Mehdi Snene (Ed.)

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Exploring Services Science

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Preface

Services represent the fastest growing sector of the economy in industrialized nations. Services science, introduced by IBM in 2002, arises from the rapid development of services across the industrial world and the need to analyze and study the organization, deployment, maintenance and operation of those related IT-based and IT-supported services. Services science represents an interdisciplinary approach to the systematic innovation in service systems, integrating management, social, legal and engineering aspects to address the theoretical and practical aspects of the challenging services industry and its economy. Services science leverages methods, results and knowledge stemming from these disciplines toward the development of its own concepts, methods, techniques and approaches thus creating the basis for true transdisciplinary gatherings and the production of transdisciplinary results. Services science is building a concrete framework for transdisciplinary purposes. The conference on Exploring Services Science (IESS) is now an established conference where researchers from around world present innovative ideas, research and applications in the design, experimentation and management of services. The Third IESS Conference was held at the University of Geneva, February 15–17, 2012. The main theme was the transdisciplinary services approach. The papers presented ideas and issues related to the innovation, services management, services engineering and services discovery.

The conference attracted 46 papers from 22 countries and the program committe accepted 22 full papers (from p.1 to p.310) and 6 short papers (starting from p.311). Given the novelty of the domain of services science we would like to acknowledge and thank all the authors for their contributions and their trust and the Program Committee members for their valuable and professional work in reviewing the submissions and crafting the program of this third IESS conference. The conference featured the keynote presentation of Gerhard Stazger from KIT, Germany. Following the conference a half-day societal forum was held and addressed issues in the areas of innovation in services.

We would like to thank the Program Committee members and the referees who reviewed the submitted papers as well as the local Organizing Committee and institution (Institute of Service Science, UNIGE, Switzerland) for all the effort and support in setting up and organizing the conference. We wish you a pleasant reading and a fruitful use of these research results in your research and applications.

February 2012 Mehdi Snene

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Towards a Process Model for Service Systems

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Abstract. Service Science is a new interdisciplinary approach to the study, design, implementation, and innovation of service systems. However due to the variety in service research, there is no consensus yet about the theoretical foundation of this domain. As a basis for a common understanding of service systems and their interactions, Service Science researchers Spohrer and Kwan proposed the service systems worldview. The ISPAR model was presented as a part of this service systems worldview as a tool for identifying ten possible interaction episodes, i.e., the sequences of activities that are undertaken by two interacting service system entities. In this paper we evaluate the use of the ISPAR model as a process model for service systems. We identify the shortcomings of the ISPAR model and propose possible improvements. This analysis leads to the development of a new service process model which is demonstrated through tree different examples.

Keywords: Service Science, SSME, service system, service process model, ISPAR model.

1 Introduction

The research presented in this paper is part of a research project that investigates the theoretical foundation of Service Science which is a new interdisciplinary field that studies the structure and behaviour of service systems. Due to the variety in existing service research (e.g., services marketing, services management, service design, service-oriented computing), there is no consensus yet about which theories and frameworks could serve as a scientific basis for this domain [1-5].

As a starting point for our research, we took the service systems worldview of Spohrer and Kwan [6]. The service systems worldview was proposed as a candidate shared conceptualization for Service Science researchers. The authors propose a domain model that consists of ten foundational concepts and explains the diversity and complexity of service systems. In addition, Spohrer and Kwan introduce a process model, i.e., the ISPAR model as a normative model of all possible service system interaction outcomes to better understand the dynamics of service systems [7].

In [8], we clarified the ten foundational concepts by investigating them from the perspective of established service theories and frameworks. By mapping the

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proposed service system concepts on the service theories and frameworks, we clarified their theoretical foundations, examined their definitions, identified possible conflicting interpretations, and discovered their likely relationships and general structure.

This paper elaborates on the process orientation of the service systems worldview. The ISPAR model shows ten possible interaction episodes, i.e., sequences of activities that are undertaken by two interacting service system entities [7]. Each of these interaction episodes is associated with a particular outcome, which can be a desired or non-desired result of the interactions. We believe that the ISPAR model component of the service systems worldview has shortcomings when used as a process model for describing the interaction of service system entities. As we will explain, the ISPAR model lacks structure and clarity which is an obstacle in analysing service processes established by two (or more) interacting service system entities.

The aim of this paper is to refine the ISPAR model to a normative process model for service systems. In the remainder of this paper, we will try to answer two clear-cut research questions. The first research question that needs to be answered is: What is a normative service process model for service systems? Therefore, the ISPAR model is evaluated and four important shortcomings are defined. For each of these shortcomings, we propose a candidate solution. Our research method consisted of comparing the ISPAR model with two established service process models or frameworks which serve as a good basis for the comparison but are in itself incomplete with respect to their coverage of possible interaction episodes between service system entities. We identified which elements from these alternative models or frameworks can be incorporated to further refine and extend the ISPAR model.

The second research question is: How to represent such a normative process model? As an answer to this question we propose new graphically represented service process model for Service Science that meets the characteristics defined by the first research question. The model is designed as an Event-driven Process Chain (EPC). As it is largely based on the ISPAR model, it includes all the originally proposed interaction episodes. However, it also includes some new elements which should serve as an answer to the identified shortcomings.

Section 2 gives a thorough description of the ISPAR model as proposed by Spohrer and Kwan. In section 3 we evaluate the model by highlighting the most important shortcomings of the model. Section 4 presents possible solutions for these shortcomings. Section 5 then redefines the ISPAR model by using an EPC representation. Next, we demonstrate the new service process model in section 6. Finally, section 7 presents a conclusion and future work.

2 The Service Systems Worldview

In [8] we investigated the proposed foundational concepts of the service system worldview from the perspective of established service theories and frameworks used in service marketing, service management, service operations and service computing research. Based on this investigation, we identified relationships between the foundational concepts and visualised this structure in a conceptual model (in the form of a UML class diagram). Figure 1 shows the developed model of the ten foundational concepts to explain the diversity and complexity of service systems: *entity*, *resource*, *access right*, *ecology*, *interaction*, *value proposition based interaction*, *governance mechanism based interaction*, *outcome*, *measure*, and *stakeholder* [9].

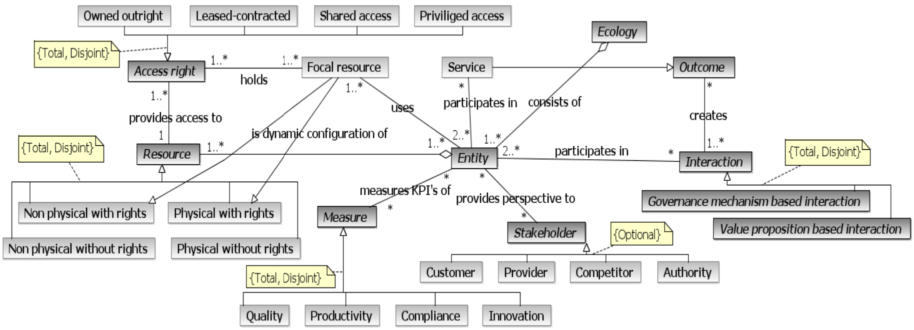

Fig. 1. UML Class diagram of the service systems worldview [8]

The ISPAR model deals with some of these concepts. It is a prescriptive model that considers all possible *interactions* and their corresponding *outcomes* between different *service system entities*. As there exists a great variety of different types of service interactions, the ISPAR model makes abstraction of this complexity by categorizing interaction episodes according to their outcome [10]. By mapping actual sequences of interactions onto the model, it becomes possible to evaluate a service system's *quality* (i.e., a specialisation of *measure* in Fig. 1). Quality can be expressed as the ratio of successful service outcomes to all other interaction outcomes of a service system. Moreover, the ISPAR model permits the mapping of (service) interactions of every possible kind of service system [11]. It is suited for typical *value proposition based interactions* between provider and customer which assume a value proposition that indicates how the interaction will lead to mutual value co-creation (i.e., what is called *service* in Fig. 1). However, it also provides a manner to model the outcomes of so called *governance mechanism based interactions* which occur in the context of collective interest, i.e., when the interaction is regulated by a governing body like auctions or court cases [6].

To show the ten possible interaction episodes and outcomes, the ISPAR model is represented as a branch model (Fig. 2) [7]. Realization (R) is the most desired outcome. In this case the value proposition is successfully proposed, agreed upon and realized, and the outcome is mutual value co-creation.

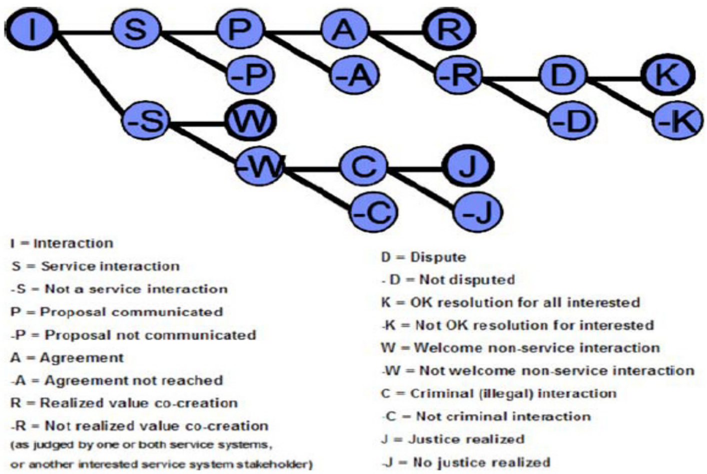

Fig. 2. The ISPAR model of service system interactions [7]

To reach outcome R two service system entities have to engage in interactions (I) which classify as service interactions (S) during which a proposal has to be communicated (P) and the service system entities have to reach an agreement about the service (A). If the service proceeds as agreed, it is said that the service is realized (R). However, the ISPAR model indicates that the service systems worldview is not a happy path theory but also takes into account other outcomes that deviate from mutual value co-creation. A service proposal may not be successfully communicated or understood by a service system entity (-P) or two service system entities may not come to an agreement about the proposal (-A). Another option is that mutual value co-creation is not realized as agreed. In this case a dispute may (D) or may not (-D) arise. A dispute can lead to two possible outcomes. Either the dispute is successfully resolved for all stakeholders (K) or the proposed solution is not acceptable for at least one stakeholder (-K).

When an interaction doesn't qualify as a service interaction (-S), it can be welcome (W), e.g., when saying hello to a colleague at work. However, a non-service interaction can be unwelcome (-W), e.g., when a restaurant discovers that two clients have been assigned to the same table. If this non-service interaction is not a criminal act (-C), the interaction sequence ends at that point. If it concerns a criminal activity (C) like theft, this can result in justice (J) if the criminal is punished or in no justice (-C) if the lawbreaker manages to escape.

As the aim of this paper is to provide service researchers with a clear service process model that enables the analysis and improvement of the service process, the interaction episodes that are composed of non-service interactions will be left aside. The service process model we aim at will thus only cover situations in which mutual value co-creation is the purpose of engaging into interactions with other service system entities.

3 Evaluation of the ISPAR Model

Although the ISPAR model gives a comprehensive overview of the possible interaction sequences between two service system entities, the model does not serve as a good process model. Overall, the model lacks clarity and structure which makes it difficult to analyse service processes. We can identify several obstacles to the use of the ISPAR model as a normative service process model.

First, a good process model should emphasize all important activities that take place during the process. However, in the ISPAR model the propose and agree activities present a necessary (even if sometimes implicit), but often (though not always) a relatively minor part of the service process, while the realize activity comprises in many cases the main part of the service process. We believe that the realize component of the model is not specific enough and doesn't show the complexity of the realization of a service. If a company has a maintenance contract for the elevators of a building, the service realization interactions may be spread over several years and range from the monthly maintenance to a phone call from the sales department to extend the contract. As the type of services performed can differ strongly, the realize activity should be further refined.

Second, according to the ISPAR model a service proposal is very concrete and direct, e.g., a service contract which is signed by both provider and customer. However, by using this limited view on proposals, a lot of potential service interactions are excluded from the analysis. A television commercial for a university could serve as a first proposal from that university to potential students, which are at the moment of broadcasting not individually identified and maybe not even aware of the service offer. We believe that a broader interpretation of the propose activity, i.e., not necessarily involving two explicitly identified service system entities that purposefully interact and are both aware of the service need and offer, could enable a more complete analysis of service processes.

Third, Spohrer and Kwan state that the ISPAR model shows service system interaction episodes which describe the sequence of activities that might be pursued by two interacting service system entities [11]. However, a few elements indicate that the ISPAR model may not be suited to describe the sequence of activities. Only the propose (P), agree (A) and realize (R) nodes of the model are real activities (where R is at the same time an outcome). The interact (I) node has no real meaning other than being the source of all further offspring. The S and –S nodes describe types of interaction episodes, i.e., sequence of service or non-service interactions. The ISPAR model thus mixes the overview of possible outcomes with the actual process flow.

Fourth, in the ISPAR model every path leads to a different outcome. However, we believe it is possible that the same outcome is reached through different paths. We use the example of a consulting service to clarify our point. A consulting firm makes a proposal to a customer (P) and reaches an agreement with that customer about this proposal (A). After fulfilling the proposed services, the consulting company invoices the customer. If the customer pays as agreed, mutual value co-creation is reached (R). However, if the customer does not pay, the outcome according to the ISPAR model would be -R. In an attempt to solve this problem (D), the consulting firm would send a reminder to the customer. If the customer pays the invoice after receiving the reminder from the provider (K), mutual value co-creation is still reached. So in that case, outcome K is the same as outcome R. In a good process model, these two paths would lead to the same end state. The same goes for the process nodes -P and -A. Although these nodes are outcomes in the ISPAR model, we argue that a badly communicated proposal can be set right by the decision to reiterate the proposal episode. Thus, the service process can still have a successful outcome. However, this cannot be read from the ISPAR model as it doesn't provide any return paths.

4 Proposed Improvements for the ISPAR Model

To propose improvements for the ISPAR model, we will formulate some ideas or strategies to counter each of the comments above. For the first tree comments, we evaluate two established service process frameworks. The first framework is a part of Alters' *work system method* which is a business-oriented system analysis and design tool [12]. The work system framework uses nine basic elements to provide a system view of the organisation [12]. Next to this work system framework, Alter proposes the service value chain, which elaborates the work system framework with service-oriented insights [2]. It presents a two-sided view of the service process as the service is coproduced by customer and provider. It shows the different steps that should be executed in a service process. Alter shows the different kinds of interactions that emanate from a value proposition (figure 3). First, customer-provider contact is based on awareness. The provider should create awareness among customers about the existence of the service. The customer should become aware of a need that has to be filled. Next, provider and customer will engage in a negotiation about commitment to the service. The ISPAR model of the service systems worldview also recognizes these two types of interaction (i.e., proposal and agreement) which show how the service process is initiated, but as already mentioned does not further distinguish between different types of interaction that occur when the rest of the service process is executed (i.e., realisation). The service value chain model further defines these interactions or service encounters. The customer makes a service request which is handled and fulfilled by the provider and the customer participates in this fulfilment. Finally, both customer and provider follow up the handling of the service.

The second framework is the *service ontology based on the DOLCE upper-level ontology* of Ferrario and Guarino [13]. As can be seen in figure 4, a service is conceived as a complex event with five main parts: service commitment, service presentation, service acquisition, service process and service value exchange. A key concept in the service ontology is the commitment of an agent to guarantee the execution of a service at a certain place and time. The authors strongly focus on commitment which they consider as the core of a service. However, commitment here has a different meaning than commitment defined by Alter. Here commitment implies more than just agreeing to a value proposition. A value proposition is usually the result of negotiations between provider and customer. Therefore the customer has already decided he wants a certain service. Service commitment according to Ferrario and Guarino means the willingness to perform a service on the side of the service provider without needing the involvement of the customer. This implies that service can exist even before the occurrence of interactions between provider and customer. So, the commitment of the provider to guarantee the production of a service content is the first step in the service process.

