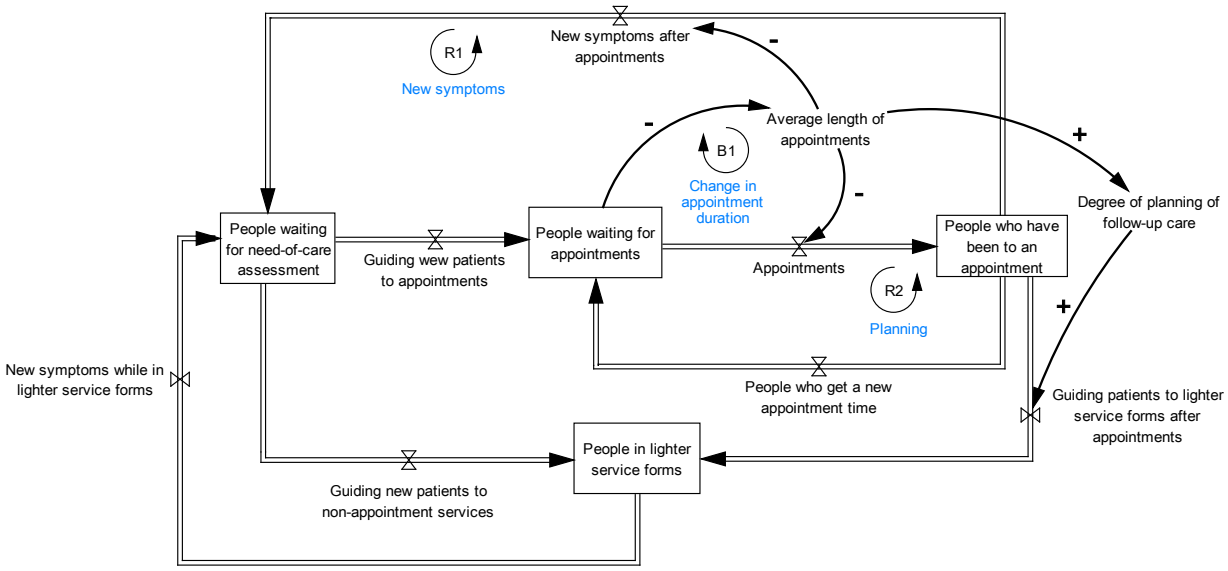
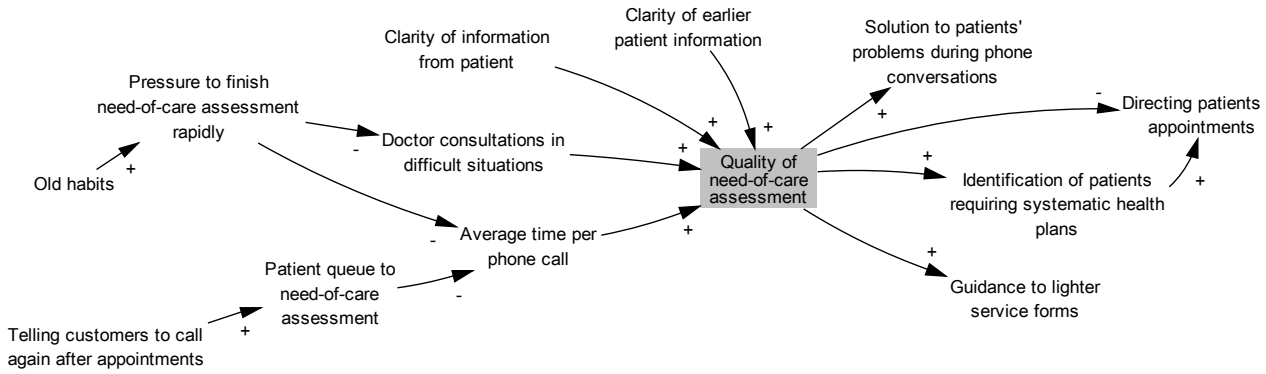


Figure 2: Model of patient flows in the primary care system of the case organization

The model is not exhaustive but shows how different parts of the system are interlinked and influence each other. Currently, the reinforcing feedback loops (R1 and R2) operate as vicious circles, but it is possible to turn them into virtuous cycles. Based on our study, we argue that this change requires paying attention to two occasions in particular: *the need-of-care-assessment point* and *the actual appointment to doctors or nurses*. These two situations are critical from the viewpoint of the promotion of lighter services and the creation of systematic health plans. The former is the first contact point with the patient and the latter is important due to its traditionally central role. To understand how the system could be developed further, we open up the factors affecting these points. In Figure 3, we first model the need-of-care assessment point, where we have identified two main groups of crucial factors: 1) the quality of the assessment and 2) the willingness of personnel and patients to utilize lighter services.

(A) Quality of need-of-care assessment



(B) Personnel's willingness to guide patient to lighter services and the patients' willingness to use them

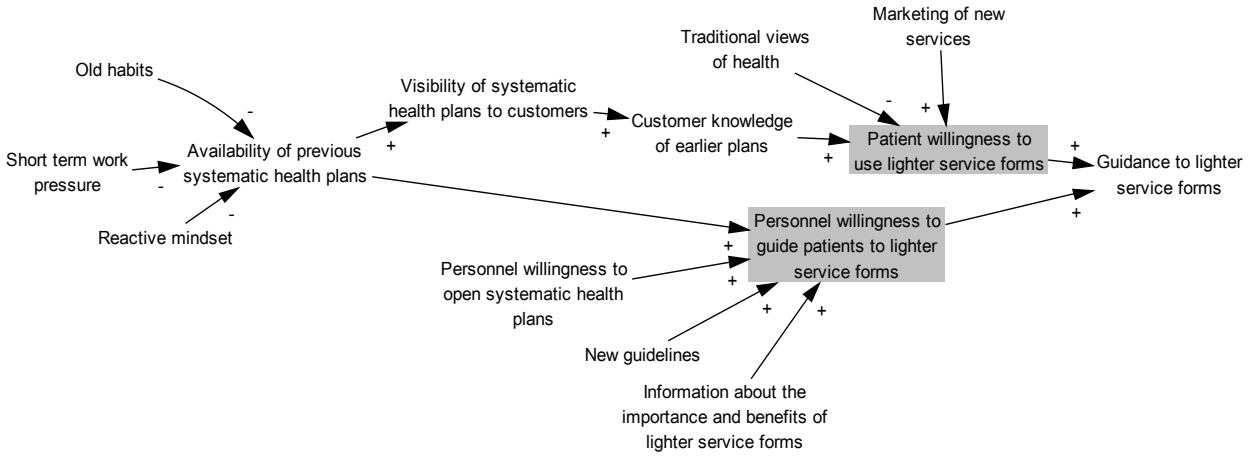
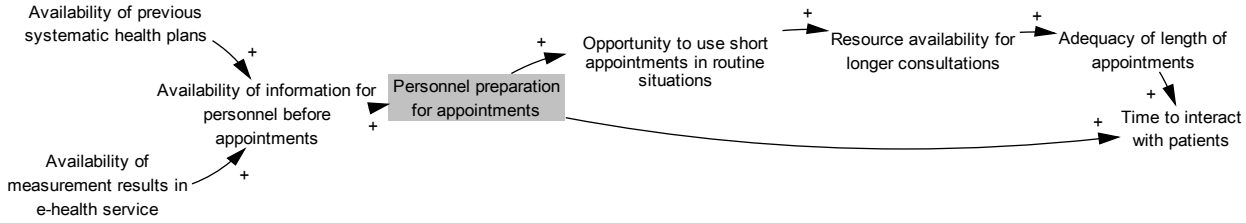


Figure 3: Factors affecting guidance to lighter services from the point of need-of-care assessment

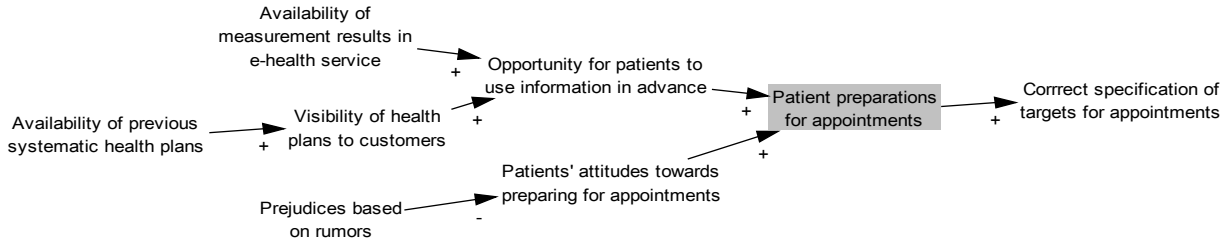
The quality of need-of-care assessment is influenced by the clarity of information given by the patients about their conditions, the clarity of documented patient information (e.g. previous health plans and notes made on the basis of earlier patient visits), and the possibility to consult a specialist in the situations where a care path is difficult to determine. Old habits and the feeling of pressure to finish the assessment rapidly instead of a more thorough evaluation of the situation affect the quality of the assessment negatively. Guiding customers to call back after appointments increases the patient queues to the need-of-care assessment, and reduces the time available for making target-oriented phone calls and thorough assessment of care needs. The willingness of personnel to guide patients to utilize lighter service forms is influenced by the availability of information about the importance and benefits of these services, new and clear guidelines and the personnel's willingness to examine previous health plans of patients as a starting point for determining the suitable care path. The willingness of patients to use lighter service forms is also a relevant factor. It is influenced by traditional views of health care, meaning that many patients expect to get an appointment to a doctor, even if their service need would not require it.

Failing to guide patients to lighter services at the need-of-care assessment point can still be corrected during the appointments to doctors or nurses. Move to lighter service forms can also be suggested and decided at this stage. This, however, requires changes in various factors affecting the appointment practices. The main factors that were identified in our study are the personnel's and patients' preparation for appointments, the quality of communication and interaction during the appointment and the support provided to patients in defining future targets (a systematic health plan). Figure 4 presents these factors in more detail.