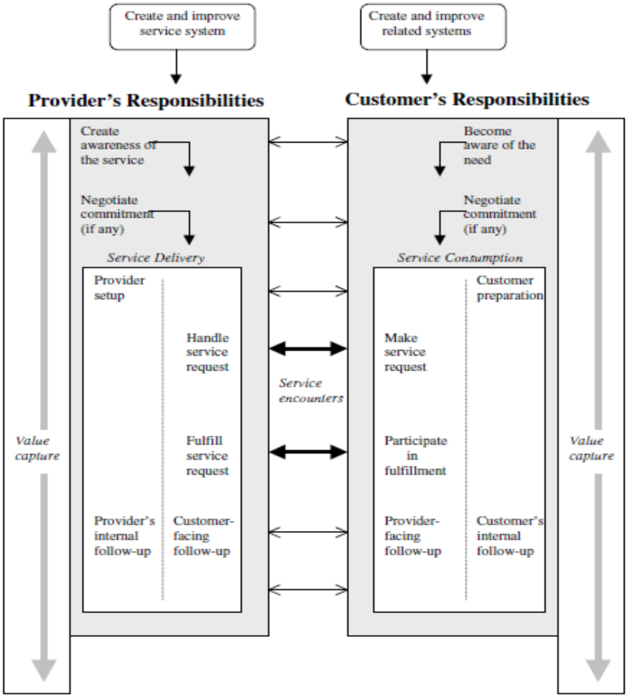

Fig. 3. Alters' service value chain framework [14]

Nevertheless, commitment is not sufficient to initiate the actual service execution as it only indicates willingness on the side of the provider. Hence, a triggering event is included. Provider entities should be notified of the occurrence of this event in order to know when the service should be executed. After the occurrence of the triggering event, the provider should bundle his services and present them to the customer. Then, service acquisition takes place at the side of the customer. After negotiating the service offer, the provider produces the service content. In order to produce the service, both customer and provider should sacrifice something, e.g., the provider sacrifices time and effort into realizing the service while the customer has to sacrifice money and possible other resources like his time.

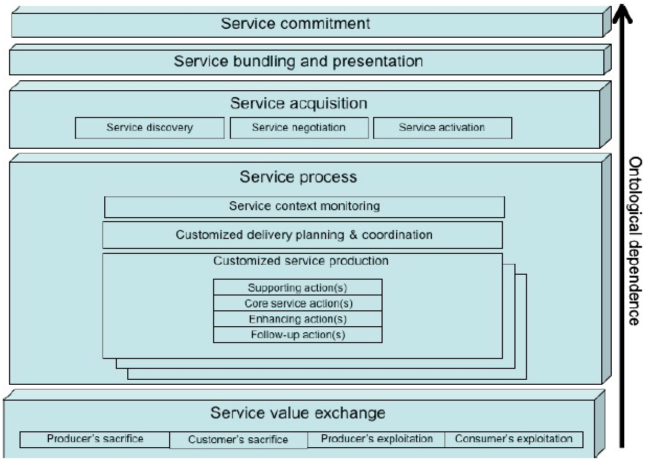

Fig. 4. The layered structure of service activities of the service ontology [13]

In our first critique on the use of the ISPAR model as a normative service process model, we suggested that the realise activity should be elaborated. Possible improvements can be found in the service value chain of Alter which identifies three different steps. First, the customer has to make a request which is handled by the provider. We believe this step may be important as agreement about a service does not always mean that the service is realized immediately. Next, customer and provider participate in the fulfilment of the service. Finally, customer and provider engage in some follow-up activities. The service ontology of Ferrario and Guarino also provides us with some useful insights. The authors also indicate that service agreement doesn't automatically lead to service execution. The occurrence of a triggering event is seen as a signal for initiating the service. However, the triggering event doesn't always have to be a customer request. For example, it could also be snowy weather which activates a snow removal service.

The second obstacle that we identified dealt with the interpretation of the propose activity. We notice that the propose activity is defined differently by the various service process frameworks. As already mentioned, in the ISPAR model a service proposition is very concrete and direct. Both the service value chain framework of Alter and the service ontology of Ferrario and Guarino provide us with a broader view of the proposal concept. We note that Alter uses a broader definition as the creation of awareness can also be done by broadcasting a commercial on television. Ferrario and Guarino introduce the concept of commitment which also indicates a broader understanding of the propose activity. According to the service ontology a fire department makes a commitment by simply existing and being prepared to provide help in case of a fire. Therefore the proposal is already done. However, as the service ontology of Ferrario and Guarino has a different definition of service which doesn't match the vision of the service systems worldview (see [8] for a comparative analysis of service definitions), we choose to adopt the interpretation of Alters service value chain. According to Ferrario and Guarino service equals commitment. We believe that this vision is suited for governance mechanism based interaction, e.g., a fire department, but doesn't account for value proposition based interactions that are typically found in business, e.g., the mere existence of a kiosk doesn't commit the kiosk owner to sell newspapers to customers passing by.

The third comment stated that the ISPAR model mingles activities with outcomes. This is confirmed by looking at the service value chain framework of Alter and the service ontology of Ferrario and Guarino. Both frameworks roughly identify a propose, agree and realize episode. Interaction and service interaction are not part of the models as separate activities. Alter indicates that each contact between customer and provider, e.g., interaction is a service encounter. This confirms our statement that every propose, agree or realize activity requires one or more interactions [5]. We can conclude that the ISPAR model should be redefined so that activities and possible outcomes or states of the system are separated from each other. To model the service process we propose the use of an EPC process model [15]. The EPC technique is a well-known Petri Net based process modeling technique. The basic building blocks of an EPC are events and functions. Functions describe an activity or task that leads from one event to another. An event describes the state of the process at a certain moment. In an EPC functions and events alternate each other. A Function is represented by a rectangle and an event by a hexagon. The events and functions can be connected through logical operators as XOR, IOR and AND.

To tackle the fourth comment we propose to change the representation of the ISPAR model. The service process model should be built in such a way that on the one hand paths which lead to the same end state are aggregated at some point in the process model and on the other hand return paths are provided to restore the service process in case of failure. The new representation of the service process model, i.e., the EPC, provides us with the opportunity to incorporate this feature into the model.

5 Service Process Model

Figure 5 shows our proposal for a normative service process model based on the ISPAR model. In this model three possible outcomes can be identified: service aborted, service successfully ended, and service not successfully ended. All possible interaction paths in this service process model will eventually end in one of these three final states. As explained in section 4, we have chosen to work with an EPC representation of the service process model. The model allows us to separate functions (or interactions) from events (including ISPAR outcomes). All ten interaction episodes from the ISPAR model are included in the EPC.

The model starts with the event 'customer is aware of service need or offer'. This event accounts for both a push scenario in which the customer seeks a provider to fulfil a service need as a pull scenario in which a provider persuades the customer that a certain service might be useful. In both scenarios the provider possesses resources or access rights to resources that the customer needs or wants. This is in fact the reason for all service interaction. Customers become aware of a certain need or want but do not possess the necessary resources. Therefore a service process is initiated by the customer (push scenario) or the provider (pull scenario) in which all kind of resources are traded. Not only technology or natural resources but also information or competences are resources a provider might possess.

After this first event, which is the starting point of any service process depicted with our model, the activity ‘propose service interaction’ is performed. As explained above, we choose to adapt the service proposal interpretation of Alter in which a proposal is not narrowly defined, but can be anything that will eventually lead to an agreement between two interacting service system entities. If this activity fails and the service proposal is not successfully communicated or understood, this can lead to the outcome ‘service aborted’. However, unlike the ISPAR model, our service process model provides a return path. This return path makes it possible to decide to revise and reiterate the service proposal.

If the proposal is successfully communicated and understood, the two service system entities can move on to ‘agreeing to the service proposal’. Again, in case of failure, the service process can be aborted at this point or the service system entities can decide to revise the agreement. After an agreement about the service proposal is reached, the service execution should be initiated. The initiation signal which is mentioned in the service process model, can be compared to the triggering event in the service ontology of Ferrario and Guarino. However, the initiation signal could be a signal given by the customer or the provider or the occurrence of an event that starts the service realization. If the initiation signal is not sent or received, the service system entities could decide to revise the initiation signal. This return path provides an opportunity for the service system entities to choose a new initiation signal or detection method. If the initiation signal is not revised, the service is aborted.

If the first three activities (propose service interaction, agree to service proposal, and initiate service execution) in the process model succeed without problems, the service realization activity can start. This is the core activity of the model as this is the execution of the service content as defined by the agreement. The outcome of this activity is judged by both service system entities through different measures. If the service is successfully realized, both service system entities perform follow-up activities. In this model, the follow-up activities are seen as internal activities, performed by both service system entities separately. However, if these follow-up activities are a part of the agreed upon service proposal, e.g., the installation of an elevator with a maintenance contract for the next 5 years, they should be looked at as a part of the service realization activity.

The service realization is not successful if one of the service system entities is not satisfied with the outcome of the service realization. This entity may decide to dispute the service outcome. If the service outcome is not disputed, the outcome of the service process is ‘service not successfully ended’. However, if one of the service system entities decides to dispute the service outcome, the nature of the interaction changes. All previous interactions are value proposition based interactions, i.e., based on the value proposition to which both customer and provider agreed. Here, we see a shift towards governance mechanism based interaction.

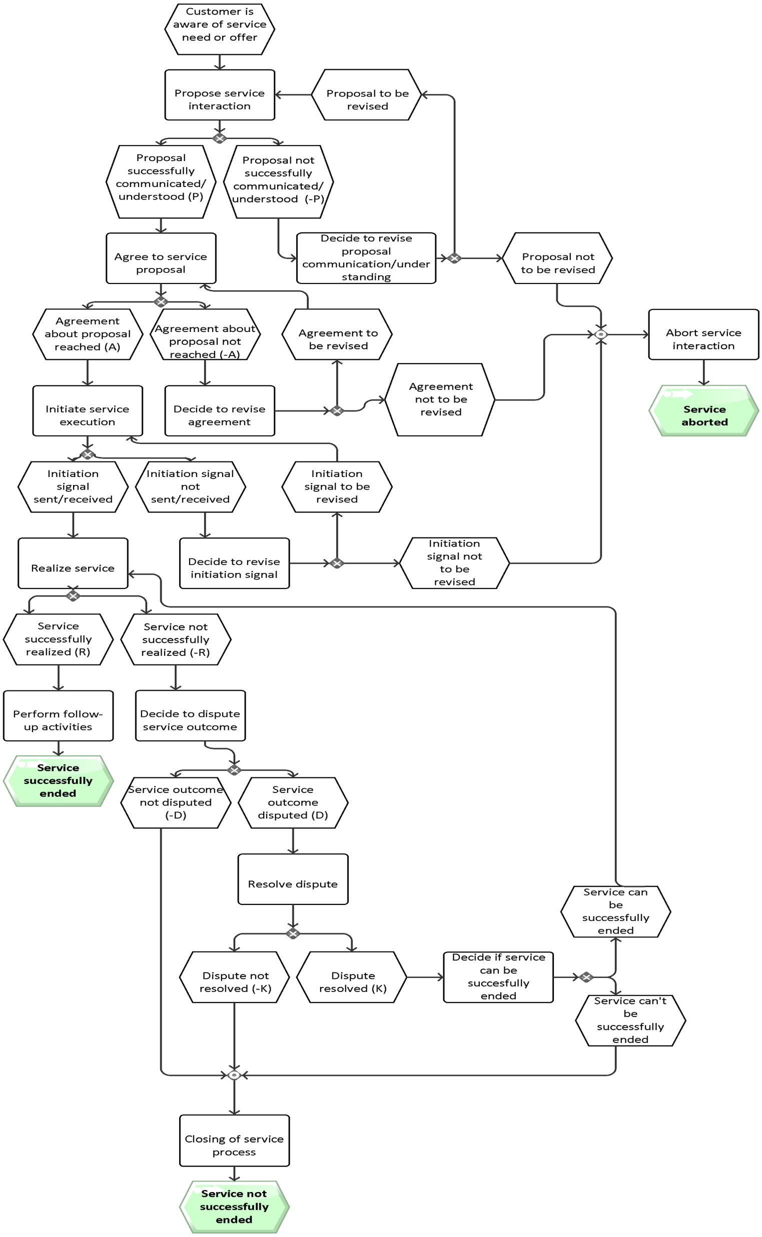

Fig. 5. EPC representation of service process model

In case of dispute between two entities, the interaction will probably be regulated by a governing body like a mediation service or a court case. If the service system entities do not succeed in resolving the dispute, the outcome is still 'service not successfully ended'. Resolving the dispute provides a return path to the 'realize service' activity. However, a solved dispute doesn't always mean that the service can be ended successfully. If a judge decides that an amount of money due by the customer is remitted, the dispute is solved but from the perspective of the provider this doesn't mean that the service can be ended successfully. To have a successful service ending, all stakeholders should be satisfied with the service outcome.

6 Demonstration of Service Process Model

To evaluate the service process model, we demonstrate three service examples which strongly differ from each other [16]. The advantage of this approach is that each example can be seen as the representation of a category of services that can be modeled in a very similar way.

The first example, a business lunch, is a type of service in which the exchange of physical resources forms an essential part of the service process. Figure 6 shows the EPC of a business lunch. The EPC shows that the service is not successfully ended as the customer didn't receive the meal he ordered. After a complaint of the customer with the restaurant owner, it is decided that the customer doesn't have to pay the meal and the dispute is settled. In the ISPAR model this would equal service outcome K. However, compared with the ISPAR model, the example shows a few improvements. First, as can be seen from the EPC, the realize activity has been divided into the actual realization of the service content, i.e., the cooking of the meal and serving it to the customer and the activity that initiates this service realization, i.e., the communication of the order of the customer to the cook. Therefore the EPC gives a more complete overview of the service process compared to the ISPAR model. Due to this division, it becomes easier for the provider, i.e., the restaurant owner, to determine the cause of the unsuccessful service delivery. Second, the model shows an unconventional proposal activity. The customer reads a lunch offer of a restaurant in a magazine. The advertisement states that a reservation is not needed. The example clearly illustrates a push scenario in which the customer initiates the service process. Although this kind of service proposal is not included in the ISPAR model, the advertisement can be categorized as a service proposal from the provider to the customer. Third, due to the EPC representation form, activities are clearly separated from outcomes. Each activity is followed by a certain state which determines the outcome of the service process.

The second example shows a money investment service. In this case there is no physical exchange. The service is limited to a more abstract form of value co-creation. A bank notices a large amount of money on a customer's account and proposes the customer to invest the money. The different investment possibilities are discussed during an appointment but an agreement is not reached. The customer then decides to make a second appointment, but again no agreement is reached and the service process is aborted. Figure 7 shows the EPC model. This example also demonstrates how the use of EPC enables a distinction between outcomes and activities. Moreover, other than the ISPAR model, our model allows a customer or provider to restore the service process after a failed agreement activity. The customer is not satisfied with the proposed investment rates and thus an agreement is not reached. The EPC provides a return path through which the customer can reiterate the agreement activity. When modeling this example with the ISPAR model, no loops can be introduced, so the model needs to be instantiated again (i.e., it seems that a new service process is started) to show the second attempt at reaching an agreement.

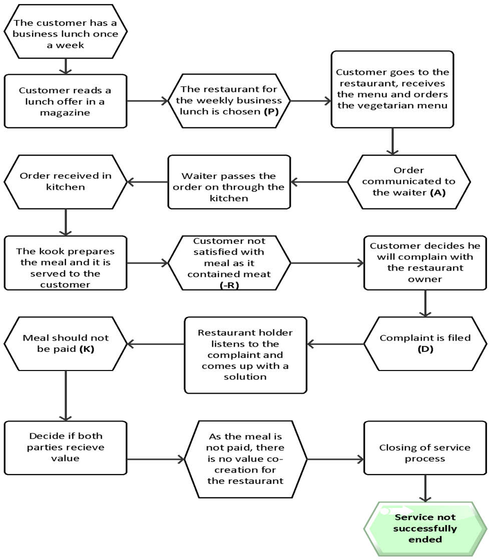

Fig. 6. EPC of business lunch

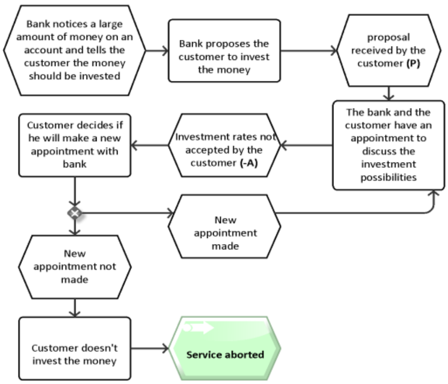

Fig. 7. EPC of a money investment service

The third example, an online newspaper service, doesn't include a physical exchange either. Moreover, there is no direct physical contact between the customer and the provider. Figure 8 shows the EPC which represents the category of online services. In this particular example the service outcome is mutual value co-creation (R), i.e., the service process is successfully ended for both the customer as the provider. However, as the proposal was not immediately understood by the customer, a return path had to be used. After calling to the customer service, the customer decides to revise the service proposal. After a second reading, the customer is willing to agree to this proposal. By analyzing the model the newspaper company could come to the conclusion that the terms of subscription are not clear enough. Based on this observation the newspaper could decide to improve the subscription terms or, to invest in an extra telephone operator to answer questions of customers. Just as in the first example, the new division of the realization activities becomes clear. Before the actual service realization, an initiation signal is needed. In this case this is a confirmation email from the provider stating that the customer has access to the online articles. The ISPAR model doesn't include an initiation signal and is as a consequence less complete. The downloading and reading of the articles represents the actual service realization. When the contract expires, the newspaper performs some follow up activities such as propose the customer to extend his subscription.

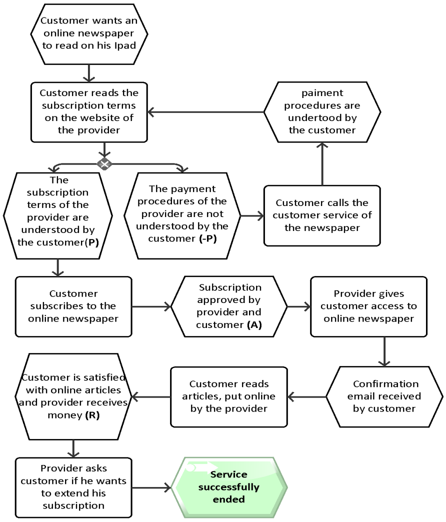

Fig. 8. EPC of an online newspaper service

7 Conclusion and Future Work

In this paper we investigated whether the ISPAR model could serve as a good service process model. Our research points out four shortcomings of the ISPAR model from which we conclude that the model in itself is not sufficient as a process model and needs elaboration with several elements, some of them handed by other service process frameworks. The new service process model includes all important elements of is the ISPAR model while adding elements of two alternative frameworks.

Future research may develop in two directions. First, the model should be elaborated such that an initiation signal can be given and received more than once. In the proposed service process model we assumed that this initiation signal had to be given only once. However, in some service situations such as a maintenance contract, the service realization might be caused by a long iteration of initiation signals. This is not incorporated in the current model and could be an interesting point of elaboration. Second, in order to fully realize the goal of integrating a normative service process model into the service systems worldview, a mapping of the service process model onto the ten foundational concepts defined by the service systems worldview is needed. It seems only logical that the description of how a service system is structured and the description of how a service system behaves are linked together in one conceptual model of service systems.

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Extending an Adaptive Interface Framework to Support Collaboration

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Abstract. We are living in a world of interactions, surrounded by electronic devices which are getting numerous and are complicating interactions. Moreover, the users are now mobile, evolving in multiple changing environments. The problem is even more complex when it comes to collaborative tasks where these conditions can inhibit productivity and software as a service adoption. This paper presents an ongoing work on the usage of adaptive interfaces to address this problem and the issues raised.

Keywords: Human-Computer Interaction, Collaboration, Software as a Service, Context-Awareness, Adaptive Interfaces, Group-Awareness, Model-Driven Engineering.

1 Introduction

Nowadays, we are living in a world of interactions. We are surrounded by electronic devices which follow and assist us in our activities. This environment implies a diversity of Human-Computer Interactions (HCIs) which will be used in a broad range of contexts of use. These contexts are also evolving over time, adding another level of interaction complexity. This complicates users' interactions but also conceptors' work to build usable HCIs, hence limitations in proposing Software as a Service. This observation has led to new paradigm of interaction such as *pervasive computing* [1] and other theories like the *situated action* [2], both of which are considering the context of use.

The domain of *adaptive interfaces* follows these researches. Adaptive interfaces are able to react to the changes within a context of use by adjusting their presentation and/or proposing different services. The aim of an adaptive interface is to preserve the usability of the interface across different contexts of use. When it comes to collaboration, the context of use is more complex due to the

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fact that organisations are dynamic and flexible. While collaborative work could benefit from being based on adaptive interfaces, the latter still have to cope with the former.

The purpose of the work related to this article is to promote the conception and the production of adaptive interfaces for collaborative environments. As a first part, this article presents the context of use concept and reports the current issues raised by in-context collaboration. The second part presents adaptive interfaces and more particularly the plasticity. The third covers the essential elements required by the plasticity to properly support the collaboration. Finally, we present a work in progress by enhancing an existing adaptive interface framework to implement collaboration.

2 Collaboration in Its Context

In the today collaborative context, users have to interact in multiple situations. These situations represent different sets of conditions (e.g. different hardware, physical environments, collaborators...). This complexify the design process of user interface and tends to limit the adoption of Software as a Service for collaborative tasks.

This section presents the notion of context and its impact on the conception of collaborative interfaces.

2.1 What Is the Context of Use?

Context of Use. In computer sciences, the most admitted definition of the context of use is given by Dey & Abowd [3]:

> "Context is any information that can be used to characterize the situation of an entity. An entity is a person, place, or object that is considered relevant to the interaction between a user and an application, including the user and applications themselves."

The context is commonly split into three components: the physical environment (i.e. weather, luminosity...), the computing environment (i.e. the technical characteristics of the device hosting the application) and the user (i.e. his/her identity, preferences, skills...).

Highly Collaborative Context. A collaborative context is more specific than the typical three-component context of use. This is due to organisations and their particularities. As stated by Mintzberg [4], organisations can be dynamic and flexible: actors are from all walks of life, have different tasks, have different job positions and their hierarchy can wield different aspects according to projects' conditions. In this respect, we will refer to this as a *highly collaborative context*.

2.2 Issues Related to Conventional Approaches

Collaborative interfaces are commonly designed as monolithic blocks that support only one specific context: the one it has been designed for. This approach is restrictive and may lead to issues related to communication, document management and the consideration of the organisation topology [5]. Hence, it is suggested that interfaces supporting collaborative work should be able to adapt to the dynamicity of an organisation and the associated activities [5] [6]. Adapting to a highly collaborative context is hinted to promote a better communication and coordination, thus enhancing the efficiency of the collaboration (but not necessarily the productivity).

As an example, the Architecture, Engineering & Construction (AEC) sector is a good representative of a highly collaborative context. Many different jobs are involved with a broad range of skills. Depending on a project phase, the actors are not the same or does not have the same role (e.g. conception phase, construction phase, building life cycle...). A construction site can be a harsh environment (e.g. noise, dust, weather...) and these conditions has a direct impact on the activities (e.g. depending on the regulation, workers may not be allowed to work under a given temperature) and on the use of electronic devices (e.g. too much light, not enough space...). Actors are mobile, like an architect who may work on different building sites, in an office or in site sheds. This makes the design of services difficult and misconceptions can lead to costly coordination and communication errors [5]. In AEC, services are tending to be integrated by monolithic software, sometime in an ad-hoc manner for specific projects. Researches in this sector are actively focused on service integration. As Shen proposed [5], using software capable to adapt themselves to this highly collaborative context would improve communication and coordination reliability, and help to conceive better and more generic services.

3 Adapting to the Context of Use

To overcome the issues of highly collaborative context, we suggest the use of interface adaptation, a type of user interfaces taking advantage of the context of use. This section briefly present the starting point of adaptation to the context and is then focused on the principle of interface adaptation.

3.1 Context-Awareness

While defining its idea of pervasive computing, Weiser [1] suggested that — for the user to be able to interact in a world of electronic devices — the HCIs have to be so intuitive to use that the user doesn't notice he is interacting. To achieve this vision, the interfaces have to be intelligent and be able to know about the user and its environment. Therefore, such information systems are said to be *context-aware*.

The Context-Awareness. The context of use can represent valuable information regarding an interaction, allowing an information system to propose more relevant services (e.g. notifying the user of a shop proximity based on the user's location and preferences). Such a capability is called *context-awareness* and has been introduced by Dey & Abowd [3] as follows:

> "A system is context-aware if it uses context to provide relevant information and/or services to the user, where relevancy depends on the user's task."

3.2 Interface Adaptation

Interface adaptation is a subsequent domain of the context-awareness. It promotes interfaces capable to adjust their presentation, the data or the components in order to better withstand changes in the context. Several definitions of interface adaptation exist depending on the problem approach. If Stephanidis et al. [7] refer to the *adaptivity*, Thevenin & Coutaz [8] refer to the *plasticity* of user interfaces. Our work is focused on the latter. Plasticity is a Model-Driven Engineering (MDE) top-down approach centred on the tasks. We think that this approach suits well collaborative work by being task-centric. Moreover, MDE conveys interesting principles regarding interface conception and service science over other approaches. Models are a formalism intended to be readable by non-initiated [9], hence enabling the possibility to involve multi-disciplinary experts in the engineering process (e.g. designers, engineers, usability experts...). There are also extensible and reusable.

Plasticity models are composed of multiple levels of interface abstraction [10] (see Fig. 1). The highest level of abstraction consists in the modelling of the task and the domain (i.e. the manipulated concepts, like dates, text fields...). Then, this model is reified through model transformations into a lower level of abstraction called *abstract user interface* (AUI). AUIs are interface models abstracted from any interactor (i.e. buttons, text boxes...) and can by simplified as the general interaction flow. The next level of abstraction is the *concrete user interface* (CUI) which instantiates the interactors. It represents a complete interface but is independent from the computing platform. The actual execution of the interface is represented by the lowest level of abstraction, the *final user interface* (FUI). The particularity of plasticity is that it supports the context of use as Dey & Abowd [3] defined it with models for the user, the computing and the physical environment. These models impact the transformations to generate adapted interfaces. Plasticity also manages translations between contexts of use.

Plasticity is an *a priori* method regarding the contexts. The different contexts have to be known at the design time in order to be modelled. Therefore, the contexts are not discovered at runtime, limiting the scope of the adaptation. But this limitation has advantages: a fine-grained and a well controlled adaptation. It also takes advantage of users involvement in the definition of the required contexts of use. Hence, the quality of the final product will be near users' expectations.

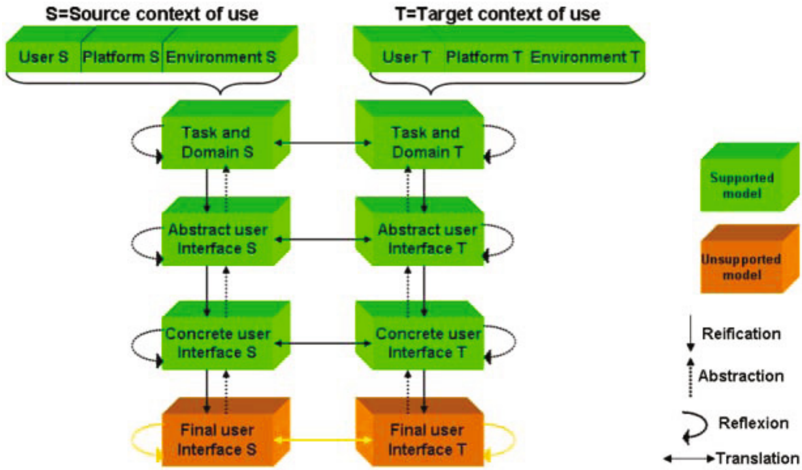

Fig. 1. The CAMELEON framewok [10][1]

The researches on plasticity resulted in the CAMELEON framework [10] and the model description language UsiXML [11] which support the models presented on Fig. 1. Several other framework based on a similar concept exist, like TERESA [12], UseML [13], MANTRA [14] or Malai [15].

4 Adapting to the Collaboration

As we mentioned, proposing adaptive interfaces for collaborative contexts is expected to promote better usability, coordination and communication. Moreover, using plasticity — a MDE approach — allows to involve users and a broad set of experts during the conception phase. However, the current plasticity frameworks are not oriented toward practical collaboration. Some frameworks, like UsiXML [11] do have a support for collaboration at a theoretical level but lacks of practical elements. More precisely, UsiXML highest level models (i.e. tasks & domain) are partly compatible with some collaboration theories but these elements does not translate well into AUI & CUI. The generated interface only consider the active user in its current task, having a focus on individual tasks and not on the collaborative activity. Hence, it does not take advantage of the theoretical modelling to promote a good coordination and communication.

The objective of our work is to bring practical collaboration support to adaptive interfaces. Plasticity being a top-down design, a framework has to comply with two aspects of collaboration (1) a theoretical support at the highest abstraction level; and (2) a practical support at the most specified level. To this purpose, we reviewed both aspects to extend the plasticity.

[1] Figure adapted from
`http://www.w3.org/2005/Incubator/model-based-ui/XGR-mbui`

4.1 Theoretical Requirements to Collaboration

Concerning the theoretical aspect, we reviewed the most important collaboration theories and how they are commonly modelled. The objective is to condense the most significant and essential concepts for a good theoretical coverage and to know how to model them. The coverage of these concepts are essential to the plasticity task & domain model because the subsequent practical support will rely on them.

Through collaboration theories reviews made by Lonchamp [16] and De Farias et al. [17] we dug into the following theories:

- The *activity theory* is a psychological theory aimed at representing the structure of the human activity. It organizes itself around the concepts actors, communities, tasks, rules, and tools. Communities are groups of actors that execute tasks depending on community rules. The tasks are mediated by tools.
- The *coordination theory* is an inter-disciplinary theory for the understanding and studying of coordination processes. It uses the concepts of resources, users, tasks, and coordination mechanisms (i.e. temporal restriction to the resources access). Users execute tasks and use different type of coordination mechanisms to access necessary resources (e.g. user A is waiting for user B to produce the resource, or user A and B can access simultaneously the same resource. . .).
- The *action/interaction theory* emphasises the concepts of interaction trajectories, actions, users, communities, and technologies. Interactions and their trajectories represent the consequential actions needed in the execution of a task. Therefore, trajectories are sequences of actions done by users. Communities are groups of users which use technologies (i.e. tools) to accomplish tasks.

Numerous other theories exist but we focused on the most significant and suitable to MDE (theories based on cognitive science are interesting to consider during the conception but hardly modelisable). Based on De Farias et al. works [17], we isolated the following important concepts:

- *Activity*, is the representation of the tasks, their decomposition and their dependency as a general workflow;
- *Actor*, is the representation of individuals that coordinate or execute tasks;
- *Organisation*, is the representation of the relationships between the actors (i.e. hierarchy) and the rules regulating these relationships;
- *Resource*, is the representation of elements which are required in the execution of a task (and can be the product of another task);
- *Tool*, is the representation of what mediatize the execution of task and/or the coordination.

We also note the recurring occurrence of the *artefact* concept which encompasses both tool and resource concepts. De Farias et al. [17] already identified most of them, with the exception of the organisation that we consider to be as important as the other regarding highly collaborative contexts (the organisation is usualy included in the activity or actor concepts). The organisation has an important impact on the coordination process.

The main concepts and their relationship identified, we looked at how they can be modelled. We based our models on De Farias et al. [17] works but also on AMENITIES [18]. AMENITIES is a methodology for the conception of groupware and uses models to be thoroughly applied. While the models of AMENITIES are based on collaboration theories and are quite exhaustive, the methodology does not intend to use them during the production phase of a groupware (i.e. the models are independent). We think that this model could fit in a MDE process and have considered them to improve the current plasticity models. The detailed additions are covered in section 5.1.