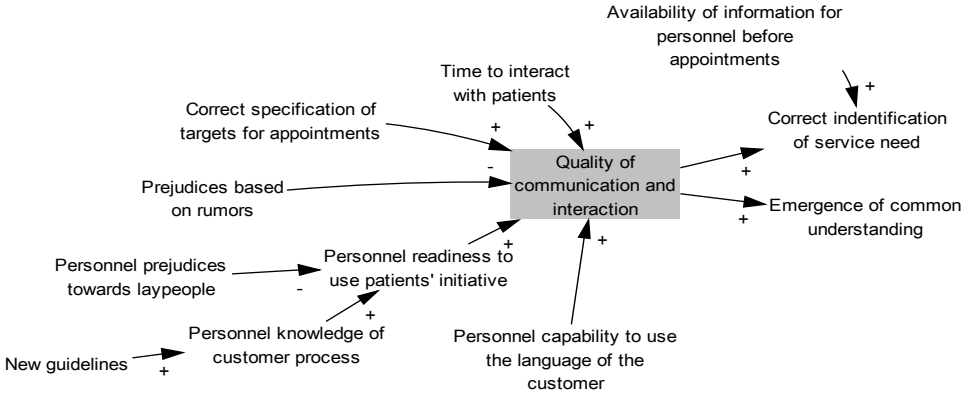
(A) Personnel preparation for appointments



(B) Patient preparation for appointments



(C) Quality of communication and interaction



(D) Support for patients in defining future targets in systematic health plan

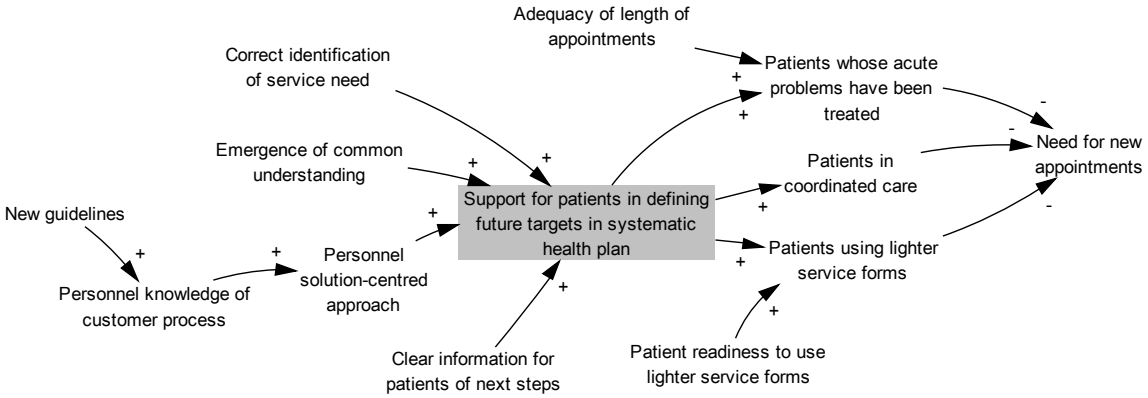


Figure 4: Factors affecting the degree of planning of coordinated care after appointments

The way in which the doctors and nurses are prepared for the face-to-face interaction with the patient is the first factor that influences the success of appointment from the viewpoint of the new goals of care. The availability of relevant patient information is a prerequisite for a good preparation, but it is also important that there is time for this task and the task is seen as a significant stage in the care process. Along with the new empowering practices, the preparation of the patient becomes increasingly important. The experts' attitude towards the active role of the patient is crucial and is "a test" of their ability to give up part of the power that has earlier been linked to their position. For instance, the use of eHealth systems by the patients should be noted in an appreciative way. Prejudices of both parties have thus great effect on the quality of communication and interaction during the appointment. The limited time during appointments sets additional challenges for facilitation, negotiation and shared decision making, and having a solution-centered approach to care and the ability to use the language of the patient are crucial in creating a mutual understanding of the service need and care paths. Providing information and expertise is not enough; it is also important to ensure that doctors and nurses have sufficient knowledge on customer processes in order to engage patients in the planning of the care. New guidelines are needed to support this patient – doctor/nurse interaction, which should result in coordinated care and patients with systematic health plans supported by lighter service forms.

Opening up the two critical points in the care process shows that the move of emphasis towards new forms of care is highly dependent on factors linked to human behavior and interaction. The roles and responsibilities of patients and the health care professionals need to be rethought, which requires a cultural change of mindset towards the entire health care provision. Prejudices, prevailing attitudes, routines and the power of professions are aspects that change slowly, which needs to be taken into consideration in developing the health systems. Informational aspects become increasingly important as well, and the development of ICT systems brings solutions to the changing nature of interaction and availability of information in health care.

CONCLUSIONS

This paper has examined the challenge of combining the system view with the multiple operational improvements that are needed at the practical level when the chronic care model (CCM) is implemented in primary health care. CCM and integrated care programs based on it have been adopted in several countries as an answer to the challenge of ageing population and the problems of public financing. These models and programs also reflect a broader transition from the paradigm of New Public Management (NPM) to network governance. Central elements in the renewals are the empowerment of patients, increasing cross-disciplinary collaboration among professionals and effective use of the new information technology systems.

Traditionally, studies on health services have focused on hospitals and specialized care, but the new integrated care programs have stimulated interest in the systems of primary care (Dunston et al., 2009). There has also been active research focusing on the micro-level interactions in healthcare: service encounters and prerequisites for success in them. However, these two approaches have usually developed apart from each other; systemic renewals have been analyzed at a quite general level and their practical implementation as a series of individual improvements without a link to the whole. Thus, we recognized a need for research that would integrate the system level and practice level analyses in the healthcare renewal – more specifically, in the adoption of CCM and the new integrated programs, which have been the starting point of our paper.

The theoretical background in our study consists of three perspectives: social innovation, system innovation and service-dominant logic (SDL). The concept of social innovation is relevant for our study because it highlights participatory processes, empowerment of citizens and the integration of bottom-up and top-down processes. The concept of system innovation is in the core of our interest due to its multi-agent approach, analysis on complexities of human systems and emphasis on the simultaneous development of organizations, technologies, services, and partner relationships. Our contribution is in combining these perspectives, and particularly in linking them to SDL that as a marketing oriented approach has developed apart from innovation theories. However, SDL is tightly linked to the strivings that characterize the current development of healthcare: it has brought to the fore reciprocal nature of value creation between the providers and users, which in the health context implies that patients are not targets but function as active agents and a resource in service provision.

We have carried out an empirical case study in Finland to gain more insight on the challenges in implementing integrated care models based on the principals of CCM. We examined the renewal of primary care in a middle-sized city and its applications of the models. With the method of system dynamics modeling, we have shown that

established routines are not easy to break down even though the organization has committed to change, set clear goals and concretized their content. Paying attention to the complex causal relations and feedbacks typical of human systems is necessary in order to make the multiple changes to strengthen each other. Recognizing the most crucial points that foster either "a vicious or a virtuous circle" in care processes, and analyzing them in terms of influential factors, supports the raising of awareness and facilitates changes. With the system dynamics models we created, we were able to illustrate the interconnections and feedbacks of two points critical in managing patient flows in a service system. Our results show how a traditional reactive and expert-centered approach to customer processes creates a vicious circle within the primary care overburdened by the increasing numbers of new patients and patients returning to the system. Our model was complemented with a more detailed level of causal diagrams of specific factors affecting the critical points in the system. Guiding patients to utilize lighter service forms that support self-management and investing in planning and coordination of care after appointments are concrete actions expected to solve the challenges. Our results highlight that factors linked to human behavior and interaction are at the center of adopting these new forms of care and care processes. One of the major challenges is the cultural mindset change in patient – doctor/nurse relationship, which requires a reformation of power distribution in the care process. This requires a shift in the professional identity from being a nurturing expert to becoming a coaching partner. The willingness and attitudes of both the patients and the health professionals are crucial factors in adopting new practices, and greatly influenced by prevailing attitudes and values that are not easily changed. The results indicate that adopting new practices also requires new skills of facilitation, negotiation, synthesizing information and utilization of patients' own initiatives in creating systematic health plans that form the basis for the care. The availability of information and the possibility to prepare for the care is a significant development, as the patients have the possibility to access and utilize their own health information. Our results thus implicate the importance of support, guidelines and education for health professionals as well as for patients in adopting the new forms of care.

Our study has served as a starting point for unveiling the complexities within service systems, and will support managerial decision-making on subsequent steps for the transformation and critical points for development. We limited the modelling method we used to illustrate the interconnections within a complex health care system and but did not examine how the system would behave if certain factors were changed. Thus, further research should focus on developing the models by utilizing simulation, which can help in understanding potential leverage points, that is, the areas of the system in which even small changes generate sustainable benefits in efficient and effective way. Dynamic modeling can also be used in a future-oriented way, which is important in the innovation context. It is possible to ask 'what if' questions, whereas most other methods in organizational science provide answers to questions 'what happened, how, and why' (Dooley, 2002). Simulation can be used when experimentation with social systems is not possible because it would be too slow, costly, or unethical (Sterman, 2002). While accurate prediction is not possible in social sciences, simulation can increase understanding of organizational systems, their relationships and principles. Experimentation with a simulation model, such as varying assumptions or adding new features, are good opportunities to build new theory (Davis et al., 2007). Future research should also focus on impact evaluation to further discover what kind of effects the implemented practices in the system of primary care can have.

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Service Innovation and Social Innovation: an Analytical Framework and its Application to Health Services

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ABSTRACT

The research fields of service innovation and social innovation have been largely disconnected. Even though they deal with somewhat similar socioeconomic issues and both are studied in a multidisciplinary way, the research trajectories have been rarely crossed. This paper proposes a comprehensive framework to set up a bridge between the two research fields. The paper defines the concept of social innovation and approaches it from a service innovation perspective. Inter-linkages between service and social innovation are shown by identifying research areas in which both find a joint heuristic field. Finding these kinds of fields is particularly possible when services in multi-agent frameworks are revisited from a social innovation perspective, leading to place citizens and organizations and/or the third sector in a prominent position in the innovation process. This approach has been illustrated in a set of case studies in the health sector in Europe. Finally, the paper aims to identify the value added that social innovation can bring to service innovation research and vice-versa.

Keywords: Service Innovation, Social Innovation, Third Sector

INTRODUCTION

Current societies face major social needs and challenges in the areas of health due to an aging society, transport due to new mobility schemes, communication due to new social media, and sustainability due to the progress of green technologies and climate change. Due to the magnitude of these needs and challenges, services and social innovation are required as part of the solution. The ability to innovate in ways that deliver better services and social welfare coincide with a growing demand by citizens to be actors in their lives and to be enabled to find collective solutions to some of the social issues which they encounter. Of course, the involvement of society in innovation processes is not new. However the modes and levels of potential engagement have drastically evolved during the last two decades. Globalization and digitalization have had a major impact on society, allowing consumers, producers, innovators and investors the possibility to connect and act, empowering individuals to participate more actively in society.

In this shift towards great social interactivity, service innovations and social innovations have come to share more and more in common. There are two factors here. First, there has been the rapid growth in service sectors both developed and developing economies – around 67% of global value added is in services (WB data) - and the majority of social innovations are occurring in service sectors. Second, and more importantly, social innovations

generally produce new or improved services for society. Consequently, it is the *service quality* that is the primary focus of innovation for the various stakeholders involved in health care, education and training, energy and environment, workforce development, etc.. Equally, the collaborative nature of creativity and innovation in services has been highlighted in the multi-agent framework used to study service innovations (Gallouj, 2002, Gallouj and Weinstein, 1997; Windrum, 2013, Windrum and García-Goñi 2008),. This collaborative aspect within health, social service, and transport sectors naturally lends itself to social innovation (Gallouj et al., 2013).