4.2 Promoting Practical Collaboration through Group Awareness

On the practical side of the collaboration and based on Lonchamp's literature review [16], one methods emerged to us: the *group awareness*. This method is oriented toward the communication and the coordination through the use of the context (which was the closest method to our needs regarding the use of contexts in plasticity).

The context is a concept that has been investigated in Computer Supported Collaborative Work (CSCW), following the *situation awareness* theory [2]. The group awareness — introduced by Gutwin & Greenberg [19] — emerged as a consensus in promoting coordination and communication. Group awareness is "the understanding of the activities of others, which provides a context for your own activity" (e.g. knowing what collaborators are online, their current task, their availability...). Enriching your own context with the context of your collaborators helps to analyse a situation, to coordinate and to communicate. This method is based on feedback mechanisms which help to inform the user on how the others activity is interacting with its own. For example, in an activity of document co-edition, one can see in real time if other users are editing the same document, what part of it and what modification they did (e.g. see Google™Documents[2]). Another common example would be to display to actors connected to the application, their availability, their current task, their location... These informations greatly help coordinating since actors know who to contact, where and when. It also takes advantages of the hierarchy: you can know who is responsible of your current task and the available means to contact him/her. It has to be noted that the group awareness is a passive interaction (e.g. the user does not ask the interface to know who is editing a document, it is always shown by non-intrusive markers). The interface elements required to give group awareness will be referred as *group awareness interactors* along this paper.

[2] https://docs.google.com/

5 Towards an Adaptation Framework Supporting Collaboration

Our solution to adaptive interfaces for collaboration is to extend the plasticity concept with theoretical and practical elements. The contribution operates at two levels (1) adding theoretical support to the highest abstraction level of plasticity models (i.e. the task & domain models); and (2) adding practical support to the lowest abstraction level. The latter involves acting on the transformations between the different levels (i.e. task & domain to AUI and AUI to CUI). The main objective is to take advantage of (1) to properly generate the practical support.

We based our approach on an existing adaptation framework. We went with UsiXML [11] which was the most documented and proven framework along with an active community and a standardisation in progress to the World Wide Web Consortium.

5.1 Base Concepts Support

Here we follow the investigation presented in section 4.1 to extend UsiXML task & domain models with proper theoretical support. We previously highlighted the essential concepts to that support (i.e. activity, actors, organisation, resource & tool). To this purpose, we reviewed UsiXML models for each of these concepts and checked its expressiveness. UsiXML has to be able to correctly model the concepts and their relationships. Table 1 summarises UsiXML coverage of the needed concepts regarding our expectations and Figure 2 presents our extension to UsiXML.

Concerning the expressiveness of UsiXML, we expect the activity to be representable by tasks (decomposed in elementary task items) and by a general workflow (defining tasks temporal dependency). In a flexible organisation, tasks may also not be governed by a process since independent and punctual tasks may occur. UsiXML provides a complex task model (based on a task tree formalism) and a process model which comply to the workflow notion. However, these models limit UsiXML to processes and don't cover the need of independent tasks. To this purpose, we added a relation between the *workflow* and *task* models to reflect to possibility to model independent tasks.

Resources are well represented and allow to model different types of resource (e.g. material resources like a computer, immaterial ones such as a service or an actor) but lack of a relationship between them — resources may be composed of other resources or be related to another.

Tool is meant to be the definition of the user interface and to this purpose UsiXML propose a CUI model comparable to what one can express with common programming languages. Hence its coverage is fairly exhaustive.

Regarding the organisation concepts, UsiXML lacked the ability to define complex organisations with a flexible hierarchy and the possibility to define the rules commanding the interaction between the actors within the hierarchy. In

Table 1. UsiXML coverage of collaboration theories (based on UsiXML 1.8)

Concept	Expected expressiveness	UsiXML coverage
Activity	Individual tasks and their temporal dependencies (to form a global activity)	Limited, the *process* & *task* models allow process modelling but don't support punctual tasks
Actor	Users' profile (i.e. identity, role, skills, particularities. . .)	Limited, the *userStereotype* model only offers stereotypical attributes like the skills, and the *job* model encompasses the role but there is a lack of real user identification and no clear link between *job* and *userStereotype*
Organisation	All types of hierarchy as expressed in collaboration theories	Limited, supports actor's attribution to an organisation but no hierarchy is implied
Resource	Description, availability and traceability of resources and also the links between them	Limited, the *taskResource* model represents fairly well all different types of resources but lack of resources relationship (e.g. composition, association. . .)
Tool	Description of the user interface	Yes, via the *cuiModel*

this respect, UsiXML is already semi-compliant with the activity theory through the possibility to form groups of actors in an organisation (i.e. the association between two organisation on the model, see Fig. 2). We added its full compliance with the concept of relationship between actors and organisations, a relationship being defined by a commanding rule to properly express the hierarchical rules (e.g. contractor, departments. . .). These rules are also dependent on the tasks to reflect flexible organisations in which actors micro-organisation may depends on the task to accomplish. Our models are inspired by a model representation of the activity theory [17] and by AMENITIES [18], making UsiXML compliant with the activity theory but also with theories presented in section 4.1.

Regarding the actor concept, we added the identification of an actor through an extension of the userStereotype model. In UsiXML, users are not directly identifiable, this identification is meant to be done at application runtime and independently of the models. Regarding collaboration and the requirements for group awareness, we needed to be able to identify users at the models level because the subsequent group awareness interactors may need to know the users involved. Our extension is meant to fill this gap with clear users identification since the userStereotype model — as it is named — is meant to represent stereotypical groups of user having the same skills and affinity with technology. We based our extension on the General User Model Ontology (GUMO) [20] which is a very exhaustive model including user identification along with user's roles, abilities and numerous other personality traits. We also added an actor-to-actor relation associated to rules (*userRelationship*) in order to express clearer hierarchy with rules like supervision or advising.

While extending UsiXML, we tried to stay true to the original definition. Our extension does not interact with it and should remain compatible.

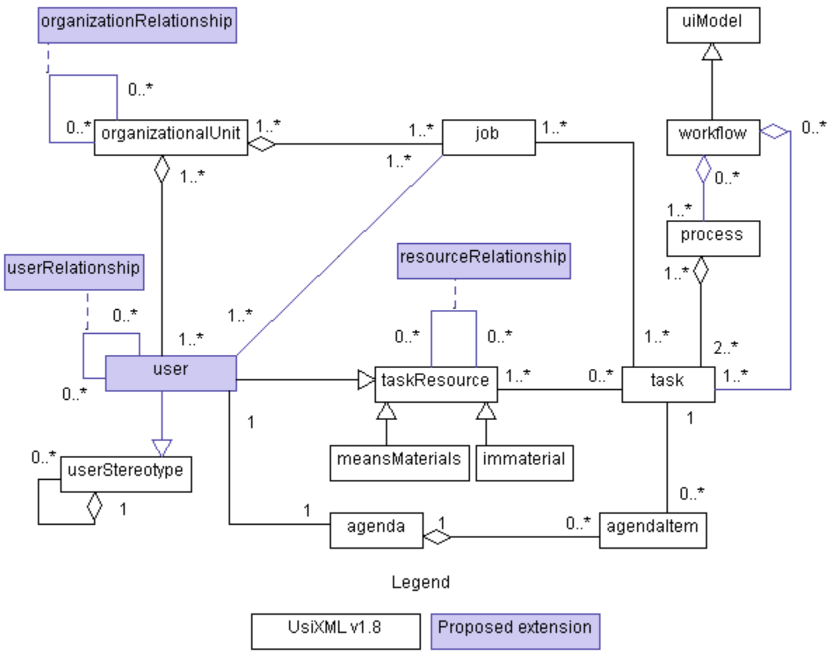

Fig. 2. UsiXML *task model* extension proposal for collaboration support presented in UML

5.2 Group Awareness and Transformations

Once the adaptation framework has a coverage of the mandatory theory support, the top-down approach exposed on Fig. 1 has to properly generate the practical aspect of collaboration. In our case, we are looking into transforming the highest concepts into user interfaces with group awareness features (see section 4.2. This part of our proposal is still on an early stage and represents the biggest challenge, therefore we are only presenting the general direction of our work.

Regarding UsiXML, the transformation part of the interface generation process is achieved through a graphs transformation mechanism [21] (AGG for instance[3]). The main steps are the reification of the task & domain model into the AUI model, and the reification of the AUI model into the CUI one. For the first step, Penichet [22] introduced a new element in the AUI model, an *abstract*

[3] Attributed Graph Grammar: `http://user.cs.tu-berlin.de/~gragra/agg/`

awareness container, intended to host interactors providing group awareness. As of the transformation itself, the problem is centred on identifying the conditions that will produce abstract awareness containers (e.g. a task involving more than one actor may benefits from a display of the list of online collaborators). To this purpose, we can find inspiration in the groupware conception methodology AMENITIES [18] (that inspired Penichet's work). The second step, the transformation of AUI into CUI, involves the instantiation of the abstract awareness containers into actual group awareness interactors. The problematic is the same as in the first step, identifying the type of interactor needed depending on the collaboration settings. This step will rely on a finite set of group awareness interactors. Such a set can be derived from Gutwin & Greenberg works [19]. A side step, important for the plasticity, is the translation between contexts. This step is done through the transformation of a model into another model of the same level of abstraction (i.e. AUI to AUI, CUI to CUI...). While this step can be done at any level of abstraction, we choose to concentrate on the task & domain translation which is the less complicated and still allows to regenerate all the lower models. We consider the other translation as shortcuts and we may address them in a future work.

6 Closing Words

6.1 Ongoing Work

Our current effort is focused on model transformations (see section 5.2). The main objective is to identify the conditions needed to generate group awareness interactors and to model the subsequent transformations.

We are also working on a validation protocol for our research. Testing adaptive interfaces raises many issues for empirical tests (notably the criteria to observe while comparing adaptive and on-adaptive interface). Currently, we are tending toward qualitative testing of the design process in order to know whether our approach is valid against conventional methodologies.

6.2 Perspectives

The interest of this work is to propose a framework for the design of user interfaces in highly collaborative contexts. This framework is independent of any programming via MDE and allows to involve multiple disciplines and users in the conception process. A practical collaboration support of this framework could enhance communication and coordination, along with a better adoption of Software as a Service in environments within which service adoption is lower due to the context conditions.

6.3 Conclusion

Facing the ever growing complexity of interacting in multiple contexts of use, we propose the use of adaptive interfaces for collaboration for better Software as a Service. Through the use of a Model-Driven Engineering process for interface adaptation — called plasticity — we are promoting a conception method for collaborative interfaces which is intended to be generic and suitable to the contexts variety. To this purpose, we presented an ongoing work on extending an adaptive interface framework — UsiXML — to better support collaboration. While our method and its results still have to be tested, we expect that such interfaces and conception process will enhance service quality and innovation in highly collaborative contexts.

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Session-Based Dynamic Interaction Models for Stateful Web Services

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Abstract. The prevalence of the service paradigm spans diverse domains like commercial, social, technological or scientific. Due to its simplicity and familiar semantics, it provides a powerful general abstraction for system programming, interaction, and integration. Several standardisation efforts have further contributed to the popularity of the service concept and its usage, since this provides a uniform access to and aggregation of entities with different characteristics and at different levels of the cyberinfrastructure. The perceived current trend on making everything accessible as a service (*XaaS*) builds on such service characteristics, and examples range from *Web-enabled Wireless Sensor Networks*, the *Internet of Things* and *Web of Things*, to *Cloud computing*, and the *Internet of Services*. Upon the acknowledgement of such high heterogeneity and of the extreme large scale of emerging service systems, *Service Science* presents a novel and overarching view on analysing and developing further the service paradigm. The high complexity of current and future service systems in this domain, require innovative solutions to be developed in order to improve service productivity and quality. To this extent, this work concentrates on service engineering Web services and proposes a solution based on the *Session* concept contributing to solve open problems on service system interaction and adaptation. The focus is on the interactions between Web services interfacing stateful resources and its clients, in particular. The session abstraction is used to: a) capture the service/users interaction context, b) support dynamic interaction models within, and c) contextualize on demand and automatic dynamic adaptations. The major goal is to capture Web service/users interactions modelled as Sessions, in order to simplify their re-use and adaptation in the context of the cited Services Sciences' complex systems.

1 Introduction

Services Science [1] aims to define and promote the systematic development and innovation in service systems, following an interdisciplinary perspective. The popularity of the service paradigm and its presence across the digital word, points to a novel services industry and economy incorporating concepts from very different areas. Management, social, legal and engineering aspects are taken into consideration on analysing and developing further the service paradigm, in order to improve service productivity and quality [2,3].

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The emerging prevalence of the service concept arises somehow with no surprise. It has been present in digital systems since the beginning (e.g. in operating systems/Internet protocol stacks), and the concepts of service provision and usage have been common sense in human societies. The service paradigm provides today a powerful general abstraction for system programming, integration and interaction, due to its simplicity and familiar semantics. Several standardisation efforts have further contributed to its acceptance on providing standard/uniform access and aggregation of entities with different characteristics and at different levels of the cyber-infrastructure [4]. Building on the overall service characteristics, the current trend is making everything accessible as a service (*XaaS*), and a few examples are given bellow. These examples contribute somehow to the cited Services Science's overarching view on analysing and developing further the service paradigm. Namely,

– *Web enabled Wireless Sensor Networks (WSNs)* [5,6] composed of either static or mobile devices, offer a high-level interface to low cost large-scale sensing of the environment, allowing WSNs inclusion in Web environments, e.g. in the context of business processes. Such allows WSNs uniform and simple access, parametrization and aggregation, and systematic data collecting. WSNs are fundamental for current and future systems supporting complex applications development [7] to which the interaction with the real world is a pressing requirement. Such includes traditional scientific applications like meteorology prediction simulations, and novel applications like urban traffic management or virtual social communities' support in the domain of Participatory Sensing [8]. WSNs are cited as crucial in the context of Services Sciences, in particular, for their relevance on the development of an *intelligent environment*. In the latter, online/real-time data is provided to service users, and conversely, service users may in turn parametrise those sensor systems. This *subject-environment interaction model* supports a *co-production partnership* between services and users and is fundamental for service systems' adaptability [2,9].
– *Internet of Things* [10], in turn, uses services as the main abstraction for the simple integration of objects and entities, either real or virtual, within intelligent contexts. Those objects and entities can be accessed through services being thus the service concept the main abstraction for such integration. This allows, for instance, service development in the business area, providing more diverse, highly dynamic, and efficient services, as described in the context of the *Web of Things* [11].
– *Cloud computing* [12] aims at providing standard solutions for different types of service access (example of a contribution in this domain in [13]). Current cloud platforms provide large-scale data and computational resources (*Data* and *Computational Clouds*), and offer services at different levels, from the low level IaaS (*Infrastructure as a Service*) to PaaS (*Platform as a Service*), offering fundamental services for application development. For the Services

Science context and the *Future Internet* in particular, the authors in [9,14] highlight the relevance of cloud (and grid) services for service systems' scalability.

- *Internet of Services* [15] aiming at using the Internet for service deployment and usage similarly to its support to the Web. In this case, services can be seen as negotiable entities, e.g. in the form of service ecosystems, and can be used to create value in the business area [16].

Analysing the above examples, we defend that one useful common concept to be considered in these domains is the notion of *Stateful Services*. By this we mean services interfacing stateful resources or continued activities. These require the realization of a dynamic/variable state which has to be kept consistent along several message exchanges between a service and each one of its clients [17]. Examples of the utility of stateful services for the above domains are resource tuning based on users' context or the history of previous parametrisations; predicting the status of running applications; or evaluating resource consumption and related cost at runtime. Additionally, and also as a consequence of clients accessing such stateful services, one pressing requirement is on systems' dynamic adaptation. This is fundamental to support service systems' evolution in order to cope with novel user requirements or modifications in service systems themselves.