It is somewhat surprising, given the overlap, that services innovation research and social innovation research have evolved in parallel, rarely crossing (Djellal and Gallouj, 2011). This is partly explained by the different origins of the researchers involved in services and social innovation research rather than by differences in the content. Another contributing factor is the technological bias in innovation studies, which tends to neglect non-technological aspects of innovation in services, including its social characteristics. Innovation in services has been assimilated by industrial innovation, not social innovation. Publications that include both topics are rare and anecdotal (Van der Have and Rubalcaba, 2013), even though each has received major contributions from management and businesses disciplines, economics and economic geography. Finally, the fuzzy concept of social innovation (Paul and Ville, 2009) has not helped.

This paper contributes to building a bridge between service innovation research and social innovation research. As the interest in social innovation grows, it is imperative that we define its theoretical core in a precise manner so that the synergies with services innovation research are identified, and a future research agenda designed. Building on a review of the existing literature in section 2 of this paper, we discuss the interactions, similarities and differences between service innovation and social innovation in section 3, and provide a theoretical framework with which to understand social innovation from a service innovation perspective in section 4. The paper applies the framework to 10 case studies of public-private innovation networks in health services. Third sector organizations play a key role in these innovation networks. This is elaborated in section 5. We conclude with an agenda for future research in the field.

A BRIEF LITERATURE REVIEW

Despite the generally parallel development of service innovation and social innovation literatures, there are some limited interconnections between them. Djellal and Gallouj (2011) provide an overview of the most important examples. First, they mention Gershuny's vision (1978, 1983) of social innovation – the transition from formal to informal satisfaction for which services are replaced by technology goods in a self-service society. This conception is very technologically emphasized. Second, they refer to a wider social view of service innovation by Normann (1984): innovation that creates new types of social behavior, use social or human energy more efficiently and link social contexts in a new way. Finally they point out the characteristics based approaches that we will be discuss in more detail in the next section.

Harrison et al. (2010) make a more explicit linkage between service and social innovations. They consider that the perspective of social innovation contributes to the analysis of service innovation in four ways. First, it helps to identify the type of service associated to a particular innovation (they mention the case of the service can be a collaborative effort between a group of members of the community and public bodies). Second, "social" can refer to a service benefiting the whole community, or a specific target group, as demonstrated by the home help services for the elderly (Ducharme, Charpentier and Vaillancourt, 2004). Third, the term refers to the non-economic aspect of economic interventions (in this case, they state services deriving from social innovation that are necessary but not highly lucrative as shown by the activities involving the social integration of disadvantaged people). Fourth, the mere inclusion of employees, user or partners deserves the term "social".

Mendell (2006) views social innovation in terms of governance, participation and empowerment, what can be distinguished through the processes of emergence and consolidation. Social innovation involves the creation of a particular type of services but pertains above all to a specific process involving both the key role of social entrepreneurs and the forming of alliances and networks. The result is the creation of an innovation system giving rise to a proliferation of social innovations whose effects on one another consolidate the basis.

Other authors have explored the relationship between social innovation and service innovation in particular services areas. Greenhalgh et al. (2004) provide a systematic overview of the state of the art in health care. They define service innovations in this context "as a novel set of behaviors, routines, and ways of working that are directed at

improving health outcomes, administrative efficiency, cost effectiveness or user's experience and that are implemented by planned and coordinated action" (ibid., 1).

As seen above, most research approaches focus on the social aspects of services innovations. The service dimension of social innovations has sometimes been pointed out by international policy organizations. The EU Commission (2011) has highlighted that social innovators seek new services that improve the quality of life of individuals and communities in labour market integration, social inclusion, health care, education, resource efficiency and environmental challenges. In the similar vein, the OECD Forum on Social Innovation (2000) emphasized the improvement of quality of life via new services resulting from social innovations. This forum mentioned the emergence of new competencies, jobs, and forms of participation in particular. The EU and OECD cases are, however, exceptional – in general, services are not included in the analysis of social innovations or they are seen just a part of them together with other outputs (goods, practices, etc.). This view is apparent in the extensive survey on social innovation by the Tepsie (2012) project, the social change and systemic approach by Howalt and Schwarz (2010) and in the evolutionary perspective by Reinstaller (2013).

A factor that at least partially explains the difference between the views of researchers and policy makers is the fuzzy and ambiguous character of the concept of social innovation (Pol and Vil, 2009), and the novelty of social innovation as a research area. Even though it is difficult to find a detailed and generally accepted definition for the concept, researchers have quite unanimously stated that the distinctive feature of social innovations is not their content but the nature of the innovation process: the goals and actors involved. It has been highlighted that innovative solutions in this context are sought for a wide range of issues, representing different realms of society: labor market, education, health, housing, etc. (Moulaert et al., 2005). A common characteristic is that the innovations concern complex economic and social problems. The outcomes usually arise in the form of a service innovation which benefits the members of a community or the whole community (Harrison et al., 2010). In a broader sense, also the outcomes in the form of products, practices or behaviors may also “serve” the community as new resources (Vargo and Lusch, 2004, 2008).

It is also possible to argue that social innovation is a particular case of service innovations – a viewpoint that has rarely been discussed. This view is included in the three-dimensional framework of service innovation proposed by Rubalcaba et al. (2012). Figure 1 presents this framework whose dimensions are innovation in services sectors, service innovation in any kind of business and services as multi-agent co-productions. The first dimension is widely discussed in sector-based service literature, whereas the second dimension represents the views of services marketing and management. Here, the service experience is on the focus and the novelty included may mean a new service concept, a new customer interaction, a new value system/business partners, a new revenue model, or a new organizational or technological service delivery system (Den Hertog, 2010). The third dimension is based on the development of multi-agent framework for service innovation (Gallouj, 2002, Windrum and Garcia Goñi, 2008). It is this dimension that can be considered social innovation when the link between the agent dimension and the activity dimension is created. The activity dimension in the multi-agent framework highlights the importance of the non-technological aspects of innovation (Gallouj, 2002, Gallouj and Djellal, 2010), leading to the inclusion of social issues and social actors in new services processes.

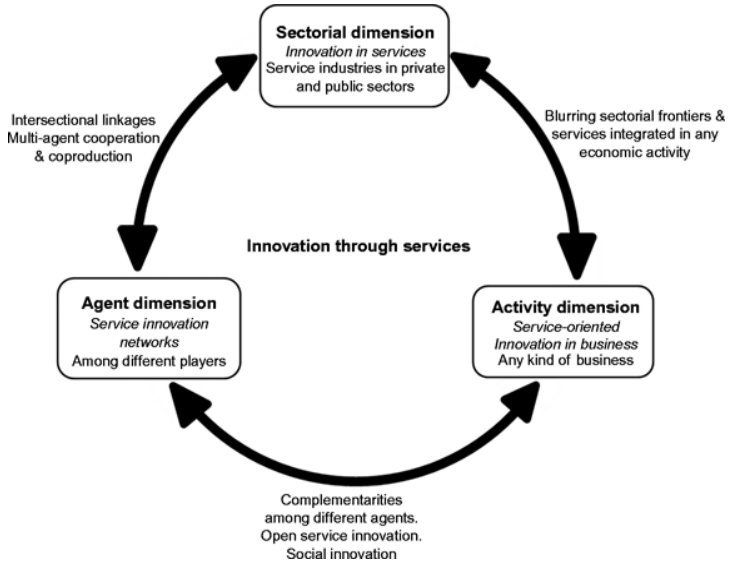

Figure 1: The three dimensions of innovation through services (Rubalcaba, 2012)

SHAPING SOCIAL INNOVATION FROM A SERVICE PERSPECTIVE

The service dimension of social innovation

Summarizing the discussion in the previous sections, social innovation can be defined as new innovative solutions or new innovative practices as response to societal challenges (social goals), based on new ways of participatory and citizens empowering systems (social means). Services and service innovation can be identified in four areas of social innovation: the challenges tackled are often in the area of services, the innovative outcomes are often new or improved services, the participatory processes often include service co-innovation, and the inputs are often based on the use of knowledge intensive services and service intangibles. These aspects of social innovation can be opened up as follows:

- *Services as areas where social innovations take place.* Social innovations include new or modified services that improve the quality of life of individuals and communities. Examples are improvements in health care, education, housing, labor markets, and increasingly solutions to the issues of sustainability.
- *(New or improved) services as outcomes of social innovation.* Most prominent examples of social innovations are services in nature or combine technology and services: prevention and treatment of diseases, new pedagogic techniques, new rural tourism initiatives, smart cities initiatives etc.
- *Service coproduction as the means for social innovation.* The participatory processes characterizing social innovation require a certain level of service co-production and co-innovation. The users may be involved in the development innovation process and the outcomes are modified in the use context.
- *Services as inputs for social innovation.* Service innovation can be considered a dimension of what is behind any social innovation process. Service dynamics are those creating service transformations, considering services as a dimension of economic and social life which takes place in any kind of economic and social sector (within agriculture, manufacturing, market services or non-market services sectors). From the many services acting as inputs for social innovation, a particular role is given by knowledge-intensive business services (KIBS) and the intermediaries from the public or the third sector to facilitate innovation processes.

This categorization highlights that social innovations may be identified as novel services-based solutions to social problems. They are more effective, efficient, sustainable, or fair than existing solutions, and provide value that accrues to society as a whole; the society's capacity to act properly grows. Figure 2 presents the interrelations included in social innovations on the basis of the role played by citizens and organizations.