The interactions to stateful Web services imply, consequently, more complex interaction models between a service and its users, besides the traditional request/response access. Examples are event subscription and notification paradigms, or stream-based data dissemination. New models and solutions for stateful Web service interaction are hence required, including the support for dynamic adaptation mechanisms. These may comprehend, for instance, support for fault-tolerance concerns (e.g. related with service or interaction medium failures), or allowing users to directly and dynamically control and modify such interactions (e.g. dynamic selection/replacement of the used interaction model with a service).

The above limitations pertaining current Web services interfaces for stateful services are described in the next section. The following section describes a proposed solution based on the *Session* and *Pattern* concepts capturing dynamic interactions models for services/users interactions. The following sections describe the implementation architecture and an application scenario. The conclusions are described in the final section, as well as future work.

2 Problem Dimensions and Proposed Solution

One of the strengths of the service paradigm is the simplicity of its basic interaction model, namely the request/reply interaction in its stateless mode, e.g. Web services in their primitive form. Several of such independent interactions occurring onward among a service and its users allow hence a true decoupling between requests and their service.

However, the growing demand on interfacing stateful resources through services suggests the need and advantage on the existence of more complex and flexible interaction models between service providers and their users. For instance, in the particular context of Web enabled WSNs [6]: a) the *Publish/-Subscriber* model [18] supports user notification on previously subscribed WSN topics, e.g. when the average temperature value collected on a WSN has exceeded a pre-defined limit, all subscribed users for this specific topic and condition are notified; b) the *Streaming* model [18] supports data dissemination of sensor collected data in the network.

Albeit new interaction models as the ones above have been made available for interfacing stateful Web services, such interactions are still limited and lack mechanisms for their dynamic adaptation. One example may be the need to dynamically aggregate diverse data streams (e.g. similarly to *mashups*) generated from different but related stateful Web services. For instance, in order to obtain more precise temperature values occurring in one particular geographic area, it may be necessary to dynamically gather data collected from several WSNs positioned at different heights from the ground; meanwhile, such data may also need to be complemented with humidity data collected from other WSNs also deployed on the same geographic area. Such dynamic aggregation of data streams may hence free consumer applications from having to explicitly access different Web services. Applications in the context of stateful Web services may therefore benefit from a richer and more flexible control on interfacing their associated services. To this extent, the following dimensions have to be considered:

- *The interaction's context* which includes: a) the context of the service user (e.g. a mobile device with limited autonomy or progressing to a different geographic area); b) the interaction medium between the service and its user (e.g. the characteristics of the supporting communication networks); c) the service's context (e.g. the status of the executing application and/or resource availability on their execution support environments).
- *The interaction may evolve in time* as a result of either an explicit user request or automatically triggered by the runtime system upon context change detection.

To deal with such problem types, in the following we describe a solution based on the concepts of *Session* and *Design* and *Architectural Patterns* [19,18].

Pattern-Based Dynamic Reconfiguration. The proposed solution is based on the pattern concept and its usage is twofold: 1. To represent (common/novel) interaction models among clients and services as pattern abstractions in the form of *Pattern Templates* [20]. These are reusable first class entities, considered both in the dimensions of structure and behaviour, which can be acted upon (e.g. parameterisation and refinement). 2. The pattern abstractions support a structured dynamic adaptation mechanism which may be dependent on the state of *interaction's context* above: a) the patterns are dynamically reconfigurable themselves; b) the adaptation/evolution of the system may be represented as a sequence of patterns, and this sequence is pre-defined and captured as a state machine, as will be detailed in Section 3.

In this work, we use pattern-based abstractions in form of *Structural and Behavioural Pattern Templates*, as well as their composition, as defined in [20]. Structural Pattern Templates (SPT) define the semantics of the structural connections among the elements within the pattern. However, they do not specify any restrictions in terms of data or control flow dependencies. Those SPT include associations like topologies (e.g. Pipeline, Star, ring) as well as Design Patterns [19] (e.g. Façade, Proxy, etc.). The allowed structural reconfiguration is conform to the pattern semantics it is applied to (e.g. modification of the number of sub-systems within a Façade, but the the central element providing a common interface to all sub-systems has to be always present within the SPT).

Behavioural Pattern Templates (BPT) define the data and control dependencies among the elements within the pattern at runtime. Additionally, BPT annotations define the role of each element – e.g. in the Publish/Subscriber semantics there are the roles of the publisher and subscribers, but also the definition of data and control flows in the form of asynchronous notifications on the subscribers. Other patterns are Streaming, Producer/Consumer and Client/Server. Again, each one is reconfigurable according to its semantics which is kept consistent. For instance, it is possible to change the number of producers and/or consumers, but at least one producer has to exist always. Moreover, the separation of concerns in structure and behaviour allow the flexible composition of pattern templates and its dynamic reconfiguration (e..g a star with a Producer/Consumer pattern which is modified to a Publish/Subscriber pattern) [20].

Sessions Embodying Service/User Interactions. The *Session* concept is used in this work to capture the interaction context to a service interfacing stateful resources, a well as the dynamic reconfiguration features possible within that context. A session includes:

- The identification of a particular service plus the particular interaction model in use at some point in time. All user accesses within the context of this session obey the semantics of that interaction model. The need to access the same service with two different interaction models, say Publish/Subscriber and Producer/Consumer, results on the existence of two distinct sessions.
- The architecture of the particular interaction model in use representing runtime data and control flow dependencies between a service and its users. An interaction model is generally captured as a composition of a structural pattern (usually a Façade or a Pipeline) with a behavioural pattern.
- A unique session identifier used by new clients joining the session.
- The identifiers of all of the session's clients at some point in time.
- The definition of a session's life time, which upon expiring results on the destruction of the session and consequent notification of all its members; if this time is unbounded, a session is only destroyed by an explicit request.
- The identifier of the *session's owner*. The owner is allowed to end the session's execution as well as to explicitly reconfigure the interaction model in use.
- The possible context-dependent structured adaptations.

The implementation of the Session concept and possible dynamic reconfigurations within an underlying middleware are described in the next section.

3 The Middleware Layer

This section presents a middleware layer for the adaptable access to stateful resources. It resorts to the notion of Session to capture the interaction context to a service interfacing those resources, as described in Section 2, and enables the dynamic reconfigurations possible within that context. The latter include the tuning and the replacement of the current interaction model.

We begin the middleware's description with an overall overview of its architecture, proceeding then to a more detailed explanation of its components.

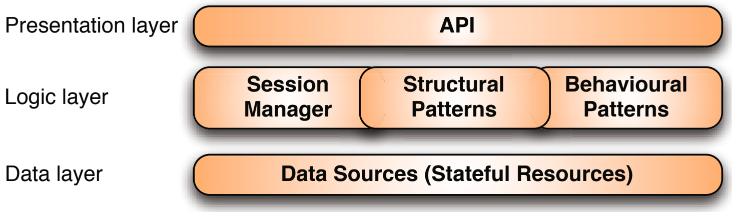


Fig. 1. The middleware's overall architecture

The middleware's architecture (Figure 1) follows a three-tier model that cleanly separates presentation, logic, and data management. The presentation layer takes the form of a Java API that acts as an intermediate between the client application and the the Web accessible middleware layer. This API will be presented in Subsection 3.2.

The logic layer provides the runtime support for sessions, namely for the featured interaction models and their dynamic reconfiguration. Besides the standard Client/Server interaction model, the middleware currently supports the Publisher/Subscriber, Producer/Consumer, and Streaming models, which are captured as behavioural patterns. Moreover, it supports the *Aggregation* of any of the former, being that this interaction model is implemented as a combination of multiple structural and behavioural patterns.

The data layer is responsible for accessing the data sources via Web service technology, and providing them to the upper layer.

3.1 Implementation

A *Session* is implemented as the combination of the Façade structural pattern with a behavioural pattern (the interaction model), and is associated to one or more topics that identify its data sources (Figure 2). The Façade captures the relationships between the members of the session: middleware and clients, and provides the means for the former to disseminate data to the latter, according to the established interaction model.

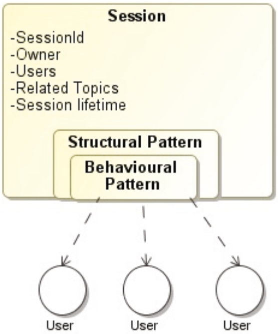


Fig. 2. Session implementation

Sessions are managed by the *Session Manager* (the main component of the system) that is responsible for maintaining their consistency and their link to the requested data sources (services). Furthermore it validates every client request, ensuring that it is applicable in the context of the current interaction model, and provides for the supported dynamic reconfiguration mechanisms. Note that reconfiguration requests can be explicitly issued by clients (on-demand reconfigurations) and automatically generated by the *Session Manager*, as a response to an alteration on the overall context of the session, e.g. a data source is no longer reachable. More detail on the reconfiguration mechanisms will be given ahead.

As mentioned before, the supported interaction models are instantiated as behavioural patterns. The sole exception is the Aggregation model, which is implemented as a Pipeline of two Façades (Figure 3). The first has the purpose of aggregating multiple data sources, being that the aggregating logic (the *Aggregation Function*) is parametrizable and, thus, supplied by the client when issuing the request for the structure to be created. The second is the dissemination façade present in every session.

Dynamic Reconfiguration. The state machine that specifies the transitions between the interaction models bound to a session is depicted in Figure 4. For the sake of simplicity, the machine was divided into four: state machines 4a, 4c and 4d depict the reconfiguration requests explicitly issued by a client, whilst state machine 4b reports to reconfiguration requests automatically triggered by the middleware to respond to specific changes in the session's context.

The first state machine (Figure 4a) refers to requests to replace the current interaction model. It is possible to reconfigure from any model to another. If the reconfiguration request is issued by the owner of the session, the whole session

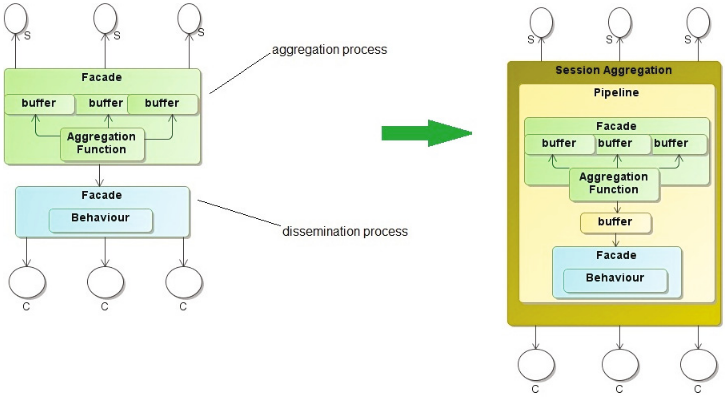


Fig. 3. Implementation of the Aggregation interaction model

is reconfigured and its clients are notified. Otherwise, if the request is issued by some other client, it is the client that is reconfigured to another session with the required characteristics. If no such session exists, it is created on the fly.

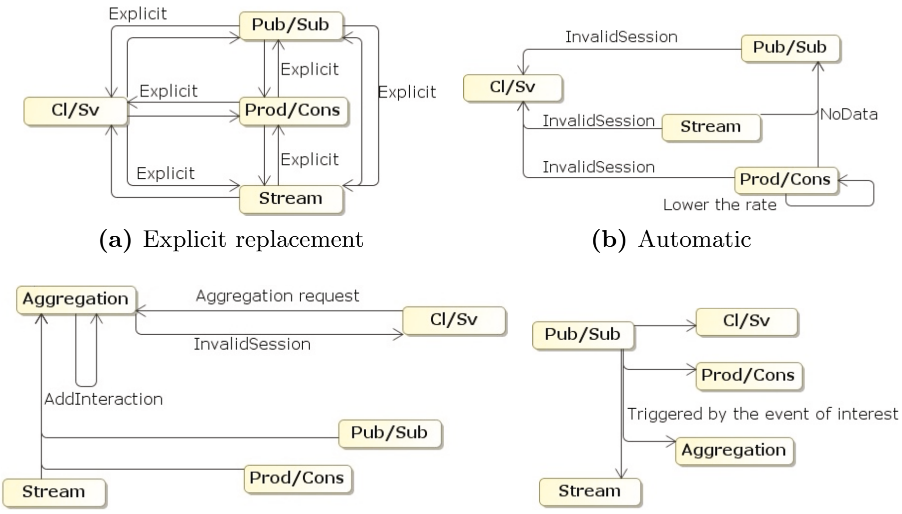
The second state machine (Figure 4b) identifies the reconfigurations that are triggered by the middleware, as a response to the changes in the context of the session, client, or the communication between them. A session becomes invalid if the owner of the session leaves it, the lifetime of the session expires, or its data sources (monitored resources) become out of reach. In the scope of the Stream and Producer/Consumer interaction models, if the data flow is suddenly interrupted, the middleware checks if its source it still reachable, and if so, reconfigures the session to Publish/Subscribe bound to the same topic. The clients are notified as soon as the data flow resumes. In turn, the *Lower the rate* transition occurs only in the scope of the Producer/Consumer model. It is triggered whenever the middleware detects that the client side is no longer able to consume the data at the rate that it is sent.

The third state machine (Figure 4c) is related to the Aggregation interaction model. Any interaction model can be replaced by an Aggregation, and new data sources can be added to an existing aggregation (the *addInteraction* transition). If the session becomes invalid, the session is automatically reconfigured to the basic *Client/Server* model.

Finally, the fourth state machine (Figure 4d) specifies the automatic reconfigurations related to the Publish/Subscribe interaction model. When a client associates the Publish/Subscribe model to a session, the middleware allows it to indicate an extra interaction model to which it is automatically reconfigured when a notification on the subscribed topic is received.

3.2 The Application Programming Interface

The middleware's interface must allow applications to create sessions, to bound them to a particular interaction model, to join currently active sessions, to



(a) Explicit replacement

(b) Automatic

(c) Aggregation

(d) Notification bound

Fig. 4. Reconfiguration State machine

associate actions to incoming data, to perform on-demand reconfigurations, and to adapt to reconfigurations performed by the owner of the session. This subsection addresses these dimensions.

Creating Sessions: A session is represented by the ClientSession class, whose instances can be parametrized with the session's duration in minutes (unbound is the default), and an interaction model in the form of a behavioural pattern. If no model is supplied, the session will only have the ability to perform synchronous queries following the Client/Server model. For that purpose, the class provides the query method. Figure 5 depicts a simplified version of the API's class diagram.

All interaction models share a common interface (IPattern) but feature specific constructors and set of operations. Common to all constructors is the topic (or set of topics) that determine the data source, and a listener that is responsible for handling all the data emitted in the scope of the present session. This includes actual application data, reconfiguration notifications, and error notifications (more on this ahead). Coming to specifics, the Stream and Producer/Consumer classes require the definition of the data transfer rate; the Publish/Subscribe class allows for the configuration of the interaction model to which the client automatically reconfigures when a notification on the subscribed topic is received; and the Aggregation class requires the name of the class that provides the aggregation function, and which is the actual dissemination model. The aggregation function must be a subtype of class AbstractAggregationFunction, extended with the the implementation of the aggregating logic. This logic must consume multiple sources and produces the data items to be disseminated to the clients.

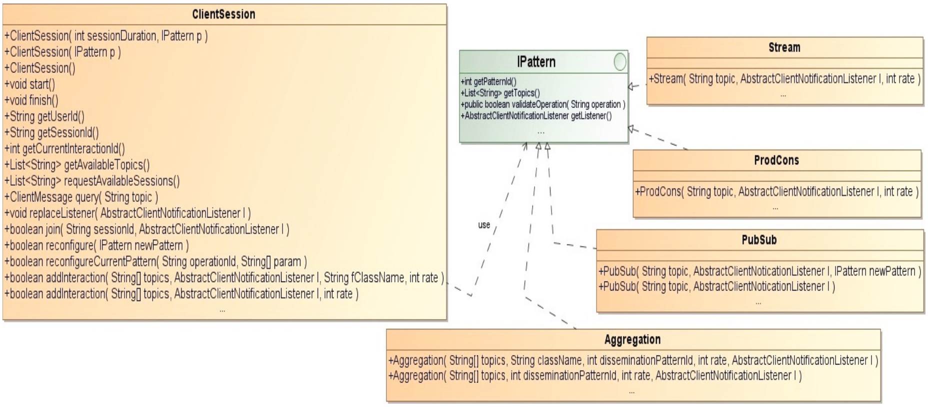


Fig. 5. Class diagram of the API

Joining Existing Sessions: The ability to join existing sessions is provided by the join method. It requires the identifier of the session to join and the listener to handle incoming data. The inquiry of which sessions and topics are currently active is possible through methods requestAvailableSessions() and getAvailableTopics(), respectively.