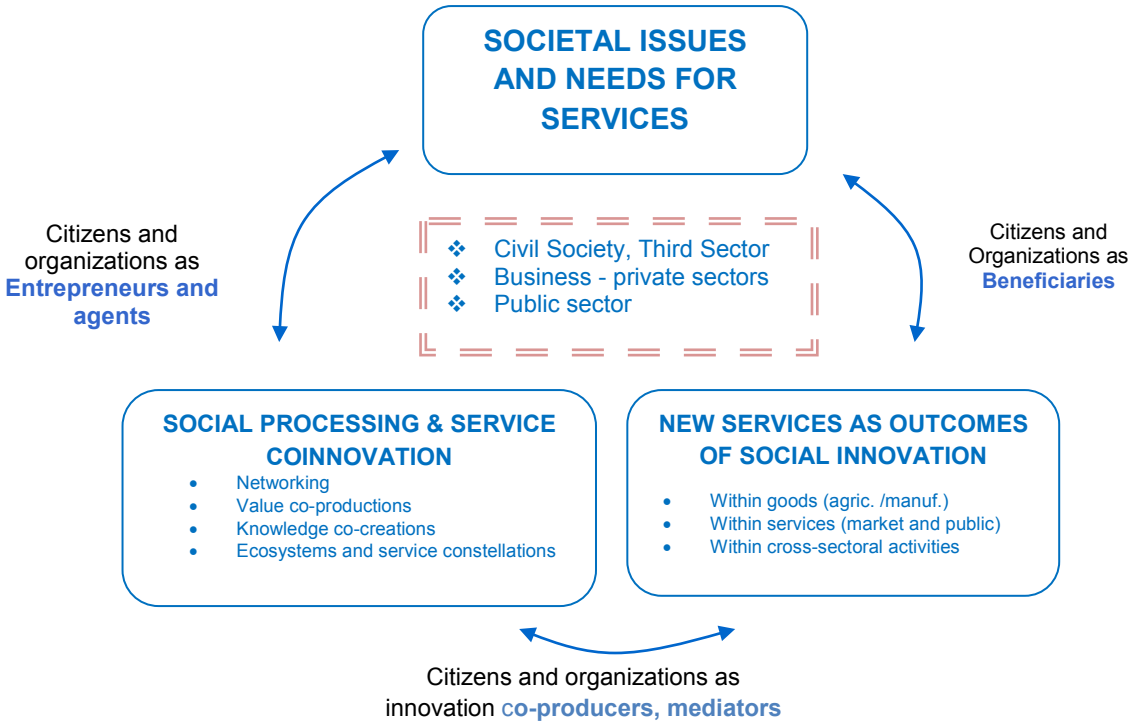

Figure 2: Services in social innovation

In the first phase of the cycle presented by Figure 2, citizens and organizations are recognized as a subject of action, causing a social innovation in event in an object within the surrounding environment. These social innovations (occurring in the form of a service) can take place within governments, within the business sector, or within the third sector (non-profit). As the subject of action, citizens play a fundamental role as producers of innovation – social agents or social entrepreneurs – working at the crossroad of market, state and civil society, often with considerable input from the public sector and the third sector. As a new answer to unsolved societal issues, social entrepreneurs and social agents aim at identifying and delivering new solutions within the system. Furthermore, while meeting social needs and tackling societal challenges, social innovations empower people and create new social relationships and models of collaboration. Approaches that favor cooperation between the public, private and third sectors often facilitate an effective respond to social needs and challenges.

Sooner or later in the process of social innovation, civil society becomes integrated via the role of users. Earlier, citizens have often been regarded as mainly the consumers of new services. Recently, the concept of co-innovation has emphasized the importance of customer-producer interactions for creative activities. Thus, citizens and organizations are becoming principal social innovators for the benefit of civil society, contributing directly to welfare. They serve as a medium (mediator) for causing a result (social processing) or for transferring information in order to improve existing services or organizational forms. In social innovation, citizens and organizations typically participate without profit as the main motive.

Finally, in the last phase of the cycle, citizens and organization become the beneficiaries of the innovative solutions. Their wellbeing become the object of their own innovation developments, as service innovations address the overcoming of societal issues that civil society is and will be facing in future. Therefore, the improvement of future standard of living is considered the result of service innovation itself.

In this context, the activities and actors involved also show the multifaceted nature of social innovations, but first and foremost they reveal the specificities of these innovations: the interactions taking place *comprise much more than a traditional service relationship*. The sources and goals of innovation are more diverse, and the participation of actors often includes some voluntary elements (combined with commitment). Social innovations may 1) emerge at the grassroots level among individual citizens who respond to pressing social problems, 2) be produced by private, public and third sector organizations separately or in cooperation, or 3) result in fundamental changes at the societal and policy level. Research in these three areas has focused on the following topics respectively: the

empowerment of citizens and stakeholders, public-private partnerships and the so-called 'social economy', and the governance and management of social and system innovations.

The discussion on empowerment highlights that social innovations combine two aspects of social life: the economic aspect and the social aspect. Thus, the aim is not only the production of services and the creation of wealth, but also the promotion of values and initiatives involving individual and collective empowerment and the development of democracy and responsible citizenship. (Harrisson et al., 2010) The process of creation and implementation of social innovations relies on participatory dynamics, which requires active input from the various stakeholders and results in fostering and utilizing the citizens' social capital in life and work (Nahapiet and Ghostal, 1998). As a research field, studies on participatory practices and empowerment are linked to studies on user- and employee-driven innovation.

Social innovation is also changing the notions on more traditional innovation activities – those taking place within and between firms and public organizations. This point of view has focused on new types of organizations and on the integration of initiatives in existing organizations (Moulaert et al., 2005). Research has been active concerning the third sector (the so-called social economy) in particular. Here, the non-economic aspects of economic interventions – e.g. the social integration of disadvantaged people – have been emphasized as an important aspect of the concept 'social'. Innovations in this context are sometimes called 'pure social innovations', because they address needs that are not satisfied through the market mechanism due to the lack profit potential. The social economy consists of non-profit organizations (NPOs), cooperatives and associations, social entrepreneurs, and of partnerships between the public and third sectors. Social innovations may be produced either autonomously by the third sector, with the state support, or in a partnership with it. In the partnerships, the role of the actors of the third sector may vary from that of a sub-contractor to common design and implementation of social policies with the public stakeholders (Harrisson et al., 2010). Public-private innovation networks as such can be considered social innovation to some extent (Gallouj et al., 2013).

Also private firms are entering the field of social innovation; corporate social responsibility and concern on sustainability are increasingly a part of their strategies (Lapointe and Gendron, 2004). The way in which the striving for social innovations changes innovation processes concerns all types of organizations – both public and private. Unlike innovations in the market sector, which traditionally have been kept outside competition as long as possible, social innovations call for imitation and diffusion. In them, open innovation is not an alternative strategy but the primary strategy, i.e. forming alliances and networks is essential. The governance and management of these networks have to support both the creation and dissemination of innovations. Dissemination is a challenging task due to two characteristics of social innovations: local nature and the lack of codification. The contribution of social innovations is typically manifested as the density of local networks and as local vitality that may result in new jobs and market activities. Scaling up innovations from this limited context requires the strengthening of their systemic features. It also may require new types of R&D practices that can facilitate the codification of social innovations and the procedures applied. (Harrisson et al., 2010)

Similarities and dissimilarities between service innovation and social innovation

The previous sections have revealed a plenty of similarities between service innovation and social innovation, regarding both the *goals* (due to the social dimension of services) and the *means* (multiplicity of agents and co-production). There are also similarities in the *nature* of innovation, since both areas share intangibility, invisibility and interactivity. Further, both of them include *policy issues* (appropriation issues beyond the traditional patents system and the lack of adequacy of public support policies). However, the most important similarity is the *process* (practice). This is illustrated in Figure 3, which is a model constructed on the basis of an empirical study in the health sector (Hyytinen et al, 2013). Social and service innovation coincide when discussing about co-creation and co-innovation among different actors, although both can have different means to contribute to the systemic change in health organizations.

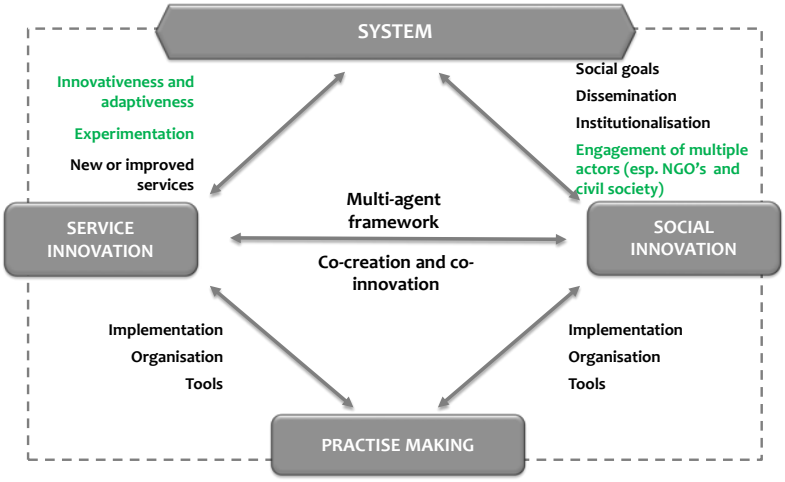

Figure 3: Service innovation and social innovation in the health sector (Hyytinen et al, 2013)

However, not every service innovation is a social innovation and vice versa. Most service innovations take place in firms seeking business profit regardless the social component. They do not engage citizens, but some customers in the most interactive cases. On the other hand, there are social innovations based on technological development (affordable technologies for inclusive innovation) that cannot be considered service innovations but which are goods-based innovations. It is also possible that social innovation includes new social practices that do not lead to any new or improved service. However, in evolutionary terms, service innovations are moving towards social innovations: they are increasingly multi-agent and multilateral, and take into account a wider spectrum of society and social goals. Correspondingly, social innovations seek to be increasingly professionally oriented, developing a wider range of services as an outcome. As showed in Figure 3, there is a trend towards a wider joint area where service innovations can be named social innovations and vice versa: *social service innovation are more and more frequent in our society*.

Towards a definition of social innovation from the service perspective

Given the previous analysis, social innovation can be redefined from a service perspective. To do this, some service elements have to be taken into account. First, the societal challenges can be addressed by social goals to be achieved via new or improved services and social goals address a target community in such a way that social innovation can be considered a service itself. Second, services have a role in the social means dimensions of social innovation, and since service co-innovation and networking is an essential component, services are also linked to collective co-creation of knowledge and new social values in new innovation and customer co-creation. Third, empowerment is a key issue to reinforce service capabilities, and a systemic change perspective is needed based on new interactions between institutions and stakeholders that can be partly linked to new service management and culture. From these service elements, and taking into account the need for simplicity in the definitions, social innovation can be defined as *"new service solutions to societal challenges, aiming to increase welfare by coproducing the creation and implementation of new knowledge and capabilities among a multiplicity of empowered actors"*. This definition covers the above-mentioned services elements, summarizes the different social challenges in the welfare objective, and conveys the idea that different social innovation types (behaviours, practices, products) lead to new or improved services in one way or another.

A MULTI-AGENT FRAMEWORK FOR UNDERSTANDING SOCIAL INNOVATION IN SERVICES

The multi-agent framework presented below is a development of prior work by Gallouj and Windrum together with their colleagues (Gallouj and Weinstein, 1997; Gallouj, 2002; Windrum and García-Goñi, 2008; Windrum, 2013). It provides a comprehensive framework for understanding the processes and outcomes of service and social innovation: it enables an explicit consideration of the competences and preferences of citizens, organizations, and policy makers and of their interaction in the processes of co-creation and diffusion of innovations. The approach is

rooted in the work of Kelvin Lancaster (1966) on product characteristics and consumer demand. Over time, services scholars have developed the framework, from an its initial focus on provider-customer interactions, to a more general model to includes the roles of government, third sector and other agents on the innovation process.. Figure 4 illustrates the Windrum-García Goñi version of the model. Compared to the Gallouj-Weinstein (1997) services model, this includes policy makers as a key actor group whose preferences and competences play a significant role in shaping innovation.

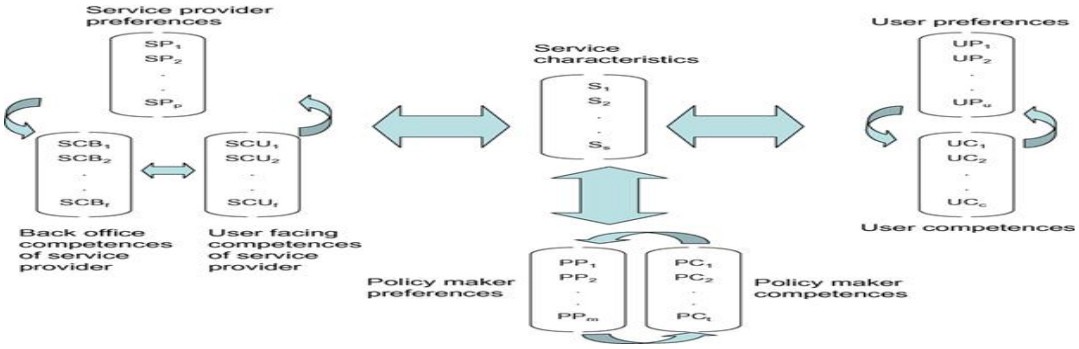

Figure 4: A multi-agent framework for understanding service innovation (Windrum and García Goñi, 2008)

In this paper, we propose a further step in the evolution of the multi-agent model for understanding better the social-service innovations. The main point is deepening the transfer from the provider-customer dyad into a genuinely multi-agent framework where different agents can take different roles. Along with the emphasis on empowerment (supported by the advancement of ICT and social media), the users are all the more often also providers. For example, new co-innovations in health are increasingly outcomes from interactions between hospitals, patients, voluntary associations and policy makers. Therefore the focus of understanding the interaction should be placed on *the different roles played by different partners in different times*.

Another important element is the many roles played by citizens in social innovation. They can be promoters, enablers or facilitators of new innovations, or they can be key mediators, co-producers and/or the final beneficiaries. In providing a new solution to unsolved societal issues, citizens engage in social processing and networking that underpins collective creation and diffusion. The diffusion of these new solutions may be driven by citizens in the role of lead users. Here citizens are not 'passive consumers' but active agents – the designers, champions and users of innovations – and key protagonists for change. Their actions transfer information about new possibilities and opportunities for services and organizational forms that better address societal issues. The impacts of social innovations are judged on their capacity to improve wellbeing, living standards, and sustainability. The empowerment of individuals, and the broadening of their choices, is a core dimension of social progress, well-being, and welfare (Sen 1999, Stiglitz et al. 2009). Individual citizens, and citizen groups, must have sufficient social capital, knowledge and skills to fully engage with organizations and policy-makers in the social innovation process. Increasing citizens' socio-political capabilities, and their access to resources often requires supporting policies and may imply potential conflicts with existing interests, beliefs, and actions of established organizations (Moulaert et al. 2005, Phills et al 2010). How these are mediated and altered is a key issue because it determines the extent to which citizens can actively become key players in social innovation. The multi-agent framework makes explicit the competences and social capital of citizens, and highlights conflicting areas of interest between citizens and other stakeholders.

In this context, the third sector deserves a particular mention in the model, since they are key actors within collective creation and diffusion of social innovation and they act as interfaces between citizens, business and policy makers. The third sector organizations often act as interfaces between the citizens and the rest of actors (firms, institutions) to coproduce and participate in the innovation processes. They identify and deliver new solutions that improve the quality of life of individuals and communities. Grassroots initiatives are commonly promoted by social entrepreneurs and other third sector agents. Innovative processes are used to establish new forms of labour market integration, improve social inclusion, and to identify and implement new ways of addressing health care, education delivery, resource efficiency and environmental challenges. Employment in Third Sector organizations has grown faster than in private and public sector organizations over the last two decades. Thousands of new foundations, social ventures and NGOs are growing around the world (Bornstein, 2004) and they are playing a more and more significant role of social change and innovation.

A great advantage of the multi-agent framework is that it enables modelling of the interactions of stakeholders who develop and diffuse social innovations, and how these interactions shape the features of new goods and services. The development and diffusion of social innovations requires both (a) the direct implementation of knowledge and competences of citizens and organizations (public, private and third sector), and (b) the mobilization of material and/or immaterial factors. Interactions between key stakeholders facilitate/inhibit the development of social innovations, shape the features and characteristics of innovations, and determine the extent to which innovations successfully diffuse. This explains why 'co-creation and co-innovation' is related to the 'empowerment' of citizens and organizations.

A key development of the multi-agent framework is its explicit inclusion of the government policy-makers within the social innovation process. Governmental organizations may themselves be designers and producers of public services, or the purchasers of services produced by citizens or other organizations, and publicly delivered. Public standards bodies may be needed to define the quality of new services and their delivery, thereby unleashing social entrepreneurship and innovation. Innovation may require the development of new practices within public sector organizations (such as New Public Management practices, and more recently Public Value Management approaches). Governments may need to experiment with market and non-market provision. This can take the form of privatisation or the nationalisation of organizations and industries (as in the current banking crisis) or propose new forms beyond the public-private dichotomy. Government may seek to stimulate organizations for the development and provision of services, such as third sector / non-governmental organizations, social entrepreneurs and citizen groups, and work together as effective partnerships for large-scale community change.

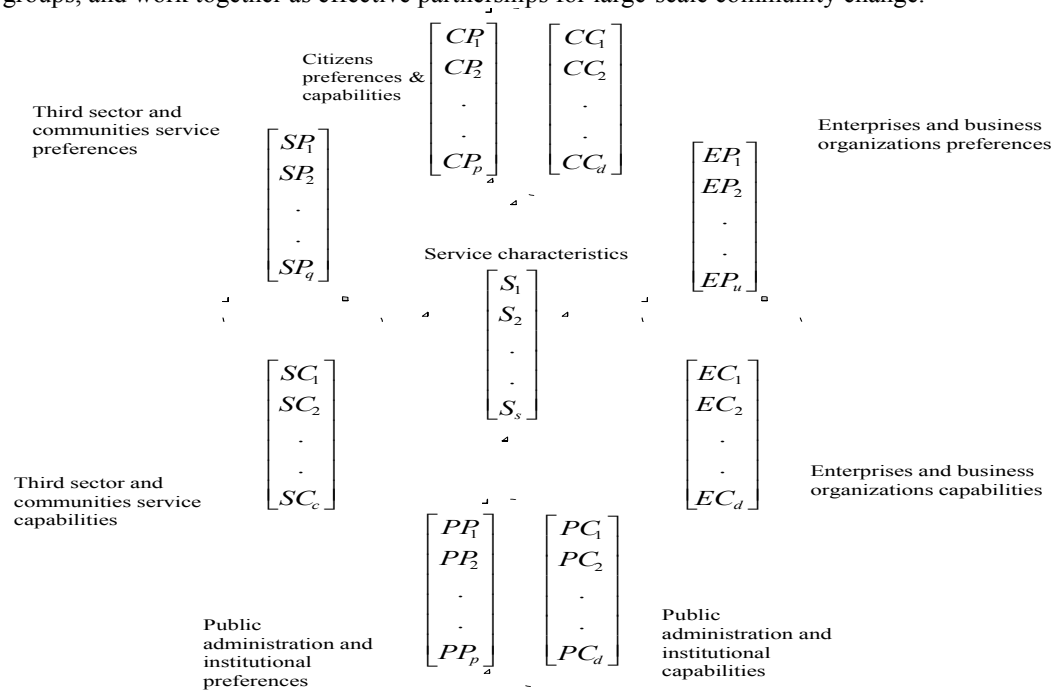

Figure 5: A multi-agent and multi-role framework for social innovation in services

Based on these elements in the multi-agent framework, Figure 5 represents the Lancasterian diagram. Here, the interactions between the provider and users have been replaced by interactions between different organization types (private, public, third sector). The third sector represents the interests of citizens and target communities in specific innovations and can be a partner in public-private innovation networks. The business organizations and firms represent the interests of the markets, and the policy makers represent the interests of the overall population in as given country, region or municipality. The targeted citizens of an innovation can be the ones providing inputs to the third sector or communities representatives. Figure 5 comprises two cases. The first one represents the case in which the third sector has a prominent role in the relationship with the target communities, and the second one represents the case in which the role of citizens is driven more by an individual participation (e.g., social innovation through on-line platforms), and the role of the third sector is not so relevant.

AN ILUSTRATION: THE ROLE OF THIRD SECTOR IN PUBLIC-PRIVATE INNOVATION NETWORKS IN HEALTH

The presented framework has been preliminary tested in a set of 16 case studies carried out in the Servppin project on public-private innovation networks (Gallouj et al., 2013). These case studies provide a micro-perspective on the emergence of innovation networks over their life cycles and can give insight into drivers, actor configurations and critical events of their evolution over time. The case studies were carried out in seven different countries. A common research framework was developed for the selection and implementation of the case studies (Weber et al., 2008). Another major feature of the project has been the development of a common set of Operational Research Questions for all case studies (Green, 2008). The case studies in Health particularly focused on the role of the third sector organization in public-private innovation networks, so this is useful to illustrate the multi agent framework in which third sector takes a relevant role. However some of the selected case studies do not involve a direct participation of the third sector. This is useful, as "control sample", to compare those service innovations with a third sector role against those service innovations with no third sector role. Table 1 provides information, for each case study, of the country in which the innovation network is located, the category of innovation produced and role of users and third sectors. In particular, it shows whether the network contains third sector organizations, and whether a third sector organization played a central role in the formation and management of the network as both beneficiaries and active co-producers (multi-role). It also shows the final users of the innovations and the role played by the final users.