On-demand Reconfiguration: On-demand reconfigurations are twofold: the ones that are performed over the current interaction model, and the ones that replace the current interaction model by another. The first is achieved through the reconfigureCurrentPattern method, which allows the application to invoke an operation valid in the scope of the current interaction model. For instance, change the data transfer rate when in the scope of a *Stream* or a *Producer/Consumer*, or change the aggregation function when in scope of an *Aggregation*. The invocation of an operation not valid in the current scope raises an exception. The second is provided by the reconfigure method that receives the interaction model to which the client wants to reconfigure to (Subsection 3.1).

Handling Incoming Data and Notifications: In order to handle the data sent by the middleware, the client must provide a *notification listener*. This listener is a subtype of abstract class AbstractClientNotificationListener that must implement the following methods:

- processMessage - to handle application data;
- invalidSessionNotification - to handle the notification that the session has become invalid;
- noDataNotification - to handle the notification that there is no data available;
- sameFlowNotification - to handle the notification that the session has been reconfigured but the topic remains the same;
- diffFlowNotification - to handle the notification that the session has been reconfigured and the topic has changed;

– pubSubNotification - to handle the notification that the session has been automatically reconfigured to the reconfiguration pattern associated to publish/subscribe behaviour;
– ownerAddInteractionNotification - to handle the notification that the session has been reconfigured because a new data source was added.

To operate over the session to which is bound, the listener can obtain a reference to the former by invoking the getSession() method.

A Simple Example: Listing 1.1 showcases a small example in the context of a set of sensor networks that monitor temperature and humidity. The goal is to create a session (st) bound to a *Publish/Subscribe* interaction model that notifies the client once the temperature rises over 5°C (lines 5 to 7). Associated to this notification is an automatic reconfiguration that alters the session's interaction model to an aggregation of the previously monitored sensor network with a new temperature network (Temperature2) placed at a different height, and an humidity sensor network (lines 2 to 4).

The aggregation function of line 1 is defined in Listing 1.2. The method to be implemented returns an instance of class NotificationMessage, which denotes a data packet to be delivered to the clients in the session. The consuming of the data sources resorts to method getNextDataItem().

Listing 1.1. Creation of a session

```
1 MyAggregationFunction aggregate = new MyAggregationFunction();
2 Aggregation critical = new Aggregation(
3           {"Temperature", "Temperature2", "Humidity"},
4           aggregate, Pattern.STREAM, 4, new Listener2());
5 PubSub normal = new PubSub("Temperature > 5", new Listener1(), critical);
6 ClientSession st = new ClientSession(normal);
7 st.start();
```

Listing 1.2. Defining an Aggregation Function

```
public class MyAggregationFunction extends
AbstractAggregationFunction {
  public NotificationMessage apply(){
    NotificationMessage msg = new NotificationMessage()
    msg.add(getNextDataItem("Temperature"));
    msg.add(getNextDataItem("Temperature2"));
    msg.add(getNextDataItem("Humidity"));
    return msg;
  }
}
```

To illustrate the definition of a listener, Listing 1.3 sketches the implementation of two methods of Listener2. Consider that the listener has access to a graphical interface (GUI) by the means of the gui variable. Whenever application data is received it is forwarded to this GUI (lines 2 to 4). If a notification indicating that no data is available, a notification is sent to the GUI and the session is reconfigured to wait for a notification that new data has been published in any of the topics. For that purpose, it resorts to an aggregation parametrized with the `any` aggregation function (lines 5 to 9).

Listing 1.3. Sketching the Implementation of a Listener

```
1  public class Listener2 extends AbstractClientNotificationListener {
2    public void processMessage(ClientNotificationMsg msg) {
3      gui.display(msg.getContents());
4    }
5    public void NoDataNotification(NoDataException e) {
6      gui.displayNotification("Lost connection to data sources"),
7      getSession().reconfigure(new Aggregation(
8       { "Temperature", "Temperature2", "Humidity"}, any, Pattern.PUBSUB, this);
9    }
10   ...
11 }
```

4 Related Work

The work in [21] presents one solution for self-adaptability of service-generated data streams targeting problems such as data loss or delays associated with communication networks disruptions. The solution uses a distributed hierarchical structure of controllers/actuators for a) adjusting data flow according to the detected dynamic variations; b) saving these data in buffers whenever necessary in order to avoid data loss; c) in-transit data processing at the hierarchy nodes hence reducing the execution time of the application generating the data. Nevertheless, interaction models are not present in the above work as explicit configuration options considering service interactions as presented in our proposal. Although the cited aproach does implement a (sophisticated) Producer/-Consumer interaction model, such is restricted to the support system (i.e. it is not explictely visible at the point-to-point interaction level between a service and its user). Furthermore, in [21] there is no reference on the possibility to dynamically add new data flow consumers. This is possible in our approach by adding new clients to the proper session. Moreover, and in the context of this same session, it is possible to dynamically acquire data from additional data flows supported as an automatic or requested reconfiguration to an aggregation interaction model. Finally, our solution includes a set of richer interaction models like the cited possibility of parameterising a Publish/Subscriber session with a new interaction model. The session's dynamic reconfiguration to the latter can be automatically enforced as a consequence of a particular notification of the subscribers.

Some other works also use the *pattern* concept for systems' self-adaptation mechanisms but in a different way than our solution, namely, by making use of reconfigurable Architectural Patterns on system definition [22]. For example, the inherent architecture of the Publish/Subscriber pattern allows it to be reconfigurable in terms of the number of publishers, subscribers, and the events they subscribe to; the Master/Slave pattern allows the addition of new slaves to optimise task execution [23]. Such is also incorporated in our solution within the context of a session. In spite of that reconfigurable system architecture definition by the cited works, these do not support the notion of a session capturing an interaction's context, nor the system's evolution as a sequence of patterns. In our proposal, this sequence is ruled by well-defined transitions which are conform to each pattern's semantics and provide forms of system's consistency guarantees. Such per-pattern reconfiguration contributes to limiting, to some extent, the impact of the system's dynamic reconfiguration.

Finally, our solution is based on the work by [20] which, however, does not target the stateful services' domain nor provides a session context. Additionally, it also does not implement systems' evolution conforming to a state machine dependent on interaction's context between a service and its users.

5 Conclusions and Future Work

The high relevance of the service paradigm is already evident across different domains may these be commercial, social, technological or scientific. Due to its simplicity and familiar semantics, it provides a powerful general abstraction for system programming, interaction, and integration. Such is perceivable on the current trend of making everything accessible as a service (*XaaS*).

Upon the acknowledgement of the high heterogeneity and extreme large scale of current and future service systems, *Services Science* [3] presents a novel and inter-disciplinary view on analysing and developing further the service paradigm. The high complexity of service systems in this domain, require innovative solutions to be developed in order to improve service productivity and quality, and for which scalability, and hence dynamic adaptability, are pressing concerns.

To this extent, this work focuses on providing richer and dynamic interaction models to stateful Web services. The proposed solution is based on the concept of *Design Patterns* to build a middleware supporting such interactions. These include data access via Behavioural Patterns like Producer/Consumer, Streaming, Publish/Subscriber, or dynamic aggregation of such collected data from distinct stateful Web services. Moreover, dynamic changes assisted by the middleware may take into account, a) The context of the provided service, e.g. service availability, or application specific characteristics. For instance, in the particular domain of Web enabled WSNs, such characteristics may be the status of the current subscribed topics to particular WSNs. b) The context of the interaction medium among the stateful Web service and its users, e.g. the current QoS of the underlying communication medium limited by network bandwidth or congestion. c) The context of these users, e.g. users accessing a stateful Web service through a mobile device with limited autonomy or processing power.

Moreover, the solution uses the concept of a *Session* to capture the characteristics relating a set of users accessing the same particular service with the same interaction model. The Session concept supports hence the modelling of stateful Web service/users interactions promoting its reuse and adaptation. Namely, on one hand, the owner of a session may, at run-time, explicitly change the interaction model to the service, being this automatically perceivable by the other users in the same session. On the other hand, the dynamic modification of the used interaction model within a session may be triggered by the middleware itself and according to a state machine following a set of pre-defined rules. This provides limited forms of coping with failures or guaranteeing some consistency characteristics, as a result of changes in the context of a session (which comprises the service, its users, or the communication medium as enumerated above).

Additionally, the novel work described in this proposal concerning session-based richer interaction models for stateful Web services, opens several interesting further developments concerning this context. For example, a) the possibility of accessing other Web services beside the ones supported; namely, work is already under development to port the proposed Session abstraction to the context of Cloud computing; b) extension of the state-machine managing the implemented dynamic reconfigurations with additional user defined rules at runtime; c) aggregation of several service interactions with the described characteristics capturing their dependencies in the form of workflows; this is also being implemented in the context of a workflow engine.

In our opinion, the proposed solution and cited extensions pave the way for an useful approach towards dynamic adaptations on interfacing stateful Web Services, and hence contributing to service systems dynamic evolution in the context of Services Sciences.

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Disassembling Digital Identity-Related Privacy into a Set of Services: SoaML-Based Services Design

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Abstract. Privacy could play a key role for digital identity protection and security, which are becoming major needs for individuals, organizations and societies. Digital identity management functionalities are increasingly delivered as sets of services, rather than monolithic applications. So, an identity layer in which identity and privacy management are interoperable could be more realistic and an acceptable situation in the context of distributed environments. Such interoperability could be offered through the design of a set of loosely coupled, publicly hosted and available to on-demand calls services and the implementation on open standards basis. The aim of the article is to disassemble digital identity-related privacy requirements that are drawn from global, domestic and business-specific privacy policies into a set of eight ready-to-use, granular and loosely coupled services that could accommodate a service-oriented architecture (SOA). OMG SoaML service architecture, service contract architecture, message type, service contract choreography, composite application components, and provisioning diagrams are provided.

Keywords: Digital identity, privacy requirements, services design, SOA, SoaML.

1 Introduction

Service-oriented economy imposes new ways of relating to their customers. In such economy, anonymous transactions are rare and a service provider has to know something about the digital identity of a service receiver such as name, preferences, and attributes that are digitally transferred across the network. In such economy, digital identity management is emerging as a pervasive infrastructure, within, between, and across organizational boundaries and it is highly perceived as a security pillar and a predicate for corporate governance [1-4].

Identity and privacy should be interoperable and distributed through the adoption of service-orientation and implementation based on open standards. Identity functionality is increasingly delivered as sets of services, rather than monolithic applications. It is hard to create an identity layer for the internet mainly due to the little agreement on what it should be done and how it should be run. The lack of agreement arises because digital identity is contextual in nature. Thus the emergence

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of a single simplistic universal digital identity solution is not realistic [5]. Privacy is to be engineered to integrate identity from the start, rather than attaching it to identity after the fact. It is confirmed that building secure systems requires privacy principles/policies to be taken into consideration from the early stage [4, 6]. Design must start from maximum of privacy is one of the design principles of European PRIME Project [7]. Organizations are realizing that they need better security, particularly identity & privacy management through a better interoperability both within and between countries. Interoperability is not just technical interoperability but the alignment of policy, services and processes with business requirements [8].

This article is organized as follows. In section 2, we explain the need of interoperable privacy and digital identity management functionalities and we describe the target system. In section 3, we specify DigIdeRP requirements that we draw from privacy policies. In section 4, we introduce OMG SoaML modeling language and we disassemble DigIdeRP requirements into a set of eight services. We provide a range of SoaML diagrams to illustrate the design and pre-implementation steps. Finally, we conclude and present future work in section 5.

2 Digital Identity, Privacy, and Interoperability

Privacy is a complex and subjective concept that has with different meanings to different people when used in different contexts [9]. It is often used to refer to some quite specific need or expectation, such as freedom from the attention of paparazzi, protections against voyeurism such as the use of mobile cameras in change-rooms. One of the most common narrow usages of privacy is to refer solely to privacy of personal data, or sometimes the combination of that with privacy of personal communications. The computer scientists [10] identify three elements of privacy: “being able to make your own decisions and hold your own views without interference; controlling information about yourself; and being in charge of your personal space”.

There is a strong bound between identity and when privacy is compromised security of the individual, the organization or the country could be threatened [11]. Digitalization gives to the Internet the power by allowing several virtual representation of reality, including that of identity. Digital identities and user profiles allow to individuals accessing online services and for this reason they become valuable assets. Protecting and securing digital identities and profiles becomes an urgent need for individuals, organizations and societies. With the lack of identity protection, people would be susceptible to identity theft, fraud and business closing through denial of service attacks. Preserving privacy could contribute to protect digital identity and avoid damages related to it such as unauthorized access, frauds, identity/profile data theft and harmed reputation. In addition, privacy could reduce power and control to organizations/individuals, which possess and collect personal information.

We adopt service-orientation in order to ensure interoperability within distributed privacy and digital identity systems. Thus, privacy requirements coupled with service orientation considerations should be incorporated into a digital identity management system from the requirements specification and the very outset of the design process [4, 11]. In other words, privacy should be engineered and integrated from the start, rather than attaching it after the fact. In addition, user-centric digital identity federation technical model [12] aspects are also to be considered as soon as the project begins. More details about user-centricity are available further in sub-section 2.1. In general, when decomposing the community into specialized, individual outlets, we will be able to achieve an environment in which outlets can be distributed. Thus, privacy should have a service-orientation to respond adequately to service economy and context. Many service and SOA definitions are suggested in the literature. Here, we adopt the definitions provided by SoaML specifications. The service is defined as "an offer of value to another through a well-defined interface and available to a community" and SOA as "an architectural paradigm for defining how people, organizations and systems provide and use services to achieve results" [13, 14].

2.1 Digital Identity-Related Privacy Set of Services: The Target System

The target system encloses a set of services that is designed as a consequence of decomposition from digital identity-related privacy (DigIdeRP) requirements. In-rest and in-action represent the possible states of the services. The fist one is represented by a horizontal arrow and it refers to an inactive and a ready-to-use service that is still not invoked by a party. The second one is represented by a vertical arrow and it refers to an active service that is invoked by a participant. In this state, a negotiation and communication channel is established between the parties: service sender and service receiver(s). If the negotiation is a success, the service is consumed and if it is a failure, the service is released. The dash line eclipse delimits services hosting/deployment environment that could be any machine, a set of distributed machines, an SOA, or a cloud computing environment (see figure 1). The eclipse represents also the circle-of-trust among digital identity federation's participants: subject, service provider (SP), and identity provider (IdP).

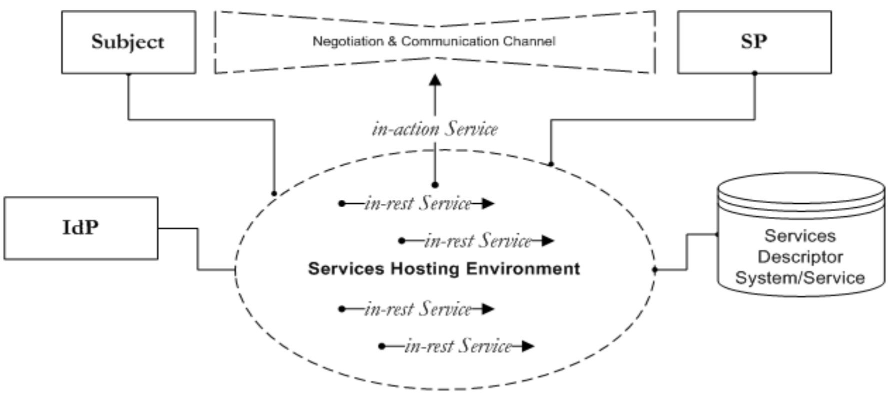

Fig. 1. DigIdeRP services

User-centric identity federation is a novel and promising approach that provides more control over digital identity [15]. OECD report [12] provides a description of user-centric identity federation technical model in which the subject send a request to SP to have a service. The subject could be a person, a machine, or an object that expresses the need to have a service such e-payment, transaction to buy an item through an e-commerce gallery and document download. The SP responds that it needs a set of subject's digital identity attributes. The subject provides IdP(s) address(es) to be contacted to have the required attributes. The SP won't receive attributes unless the subject sends attributes release consent to IdP(s). The SP consumes attributes and sends the service back to the subject. Multiple SPs and IdPs could share the same digital identity federation within a circle-of-trust.