Table1: Description of cases by country, innovation category and roles of final users and third sector

Innovation	Country	Category	Final users	Users active role	3rd sector active role	Central multi-role
Third sector cases						
• Diabetes Education	UK	Intangible service	Patients	No	Yes	Yes
• Social network site for health professionals	Spain	Network	Professionals	No	Yes	Yes
• Handheld defibrillators	Austria	Network & Technology service	Citizens	No	Yes	Yes
• Public-private network for elderly care innovations	Denmark	Network	Elderly	No	Yes	Yes
Non-third sector cases						
• Health school for illness prevention	Denmark	Intangible service	Families	No	No	-
• Capacity Planning	UK	Organizational /Process	Staff	No	No	-
• IT risk adjustment software tool	Spain	Technology mediated service	Managers	No	No	-
• Virtual reality rehabilitation therapies	France	Technology mediated service	Patients	No	No	-
• Supersonic imaging	France	Technology mediated service	Patients	No	No	-
• Public-private partnership for research	France	Organizational /Process	Researchers	No	No	-

The case studies can be briefly described as follows (for more details see Windrum, 2013). The UK study of capacity planning concerns the implementation and embedding of a capacity planning process within a primary care trust. The trust brought in expertise from a private sector business and together they co-produced an IT-based planning system. This provides the information needed to cost services, which is essential for higher level managers in their negotiations with NHS groups that purchase services. The information is also useful for line managers to more effectively structure their resources and services. The Danish case study of a health school for illness prevention involves collaboration between a private sector healthcare and a local municipality. The health school is dedicated to the prevention of illnesses through the development of patient-centred health. The French public-private partnership for research is an organizational innovation between a private sector pharmaceutical company, CNRS (National Centre for Scientific Research), and a public sector research laboratory. It addresses the complex rules that demarcate public and private sector funding and research activities in France, in order to develop research programmes that are of mutual interest and benefit to the partners. The remaining three case studies involve information and communication technologies. A Spanish IT risk adjustment software tool is designed to manage budgets for pharmaceutical expenditure. This promises to better support regional health authorities to allocate budget resources for pharmaceutical expenditure. The French case study of rehabilitation therapies involves the development and application of new therapies using interactive 3D technology (Virtual Reality). The key to their

clinical success is the service innovation - the way to approach the therapy for the patient – rather than the software and peripherals that are used. Finally, the supersonic imaging case study involves the application of waves and acoustic technology to the development of new, non-destructive testing and medical imaging. This has great potential benefits in areas such as cancer.

All case studies could have been potentially useful to analyse the role of third sector, since all innovations address target communities of final users most of which are well organised through patients, professional associations or trade unions, but only four of the ten cases included third sector members. Six of the case studies do not contain a third sector member as the promoters did not consider them essential for developing the innovations. However, what is important, it was a third sector organization that played a central role in the formation and management of the network in all four third sector cases: when third sector was involved, it was really engaged.

A striking feature is the absence of end users (i.e. patients) in the health case studies. This is despite the fact that health policies in many of the countries which we studied have been encouraging greater direct patient participation in health. It is also striking given the growing academic and policy literature on the importance of user engagement in innovation. This does not appear to affect the functioning of our health ServPPINs, or be a critical factor affecting success or failure of their innovations. It may be that health practitioners' knowledge of patients' clinical needs and long-standing interactions with patients, plus the trialling of innovations and the advocacy role played by Third Sector partners in these ServPPINs may explain this. Therefore, the role of end-user in the model is somewhat replaced by the role of third sector organizations: they play a key role in the construction, management and leadership of health sector ServPPINs. Around half of the case studied involved a third sector organization. These are very diverse organizations, ranging from charities to not-for-profit businesses to NGOs. This level of participation was unexpected. Just as unexpected was the leadership role which these organizations take. Where present, the third sector organization was invariably the leading organization in the invention network. This result implicitly suggests that third sector can be empowered enough to undertaking innovation processes and they may be ready to also lead the process as they capitalize a major bulk communication with the final users, whether getting information from the final users members of the third sector organizations, whether disseminating the results of the innovation in a later stage.

The case studies offer additional interesting results. The majority of case studies were invention networks. These are organisational and professional networks, not social networks. They are alliances between public, private and third sector organisations and – importantly - typically contain a small number of these organisations (between 2 and 5). The presence of third sector does not make them less professional. These are goal orientated networks, with no significant distinction between third sector cases and non-third sector cases. They typically come together to develop a particular research project and, once completed, may well disband. One should therefore not mistake the ending of a ServPPIN as an indicator of a network failure. It may well be that the diffusion process requires a different set of institutional arrangements in different European countries. For example, diffusion may require enactment in law, or be embodies in the minimum specification of services by health insurance companies.

This research also highlights the importance of the composition of members belonging to a ServPPINs. There needs to be complementarities between the competences of partner organisations, and with regards to access to finance and other resources. Further, commensurability and non-rivalry is found to be a key factor where more than one partner is from the private sector or third sector. Besides, the role of public and private entrepreneurs has highlighted as a key success factor. Entrepreneurs need to hold key positions within their own organisations. This enables them to ensure long term commitment of resources and the support needed to develop the ServPPIN innovations. Furthermore, entrepreneurs need to be able to understand the different contexts and backgrounds of their partners in order to overcome the so-called 'binary divide' between public and private sectors. Actually, this supposed divide is really not in evidence in health. Many key participants have moved between public and private sector organizations within health, and have personal contacts in a range of public, private and third sector organizations. In this sense, social innovation in services can be considered in the framework of the multi-agent framework previously described, but also considering the mobility of people and actions between the different agents, so the multi-agent framework is also an inter-agent framework to some extent.

Finally, trust is a distinguishing feature of the health ServPPINs. In only around half of the case studies are formal contracts drawn up between partners. In part this reflects good understandings of partners and previous connections between key members. It is also due to the non-rivalrous composition of the members. Each member has different needs and interests. One may be interested in the commercial exploitation of the innovation, while another gains from the clinical benefits of using the innovation in practice. The importance of trust underlines the need of a pro-trust environment in the interactions among the different actors supporting service innovation. A certain social

innovation may be required to make this service-oriented trust possible. This trust is not always possible through the involvement neither of third sector (no necessarily needed in the non-third sector cases) nor from the direct (often rare, difficult or none, as in all the analysed cases) involvement of ends users. Lack of trust towards final users and third sector can explain how many service innovation network limits the type and number of agents involved, and can become successful with no need of becoming large-multi-agent social innovations.

In summary, these results suggest that i) certain substitution effects can exist between the role of third sector and final users, so the multi-agent framework can be scalable/sizable depending on the particular innovation requirements –more agents, less agents-; the professional character of innovation networks may lead to work with professional organizations representing the society more than with the direct users themselves, ii) social innovation may happen more and be more effective in professional networks than in social networks with the involvement of a large number of final users; the case studies did not consider this as an alternative option, iii) the multirole of the third sector, representing both the user coproduction and the user beneficiary role, is a way to develop social innovation in services beyond the traditional supplier-client service co-productions, so in this way the theoretical framework presented in previous section is confirmed and iv) the professional nature of innovation in services does not depend on the inclusion or not of third sector and there are not significant differences between the case studies with and without third sector: a large number of agents is not necessary for all kinds of service innovations; however once the third sector is engaged, its role become really essential.

CONCLUSIONS

Despite the research fields of service innovation and social innovation have been largely disconnected and the research trajectories have been rarely crossed, both areas deal with somewhat similar socioeconomic issues and there are multiple interconnections. This paper has proposed a comprehensive framework to set up a bridge between the two research fields. In particular, the paper has defined the concept of social innovation from a service perspective, identifying the role of services in the social innovation outcomes, inputs, processes, and areas-sectors. Services can be considered essential to develop social innovation, as has already been recognised by some scholars (Gallouj and Djellal, 2011) and international organizations such as the OECD or the EU Commission. The particular role of citizens and organizations in service oriented social innovation are outstanding. Citizens and organizations can be actors and entrepreneurs, beneficiaries and mediators of social innovations in such a way that the frontiers between suppliers and users become blurred to some extent. Service co-productions are translated into social innovation co-productions where plurilateral interactions become possible beyond the more traditional way of services co-productions between one client and one provider.

Besides, this paper has showed the inter-linkages between service and social innovation by identifying similarities and dissimilarities and the areas in which both find a joint heuristic field. The proposed field has been built on the multi-agent frameworks developed by Gallouj and Windrum, among others. A new version of this framework is proposed to cope with the social innovation. This is identified by the new role of agents being both co-producers and co-consumers of service oriented social innovation, the role of a plurality of agents, including public administrations and third sectors, and the role of citizens and organizations able to fully participate as far a certain empowerment is given. This exercise allows us to identify the value added that social innovation can bring to service innovation research, by enriching the multi-agent perspective with different social goals and actors and with a more systemic view, and vice-versa, enriching social innovation thinking by focusing social innovation on its services contents and services co-productions means for which multi-agents framework like the ones presented in the paper can be particularly useful, as the application in the health sector, in public-private innovation networks, have shown. When third sector plays a role this can be a leading role, assuming/replacing to some extent the role of citizens since the representative organizations can provide more professional behaviors and trust. This does not mean that all service innovations need to become large multi-agent social innovations: the direct engagement of citizens or third sector should not be considered the panacea of any service innovation. In any case, the future of many service innovations will be more and more linked to an active role from their side, being co-producers and the same time as beneficiaries. The extended Lancasterian model proposed in this paper deems to be appropriate to capture both the multi-role and the multi-agent dimensions of social innovations in services.

With this line of research, we want to contribute to perform a further step in theory building in social innovation and services innovation by linking the two of them, and by providing elements for the foundations of the evolutionary view of innovation, in which service innovation and social innovation are two changing interconnected elements of economic and social change. Further work in this direction is needed, to connect the evolutionary perspective of social innovation (Reinstaller 2013) with the results obtained from this research on services and social innovation.

The paper results expect to endeavour to establish a certain dialogue between these two fields of research, with mutually rewarding results for both. The fact that social innovation is often a service innovation, but also just as often (and increasingly) an innovation *in* services, makes this dialogue all the more desirable. In fact, the services sector is a particularly fertile ground for social innovation. This is true of market services, taking into account the density of social interactions (particularly with customers) that characterise them. It is even more evident in the case of public administrations, in which the density of these social interactions is formed in a 'public service spirit' based on the principles of fairness, equality of treatment and continuity. This is also true to an even greater degree for the rapidly expanding conglomeration of tertiary activities in developed economies, which are grouped under the term 'third sector' (social and solidarity economy).

The areas for dialogue which will be raised are the theoretical perspectives favoured, the nature of innovation and the question of its identification and measurement, its modes of organisation, its appropriation regimes and the evaluation of its impacts. However, other areas would also merit attention, in particular public policies to support social innovation and service innovation. A better understanding of social innovation in the light of service innovation and vice versa is likely to help reduce even further the hidden or invisible innovation (the innovation gap) in our economies and enable us to advance towards a new comprehensive innovation paradigm.

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Are the Social Layers of Ecosystem Services Understandable Through Service Dominant Logic: The Business Potential of Forest as an Experience

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ABSTRACT

In the state-of-the-art Service Dominant Logic debate (e.g. Vargo & Lusch 2004, 2008, 2011), the user, customer or utilizer defines the value of an offering. This paper reports the preliminary results of an inquiry into the ecosystem services and the value they deliver for forest owners (e.g. Millenium ecosystem assessment. 2005). We used Finnish non-industrial forest owners as a proxy for a high-involvement group of ecosystem service utilizers. Within this group we tried to identify new spearhead groups in order to try to understand the future of forest resource utilization. This paper reports survey findings of 302 personal (phone) interviews with Finnish forest owners. An 18-point scale was adopted in measuring respondents' personal views on forests they own, in particular, seeking to find out what forests mean for them. These questions were contrasted with questions measuring forest owners' multi-use views of our natural surroundings. We found a clear five dimensional valuation structure in a principal axis factoring analysis and we were able to identify a group of highly multi-use orientated forest owners from the sample. The factor structure explained almost 60% of the variance existing. The multi-use owners had differed views in all five dimensions of forest meaning (economic income from the forest, hedonistic value of forest, self-efficacy related to forests, perceived health effects of natural forests and nature protection locally & globally. Thus, the results portray new types of nature based and nature originating value creation, and thus, highlight the business potential of new types of services catering this group.