The services descriptor directory system plays the role service discovery system, which describes all available services in term of a service's objective, a detailed description, a hosting system address, constraints, etc. and allows service access by the participants.

3 Digital Identity-Related Privacy (DigIdeRP) Requirements

It is confirmed that Digital identity related privacy (DigIdeRP) requirements are to be specified from privacy policies and such requirements are to be taken into consideration from an early stage of the project [4, 16]

3.1 Privacy Policies

They are classified into three main categories: 1) global privacy policies: CDT's 2007 Privacy Principles for Identity in the Digital Age, OECD's 1980 Guidelines on the Protection of Privacy and Transborder Flows of Personal Data, OECD's 2008 Data Protection and User Control for Identity Management Systems, and (95/46/EC1) European Union Data Protection Directive; 2) domestic privacy policies: The United States Privacy Act of 1974, CSA Model Code for the Protection of Personal Information of 1996, the Canadian Personal Information Protection and Electronic Document Act of 2000, the Canadian Privacy Act of 1983, the Japanese Act on the Protection of Personal Information of 2003, and the Australian Privacy Act of 1998 (Private Sector); and 3) business-specific privacy policies: the 1996 Health Insurance Portability and Accountability Act and the 1999-Bliley Financial Services Modernization Act.

3.2 DigIdeRP Requirements Specification

We draw DigIdeRP requirements from policies of three types of initiatives regarding privacy: global, domestic, and business-specific privacy policies related to digital identity. Digital identity systems should be fully designed in accordance of DigIdeRP requirements: 1) purpose specification: digital identity attributes that have been collected shall be associated with the purpose. As a consequence, attributes processing or communication should be in a consistence with the purposes for which attributes has been collected. The purpose of the system and the purposes for which identity information will be collected and used should be directly linked; 2) consent for attributes usage/release: the individual provides his consent for usage of the attributes that they have provided for the specific purpose. For instance, a user can give consent for his attributes to be released for medical research purposes. Individuals should be notified when other information is gathered about them and linked to their identity; 3) limited usage of attributes: attributes that are collected shall be limited to the minimum necessary for accomplishing the specified purposes. For instance, requirement of bank account number for medical records is absurd. Identity, authentication, and linked information should be used, shared and retained only for the specific purposes for which they were collected/shared/retained; 4) limited retention of attributes: attributes shall be retained only for the necessary period of the purpose's fulfillment for which it has been collected. For instance, a patient medical history can only be retained for a period of 12 months after the treatment, unless the patient has given attributes release consent for research purpose; 5) accuracy of stored attributes: attributes that are stored in the database shall be accurate and up-to-date. For instance, administering a wrong medication to a patient due to outdated attributes in his medical record may cause serious injury and illness; 6) openness: the individual should be able to access to his stored data. Attributes should be easy for individuals to access, view, understand and change. Individuals should also be able to challenge conclusions drawn from digital identity aggregation. Whenever possible, individuals should be able to see when their identity attributes has been disclosed and to whom; 7) authentication and enrollment needs: individual's enrollment and authentication should be with different identities for different purposes. Using a single identifier or credential for multiple purposes creates a single target for privacy and security abuses. When linking attributes within different systems is deemed necessary, appropriate safeguards should be implemented to limit the associated privacy and security risks; 8) choice and terms of the contract: a system should offer individuals reasonable, granular control and choice over the attributes and identifiers needed to enroll in the system and the credentials that can subsequently be used within the system. Moreover, if an individual declines to accept the terms of contract, no information should be collected; 9) secondary use: secondary use, sharing, and sale of identifiers or credentials should not be permitted. Thus, multiple uses of identifiers and credentials should be avoided particularly in the authentication context. Identity, authentication and linked information should be shared with third parties including data transfers between government and commercial entities only when necessary, and should be stored by third parties only until the purpose for which it was shared has been completed; and 10) compliance: an individual should be able to check privacy compliance with the above principles [16].

4 SoaML-Based Modeling of DigIdeRP Requirements

DigIdeRP requirements are decomposed into a set of eight granular and loosely coupled services.

4.1 OMG SoaML: Service Oriented Architecture Modeling Language

SoaML specification describes UML profile and metamodel for designing architectures with a service orientation. The specification extends UML2 to support the activities of service modeling and design and to fit into an overall model-driven development approach that helps to map a business model through logical and physical models into a resulting in technology implementation. Among others, SoaML goals are: 1) identifying services, functional capabilities, requirements and dependencies between the services; 2) defining service consumers and providers; 3) and policies for using and providing services. Particularly, the profile and metamodel accommodate different perspectives: service consumer perspective, service provider perspective, and system design perspective and describe consumers requirements, providers offerings and the interaction and agreements between them. SoaML serves organizations that are looking for a semantically rich notation in which to create abstract yet very precise definitions of their SOA Services, which can later be mapped to implementation artifacts [13, 14]. Cameo™ SOA+ plug-in is integrated into MagicDraw UML modeler tool to perform SoaML-based design of services.

4.2 DigIdeRP Services Description

DigIdeRP Services Architecture Diagram. In the following diagram, figure 2, we present the participants that we've identified (subject, IdP, SP) and we highlight service contract type interaction between them. The service contract specifies the service without regard for its implementation [13]. It is the first step in the definition of services. The dash lines and labels represent the roles (consumer, provider) of each participant in the service architecture.

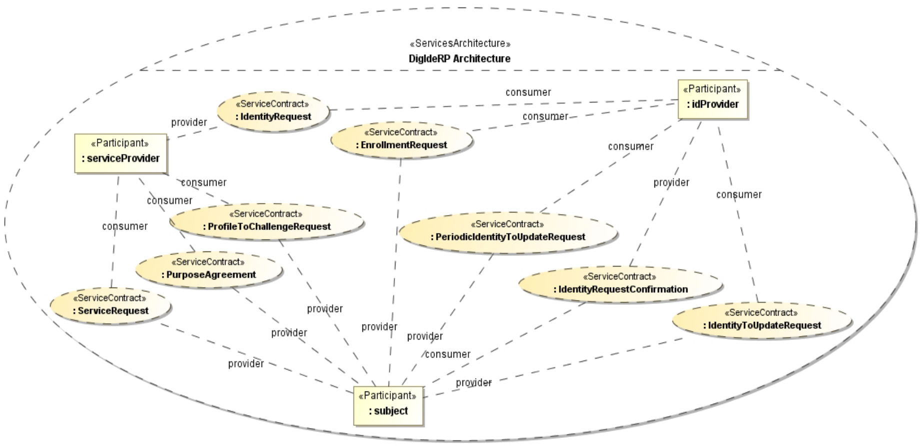

Fig. 2. DigIdeRP service architecture diagram

Below, the eight service objectives are detailed. Methods are available either in consumer service interface or provider service interface. The latter can invoke methods that are available through consumer service interface and vice-versa. Moreover, different inputs of the methods are messages that are described in messages diagrams.

ServiceRequest Service. The service is available for subjects that are in need of services to be provided by SP through service interfaces: ServiceReceiver and ServiceSender interfaces (see figure 3).

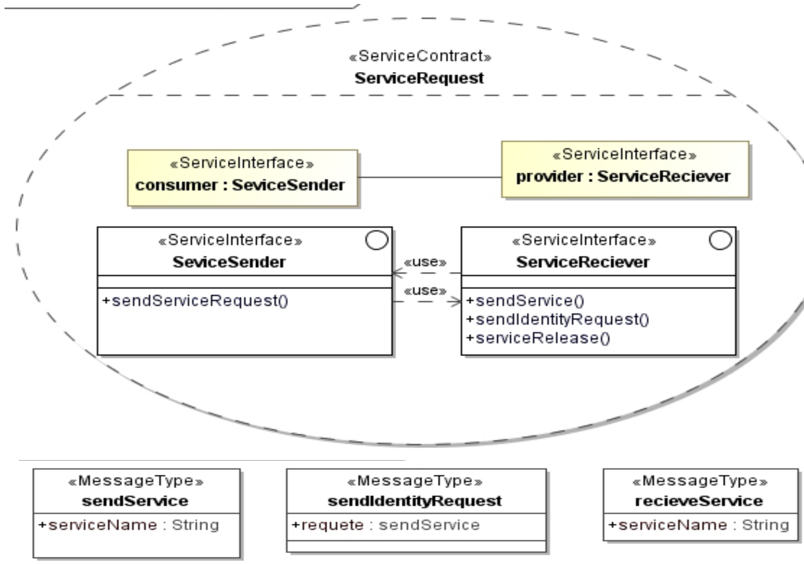

Fig. 3. ServiceRequest service contract and messages diagrams

PurposeAgreement Service. The service could be called by the subject in order to set an agreement with SP on the purpose of identity collection, identity handling (retention) duration, and identity access capabilities (see figure 4).

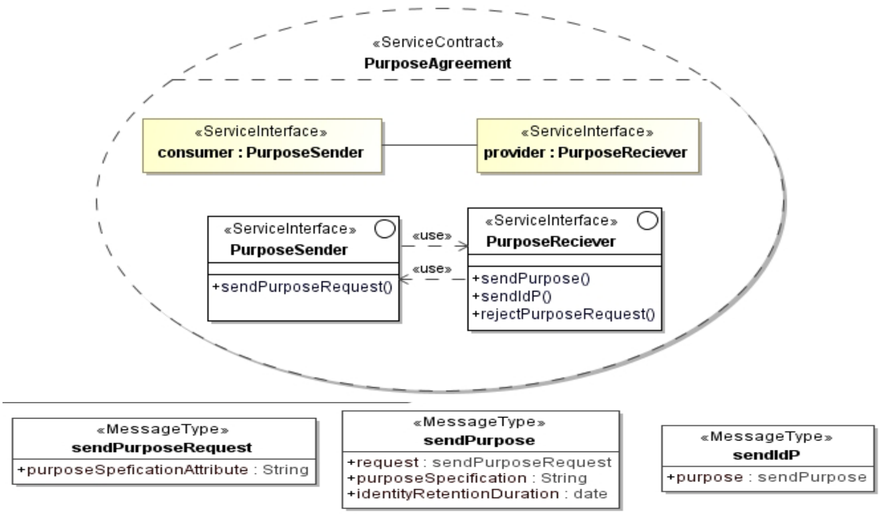

Fig. 4. PurposeAgreement service contract and messages diagrams

IdentityRequest Service. The service is available for SP in order to receive IdP(s) specification. IdP(s) will be required to transfer to the requester SP the subject's identity attributes. The transfer is not possible if the subject has not given his consent (see figure 5).

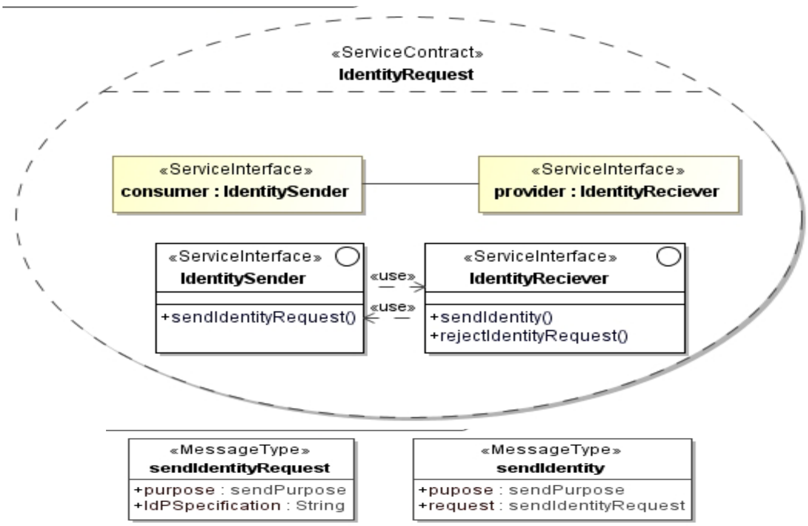

Fig. 5. IdentityRequest service contract and messages diagrams

IdentityRequestConfirmation Service. The service is available for subjects to provide his decision on either allowing identity attributes transfer to the SP or declining such transfer (see figure 6).

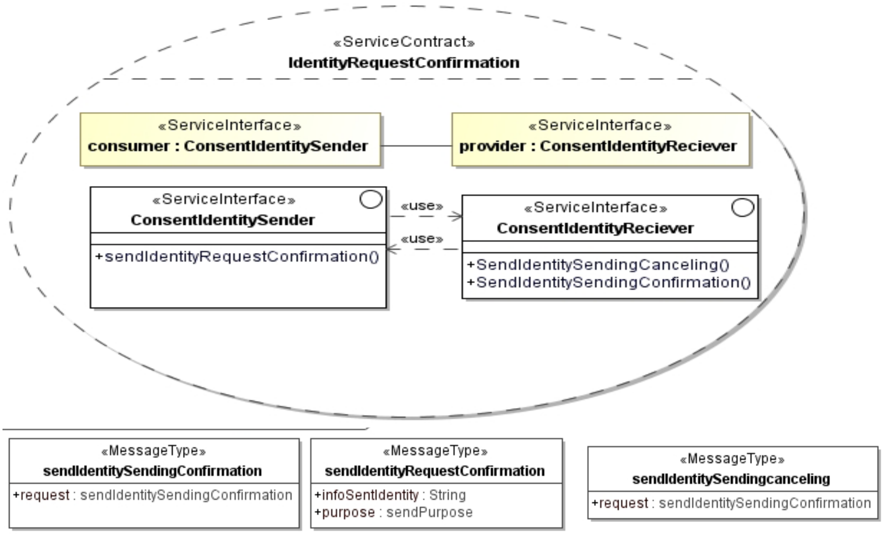

Fig. 6. IdentityRequestConfirmation service contract and messages diagrams

EnrollmentRequest Service. This service is available for the subject to make an enrollment allowing him to delegate digital identity management at the IdP. The subject has also the capability to check digital identity attributes (see figure 7).

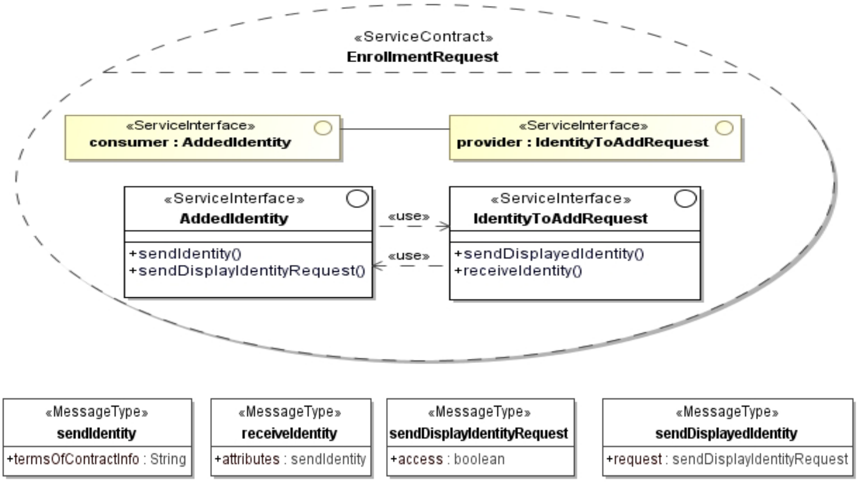

Fig. 7. Enrollment service contract and messages diagrams

ProfileToChallengeRequest Service. This service is available for the subject to be able to access and challenge his profile that is in hold by SP (see figure 8).