Keywords: Ecosystem Services, Service Dominant Logic, Finnish forest owners

INTRODUCTION

It seems our economic form of organization is changing. The previous industrial form of production is giving way to post-industrial economic systems. While the concept of post-industrial production is often associated with high-tech, knowledge-intensive forms of renewal the content of this renewal seems to point to truly new forms of economic exchanges. This happens even to the degree that our economic statistics are un-able to reflect the servitization

(Toivonen & Tuominen, 2009) and intangible exchanges going on in our societies. Only the huge GDP share of the services seems to reflect the change. Of course, one can argue, that services as such are nothing new, and service exchanges existed long before any form industrial production. However, the present challenge seem to be our lack of knowledge on: a) how to provide services on an industrial scale and b) how to renew the present industrial organizations to meet the challenges of the future. Our aim in this paper is to dive into the latter challenge on a very preliminary level. Our task is to search for the intangible, experiential, or emotional dimensions of our relationship to our surrounding nature. We use the axiomatic framework of Service Dominant Logic (Vargo & Lusch, 2004) to search for multi-use values and new forms of relating oneself to the surrounding forests. We make a survey into the values and thoughts of Finnish forest owners and try to identify groups of people with non-traditional views on forest usage. In searching for these "needles in the haystack", we hope to provide light into potential new customer needings and thus possible new value basis of new businesses.

This paper is a part of a research program aimed at understanding forest sector renewal in Finland and elsewhere. We begin by first presenting the theoretical ideas that for the logic behind the work. After this we describe the data collection and the measurement development associated with the survey. After this we present the result of the survey with a sequence of multivariate analysis that start from profiling respondents based on multi-use values. Of the last we used a tentative term of LOHAS-consumer (life of health and sustainability) earlier but have given up this term as our aim is not to describe new consumer life-styles but to search for some type of multi-use, front-runner, opinion-leader type of a "black-box" of a consumer. After profiling we compare the respondent profiles with their forest use aims. Via this we produce three characterizations of possible new consumers.

THEORETICAL BACKGROUND

Research interest in services, service innovations and value creation has evolved from various disciplinary backgrounds. A distinct area of service research has stemmed from business-oriented research into knowledge intensive services (Gallouj 2002, Miles 2005, Kuusisto 2005, Toivonen et al. 2007). In marketing theory, Vargo and Lusch (2004, 2006, 2008) and Grönroos (2008) have been vocal on the need for propagating a new service marketing discipline.[1] These issues have been discussed in studies on services under the topic of 'company driven inside-out view of the approach to one's markets' vs. 'outside-in view of a customer driven service-company'. If the organisations in the markets truly have a customer-driven approach as a basic premise, there actually should not be a wide gap between the service supply and demand for these services. Instead, the forestry service offerings should already have been adjusted to the on-going structural changes among the customers.

Who would then be the customers of nature & forests? The broad concept of ecosystem services (Millennium Ecosystem Assessment) seems to beg the question here? Simultaneously, the service-dominant logic (SDL) introduced by Vargo and Lusch (2004), theorizes the (here nature produced) value existing in the form of the service provided. Thus, the nature and forest consumers define the value produced vie their own perceptual processes. While in business relationships the perceptions of the other are displayed in the level of commitment and trust (Morgan & Hunt, 1994), the tools used in these processes are similar to all interpersonal engagements (Berghäll, 2003). From the ecosystem services point of view, nature can be interpreted as a service provider that offers various ecosystem services for people for free and the cost to the user originates from the alternative costs. Therefore, we are likely, to evaluate the spectrum of ecosystem services via the self-created value perception of the nature surrounding us. However, as social beings, this value is likely to be at least partially dependent on our contexts. In line with this it would be logical to assume that with the pressures of increasingly sustainable use of our natural resources the value of different dimensions of ecosystem services would be increasing. This is especially true to Finland were the use of forests has traditionally been driven by round-wood market needs and optimization of industry raw-material flows. This hegemony of goods-dominant logic (GDL – Vargo & Lusch, 2004) presents us with a case for mapping the, sustainability driven, new logic and the possible business opportunities the forestry sector.

[1] From the strategic perspective of the firm, Kim and Mauborgne's (1999) value creation concept would be, for example, another view to emphasize the key importance of information on customer needs in the process of firm value creation.

As nature, as such, might not be depictable in strictly interpersonal terms we used the four layer structure of *Customer value creation* by Smith & Colgate (2007) to supplement our theoretical basis with the concepts of functional, experiential, symbolic and cost/sacrifice value. This supplements the cultural, provisioning, regulating and supporting services perceived by the forest owner. We combined the layer of ecosystem services with the four layers of customer value creation and earlier forest owner objectives with the schemata below.

	Use values				Non-use values	
	Direct use values			Indirect use values	Bequest values	Existence values
	Consumptive		Non-consumptive			
	Wood production	Non-timber forest products				
Economic/source of income	*Wood trade income*	*Income/savigns from NTFPs*	*Income from tourism, landscape etc.*	*Compensation from global benefits (carbon storaging)*	*Forest as inheritance*	*Increasing prices of forest land throung new forms of use*
Experiential/Emotional	*Enjoying of cultivation / growing*	*Health effects of NTFPs*	*Recreational effects of own forests*	*Feelign of being responsible by maintining forests*	*Leaving a memory for next generation*	*Feeling good becaise taking care of nature*
Symbolic/Expressive/ Social	*Power of decision of using forest*	*Feeling of independency (relaterd to NTFPs etc)*	*Enjoying of forests together with friends and relatives*	*Global benefits (CO2 etc) for whole planet*	*Continuity of family values and traditions*	*Taking care of nature because of its absolute value*

Figure 1: The value map behind forest owner profiling and value measures
Source: Mattila et al. 2013: Based on Rchnau et al. 2013, combining the Millennium Ecosystem Assessment (2005) and Smith and Colgate 2007

While the forests can bring all the layers of ecosystem services into view (i.e. the cultural, provisioning, regulating and supporting), the value is created by the perceptions of the forest owner. A rough division would thus be to divide the values into use and non-use (or existence) values (Krutilla 1967, Jacobsson and Dragun 1996) including the direct aspects of the ecosystem services (Millenium… 2005): provisioning, regulating and cultural services. We excluded supporting services (that enable the previously mentioned services) because they were expected to be too far away from the everyday life of the interviewees. At the same time the three layers of consumer value types divide the previous two into sequentially deepening level of intangibility (or experience). Based on this classification, we grouped the scales and measures under the above titles. The following describes the process more deeply.

MEASURES

The first phase of measurement development consisted of two strategies. First, the Forestry literature scales under the above mentioned topics (Fig.1) were screened and collected into a data base. The scales included at this phase were Horne et. al. 2004, Häyrinen 2012, Taari 2013, Hänninen et. al. 2000 & 2010, and Karppinen 2010. Second the measures from a general handbook (American Marketing Association Handbook of Marketing Scales, 2000) of related scales were screened. The topics under scrutiny here were scales related to involvement, innovativeness/conservatism, attitude towards consumption/products, measures of affect, and concepts that describe the respondent angst or feelings towards ones surroundings. These scales included: Hawes and Lumpkin 1984, Saegert et. al. 1985, Moschis 1981, Lumpkin and Darden 1982, Gaski and Etgar 1986, Shimp and Sharma 1987, Lambert 1980, Holbrook and Crofman 1984, Slama and Taschian 1987, Rahtz el. al. 1989, O'Quin and Faber 1989, Lumpkin and Hunt 1989, Goodwin and Etgar 1980, Dillon et. al. 1984, Joseph and Vyas 1984 and Raju 1980. The scales were combined and grouped under the Fig. 1 themes. After this overlapping items were identified and removed. This procedure resulted in over 100 questions that were screened in two phases. The first consisted of few personal interviews done both by the researchers themselves and the research company. The feedback from these two spheres was combined in preparing separate versions of the questionnaire. As we strived for personal interviews (done by phone) the length of the questionnaire was a serious issue. Further, as we searched for new views and insights, the aim was not to build representative measurement scale. Thus, we balanced the length with the depth.

Therefore, the first interview phase built a shortlist of 100 questions. These questions were then put through the first pilot. This resulted in 18 items measuring forest owner perceptions of their forest supplemented with 9 items measuring forest owner multi-use values (profiling tool). The following describes the analysis process.

DATA & ANALYSIS

The data was collected based on a nation-wide registry of Finnish Forest Owners. The registry is held by the state agency of Finnish Forest Centre. The registry has the addresses of over 300.000 forest owners. From this registry a random sample was picked. The sample consisted of 100 + 300 addresses were the first 100 addresses were used for pilot-testing purposes after which the remaining 300 were used for the main interview phase. All interviews were done as telephone interviews by a Finnish survey research company. Extra effort was put to train and inform the interviewers on the challenges associated in interviewing forest owners about future and possible new uses of Forests (and nature in general). This was done to secure that the responses would reflect new ideas more than conventional forest management thinking.

As the interviews were telephone interviews this paper represents the results of the complete data. Thus 400 interview results are reported. In case the surveying company was unable to reach a pre-selected respondent they supplemented this lack with another randomly picked respondent.

After receiving the data it was checked for basic distributional properties and possible problems related to missing values or outliers. As the observations were relatively complete and no other problems were found the data was entered into a sequence of multivariate analysis. Two separate multivariate analyses were done. One for the multi-use measures and one for the meaning of ones forest. After this we checked whether the respondent profiling might have any predictive power on the respondent evaluation of ones forest and their usage. The following reports the results of these computations.

RESULTS

Respondent Background

By age, 24% of the owners are 40-49 years of age. Likewise 24% consist of 50-59 year old forest owners. 26% are over 60 years of age while 26% are 39 years or younger. This somewhat biased distribution is due to the natural fact that most of the forests are inherited. Most of the forest owners are male (72%) by gender leaving the female as a growing minority (Karppinen et. al, 2010) of 24%. Due to their age the level of education is relatively low with 69% having upper secondary school or lower education. Only 12% hold an academic degree. By profession, two biggest groups are pensioner (21%) and people employed by agriculture or forestry (24%). The forest hectare varies from almost nil to estates over 100ha. However, 77% are less than 50ha in size. For a big majority (40% of the owners) the forest income is 0% of their total income. While for 20% the income is over 30% of their total income. 55% of the forest owners live in rural are while others live in bigger or smaller towns. Thus, our sample is slightly biased towards rural dweller in that in the general population 48% live in rural areas while the rest live elsewhere (Karppinen et. al. 2010).

Respondent profiling tool

As mentioned earlier the profiling tool consisted of 9 questions. The basic properties were first screened on the level of basic distributions. After this the questions were fed into a Principal axis factoring analysis in SPSS18[2]. The aim was to check for the dimensionality of the measures and, as the measure was used the first time, to screen out possible errors caused by questions definition, scale misspecification etc. Via this procedure three questions were left out of the original nine. One was a reverse coded question that seemed to be miss-understood as it distorted the whole factor solution via clear heywood case[3]. Second the items measuring furniture buying and an individual

[2] Statistical package for social scientist - SPSS
[3] division by zero, resulting on 0,999 factor loading in one of the questions.

possibility to affect global environmental problems were left out due to low factor loadings. After this we got the following uni-dimensional solution.

Measure	F1	Commu
I am among first people to adopt eco-friendly products	0,645	0,416
I do not to buy a product if I have doubted the responsibility of the production	0,558	0,311
I am aware of environment change	0,461	0,213
Through my own decisions, I want to reduce the environment impacts of consuming	0,608	0,37
I prefer energy efficient appliances	0,489	0,239
I buy only products made of certified raw materials	0,582	0,338
I prefer products that are made of organic or natural materials	0,696	0,484
Cronbach alpha	*0,75*	
Cummulative variance explained 33,89%		

Table 1: Factor solution of the profiling measures

While the level of common variance explained is low it seem the reliability point towards some level of uni-dimensional consistency in the measures. The solution was checked for sensitivity by computing alternate versions of the solution both with the low-loading questions included and also by computing two dimensional solutions. The most logical and interpretable outcome was the above mentioned factor solution. A two dimensional solution resulted in one or two factor loading on the second factor but having a very artificial interpretation. Thus, we concluded that the above six-question solution reflected what we sought for. Next the solution was saved as factor score variables. Thus, we got a new uni-dimensional solution measuring (in theory) forest owner multi-value orientation towards the sustainable use of natural resources – i.e. a proxy for the social dimensions of the ecosystem services.

Meaning of forests

The relationship, to ones forests, was measured with an 18 item scale. The table also shows the factor solution acquired.

Question	F1	F2	F3	F4	F5	Comm
Positive health effects based on walking in your own forests			,424		,669	,660
Enjoying own forests together with family and friends					,682	,471
Forests as inheritance in order to economic security for the next generation		,862				,682
Leaving a memory of yourself through forest		,738				,645
Maintaining family traditions through forest		,837				,684
Feeling good through nurturing nature	,807					,814
Nurturing nature for itself	,771					,787
Feeling of fullfilling own responsibilities by keeping forests growing	,595					,574
Global benefits (e.g. carbon binding and air cleaning) for planet	,583			,404		,600

Wood trade income				,511		,338
Incomes from hunting, tourism and landscapes				,565		,340
Monetary compensations from global benefits (e.g. binding carbon)				,848		,479
Satisfaction from forestry work and growth of forests			,463			,418
Own power to make decisions on how forests are managed			,536			,373
Feeling of being self-sufficient by owning forests			,627			,526
Income and/or savings by utilizing NTFPs of own forests			,806			,540
Cronbach alpha	*0,842*	*0,84*	*,857*	*0,68*	*0,81*	
Cumulative variance explained 61,94%						

Table 2: Meaning of ones forests

The above table displays a five factor solution. The cut-off point for displaying the loading was 0,4. The factor analysis was computed by principal axis factoring utilizing the Varimax rotation. Thus, it is a classic exploratory analysis (Hair. et. al, 2000) with its benefits and handicaps. However, as can be seen the explanatory power of the solution is relatively high 62% of explained variance. Also, the Cronbach alphas display a good level of factor consistency. As exploratory solutions exist in the number of hundreds or more, the critical thing is to check for the stability of the solution. We did this by both varying the number of factors and the scales entered into the analysis. Our core conclusion was the above solution as alterations would only combine the loadings in an un-intelligible way while the level of explained variance would vary only slightly.

Based on the above, our key result is, that forest owner perceptions of ones forest can be described by a five dimensional space. The five dimensions seem to center around the concepts of economic income from the forest, inheritance value of forest, self-efficacy/sufficiency related to forests, perceived health effects of natural forests and nature protection locally & globally.

Next we delved into inquiring could these conceptual spheres of forest meaning and multi-use profile be contrasted to each other in order to gauge the social and psychological meaning of the different layers of forest provided experience or service as such (Vargo & Lusch, 2004).

Forest owner profile as a predictor of multi-use value

We picked two different approaches to describing the relationship between forest owner multi-use profiles and perceptions of forest meaning. At first we divided the forest owners into three groups according to their factor score coefficients of the first factor analysis (multiuse value). The factor score means were then plotted on the radar-type figure below.

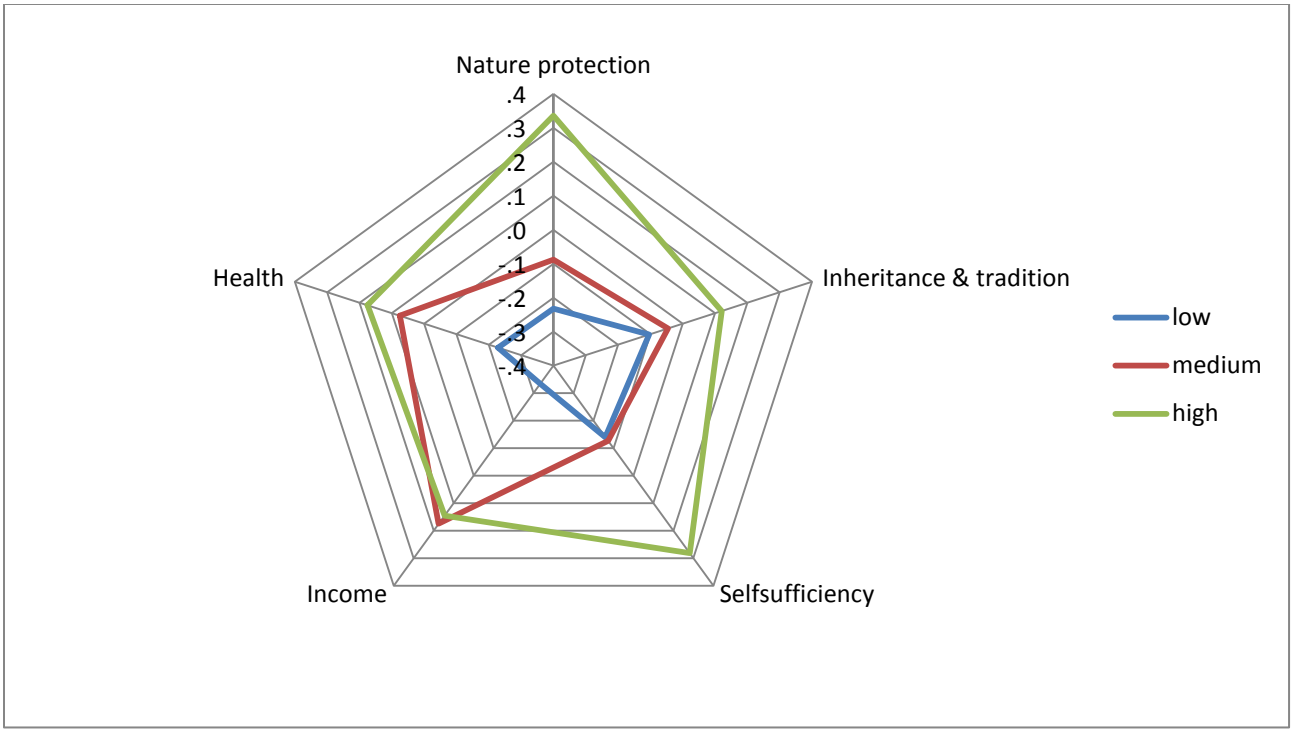

Figure 2: The high, medium and low multi-use groups of forest owners depicted against the meaning of the forest factors.

As can be seen the differences are dramatic between the groups. All differences are significant ($p<0,00$) in the areas were the points do not exist close to each other. What the figure seems to suggest is that there could be a group of forest owners to whom the meaning of the forest is much higher that to the two other groups of low and medium, but further, that to this group the picture of forests as such is more complicated than purely as income, health (recreation) and inheritance.

Next we made another attempt to understand the relationship of the profiles with the perceptions of ones forests. Thus, to find out if the respondent valuation would have an effect on the valuations of the different "produce" (or services) of the forests, we computed a few simple path analyses where the multi-use values were the predictor of each of the five factor acquired in the previous section. As the level explained variance in the profiling measures (the first factor analysis) was only slightly above 30%, we felt, that one could not search for high level of predictive power in the path models but only gauge whether the relationship between the predictor and the predicted might be significant. The following table displays the results.

Predicted factor	Beta	t	Sig.
Nature protection	0,329	5,527	0,000
Self-sufficiency	0,290	5,091	0,000
Income	0,241	4,03	0,000
Inheritance	0,111	1,738	0,083
Health	0,202	3,596	0,000

Table 3: Multiuse as predictors of the five dimensions of forest meaning.

As can be seen all but one of the dimensions is predicted to a significant degree. Also, for the remaining inheritance, the significance figure has an accentuated level. The relationships seem to be that strong that the sample size effect is not able to counter these last results. Thus, we feel, that the tentative outcome of this exercise is that there seems to be a group(s) of forest owners to whom the provisional and social layers (at least) of ecosystem services have a positive value as such. Turned around, the service perceptions of the five factors seem to reflect new potential in

building services based on the sustainable use of natural resources. The following ties the findings together and reflects on the results via the proposition presented earlier.

CONCLUSIONS

The core of this exercise was to explore opportunities for value creation in the group of people with non-traditional views on forest usage. The aim was to build a preliminary understanding on if forest owner perceptions of their forest use could contain material that could be tied to or organized under the banner of ecosystem services. Further, we wanted to find out, if such layers of perceptions could have enough potency to act as a proxy to understand future service value of the forest or nature in general. We advanced from profiling forest owners based on their valuations and their views on sustainability. Via developing measurement scales for both the two conceptual spheres we were able to describe and predict the forest owner views on their forest usage. While the results are still on a tentative level they see to provide some assurance to new forms of needing as existing, at least in this group of people. While our measures, originally designed for gauging LOHAS-lifestyle was latter seen to be a narrower measurement by nature, the results still seem to have some level of predictive power. Further, the five dimensional factor solution was clearly valuable in depicting the vast differences of attitude towards forest utilization. We will continue to search for the logic explaining the perceptions of the high multi-users but believe that in their value structure lie a good description of the future ecosystem-based service businesses.

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