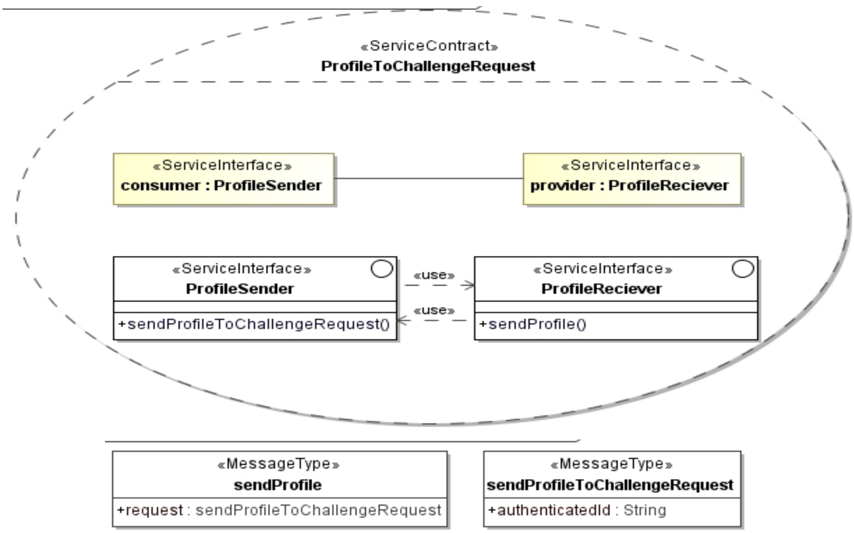

Fig. 8. ProfileToChallengeRequest service contract and messages diagrams

IdentityToUpdateRequest Service. This service is available for the subject to make the desired changes and updates of digital identity attributes (see figure 9).

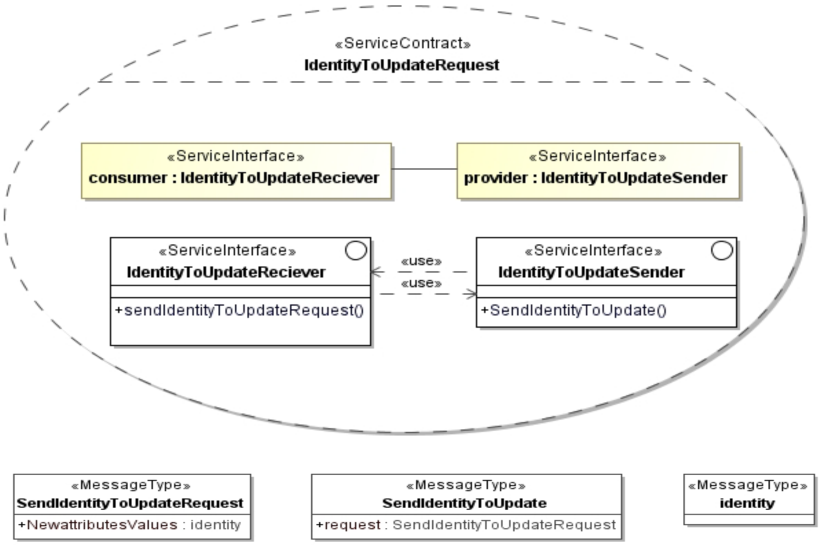

Fig. 9. IdentityToUpdateRequest service contract and messages diagrams

PeriodicIdentityToUpdateRequest Service. This service is available for IdP to make a automatic and periodic digital identity attributes updates. Subjects are already given to IdPs their consent to proceed for update operation (see figure 10).

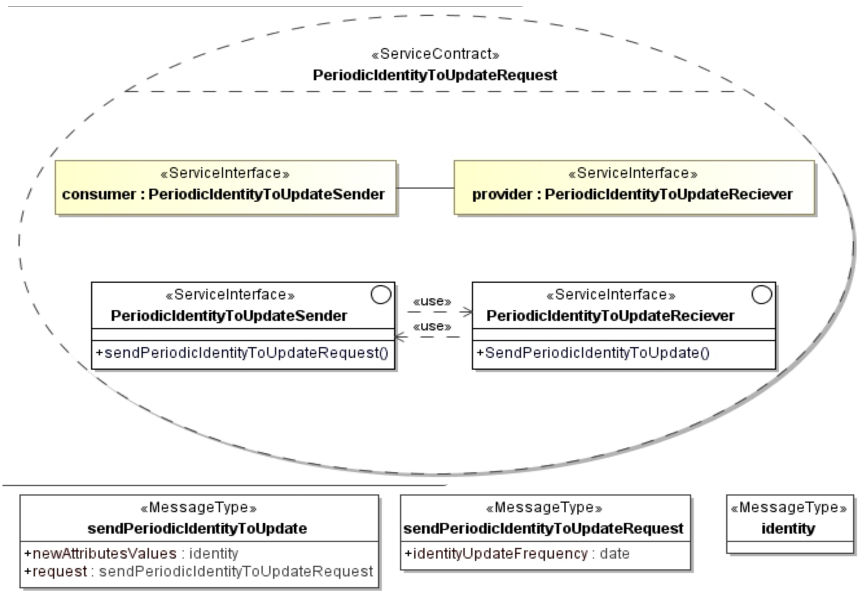

Fig. 10. PeriodicIdentityToUpdateRequest service contract and messages diagrams

4.3 DigIdeRP Service Choreography Diagrams

Services choreographies describe the cooperation between available services, more specifically between service interfaces, to respond to participants' needs. In this article, we provide only a only the PurposeAgreement service choreography (figure 11), which highlights the negotiation and communication process between service interfaces in term of calls of methods.

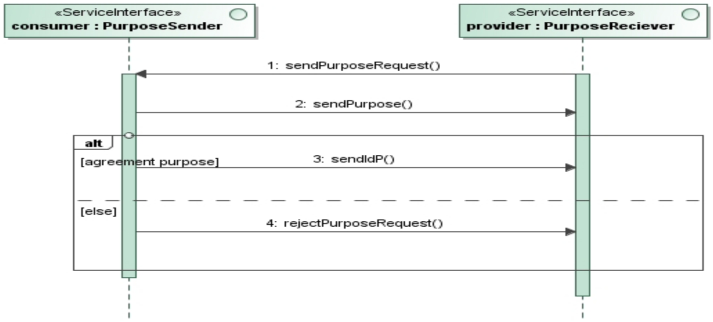

Fig. 11. PurposeAgreement service choreography

4.4 DigIdeRP Services Pre-implementation Step Diagrams

In the pre-implementation step, we provide and describe, through composite application component diagram (figure 12), different components to be implemented further and we specify service channels that link service points and request points.

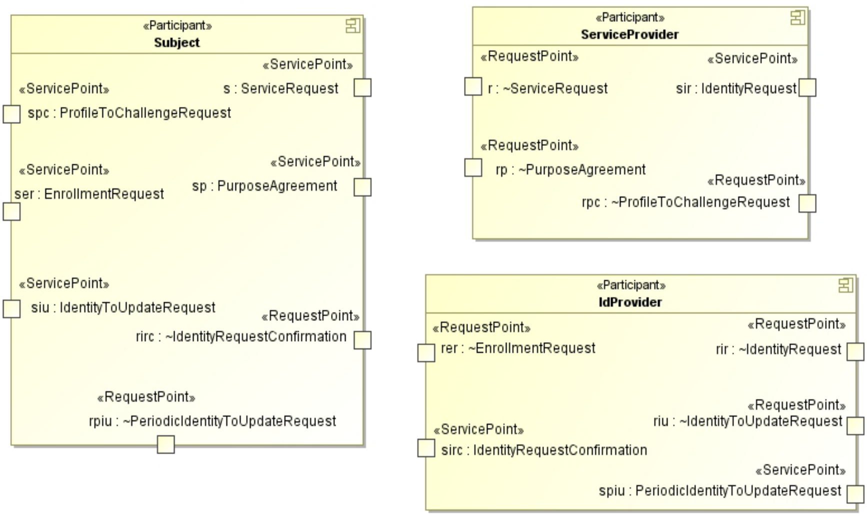

Fig. 12. DigIdeRP composite application component diagram

Service channels are clearly represented in this diagram through service interface name and its correspondent conjugate service interface name. For instance, PuposeAgreement and its conjugate ~PuposeAgreement. The composite application component diagram is a platform-independent diagram; however, the provision diagram (figure 13) is a platform-dependent one. The three components that are enclosed in DigIdeRP composite application component diagram are transformed into three JEE Web services that are deployed within GlassFish JEE application server. Service channels and points are transformed in provision diagram into eight web services interfaces (DigIdeRP services) that are represented with line connections.

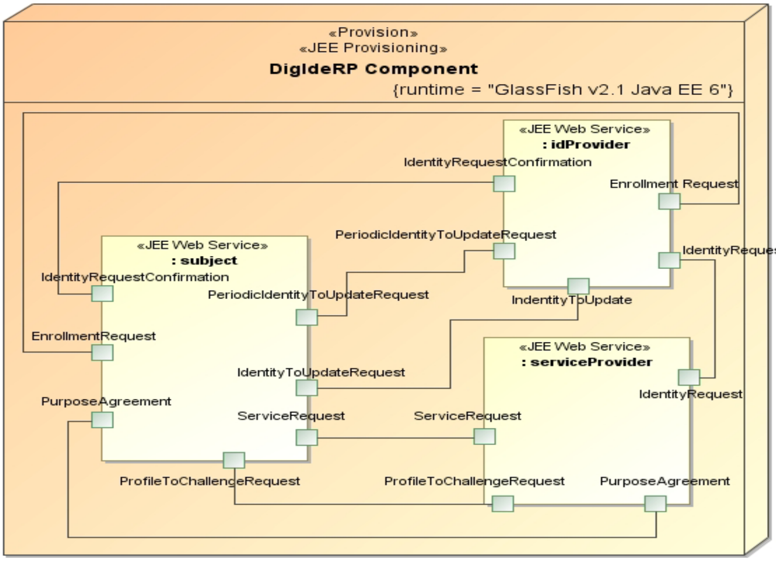

Fig. 13. DigIdeRP Provisioning diagram

5 Conclusion and Future Work

With the emergence of service-oriented economy and cloud computing, many software industry experts and evaluators are encouraging the development and adoption of service orientation as a mean of interoperability. In addition, it is recognized that technical initiatives, emerging standards and protocols are not enough to guarantee resolution for the concerns surrounding a multi-facets and complex issue of identity and privacy. A technical approach is not sufficient enough to tackle privacy issues. Law, policies, regulations and technologies must be crafted together. DigIdeP requirements are drawn from global, domestic and business-specific privacy policies and they should be incorporated from the very outset of the project. We've shown in this article how we've turned DigIdeP and user-centric requirements into a set of eight services that could accommodate SOA in response to the service-oriented environments needs. SoaML service architecture and service contracts diagrams were the starting point that helped to specify service candidates.

SoaML modeling capabilities support the service “contract-based” and “interface-based” approaches, which follow the “ServiceContract” and “ServiceInterface” elements [17]. In this project, we adopted the service contract-based approach, but in the near future, we intend to explore the other approach and compare it to this. We are willing also to find a business process modeling notation/language such as BPMN 2.0 that could help to make the requirements clearer and easier to automate in accordance to service orientation.

Acknowledgments. We gratefully acknowledge and express deep appreciation to Afef Mestiri for her engagement and valuable contributions to the work.

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Are Services Functions?

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Abstract. This paper proposes an ontological definition of services. Such a definition is one of the fundamentals of service research. The understanding of essentialities of the notion of services as its definition, which differentiates services from the other notions, contributes proper modeling and conceptualization of services in services design and knowledge management of services. The existing definitions and characteristics of services, however, cannot differentiate services from other concepts: especially function of product. In this paper, we propose a new definition of services based on ontological consideration. Our definition can differentiate services from product functions. Firstly, we discuss the problem of the existing definitions and characteristics about the distinction. Secondly, we explain our definition and the essential characteristics of services using an ontological model of services. Lastly, we demonstrate its applicability of our definition using some examples and compare it with the existing definitions.

Keywords: definition of services, services ontology, meta-services, function.

1 Introduction

The definition of the notion of services is one of the fundamentals of service research. Especially, in order to establish and develop a new discipline of services such as the Service Science [1], we need to reveal essential characteristics of services that differentiate services from other notions. In fact, in the early period of the research of services marketing, many researchers have compared services with (physical) goods to establish the services marketing as a new independent discipline from the traditional goods marketing [2]. Then, they have revealed some characteristics of services and defined the notion of services in their own way. Yet there is still no widely accepted definition of services [1].

The existing definitions and characterization of services are, however, insufficient for the differentiation between services and other related concepts such as functions. In most studies, the characteristics of services are taken as intangibility, heterogeneity, inseparability, and perishability (IHIP) in terms of the comparison between services and goods [3, 4]. As discussed in Section 2 below, the IHIP is not specific to "service" rather than "process", which are one of the aspects of functions. Although IHIP nicely differentiates services from products, it does not adequately describe differences between

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services and functions, because functions also have characteristics of process and satisfy all these four. In fact, some prominent service researchers pointed out the problem with associating IHIP with the essential characteristics of services [4].

In addition, from a practical point of view, it is also important to understand the essential characteristics of services in order to establish appropriate models of services and service ontologies for service design and to manage knowledge of services (knowledge management for services). Use of the concepts defined in a services ontology enables us to describe the models of services for increasing the interoperability and reusability of the models. The notion of services is a fundamental in both the models and the ontologies of services. If the definition of services that the models are based on does not capture the essential characteristics of services, the models of services will miss the crucial conceptual elements of services.

Thus, in this paper, we discuss essential characteristics of services through the comparison between the services and product functions, and then propose a new definition of the notion of services. Through these discussions, we answer the question: “are services functions?” in the title of this paper. By “Functions”, we mean not only functions of products but also those performed by humans.

This paper is organized as follows. In Section 2, we analyze definitions of services found in the existing research and describe their fundamental concepts. Based on this, we show that the differentiation between services and product function in the existing definitions is insufficient. In Section 3, we propose our definition of services and characteristics differentiating between services and product functions. In Section 5, we provide a final summary of this research and look at future prospects.

2 Analysis of Definitions of Services

2.1 Similarity between Services and Product Functions

By analyzing the existing definitions of services in the literature, we derive conceptual characteristics, and then reveal some fundamental concepts of services. For example, Shimomura et al. defined services as follow: “*Service is defined as a deed between a service provider and a service receiver to change the state of the receiver*” [5]. We can derive the characteristic of *process* from the phrase “change the state” because *process* involves some state-change.

We analyzed the definitions from 15 papers [5-19] in the various fields of service research and have derived 45 characteristics. Table 1 shows a part of correspondences between those definitions and those derived characteristics. To analyze the fundamental concepts, we grouped the characteristics associated with the same concepts and came up with three groups: *process*, *provision*, and *value*. By *process,* we mean a temporal change of a state and, consequently, which includes the characteristics of *action*, *state-change*, *performance*, *intangibility* and so on. By the *provision*, we mean that an agent provides something to another. This concept implies the existence of a provider and a receiver, and, consequently, includes characteristics such as *provider (person)*, *receiver (person)*, and others. Finally, the *value* is a concept associated with evaluation of usefulness (value, benefit and request) from the receiver’s perspective. Consequently, the *value* includes characteristics such as *providing value/profit*, *fulfillment of expectation* and so on.

Table 1. Correspondences between existing services definitions and the derived characteristics (Partial)

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
		Shimomura et al.[5]	Albani et al.[6]	Ferrario et al.[7]	Fitzsimmons et al.[8]	Grönroos [9]	Hill [10]	IBM [11]	IfM [12]	Kotler [13]	Lovelock et al.[14]	Lusch et al.[15]	Rai et al.[16]	Weigand et al.[17]	Yoshikawa [18]	Zeithaml et al.[19]	counts
1	Process	○		○	○	○	○	○	○	○		○	○	○	○	○	13
2	Activity					○					○				○		3
4	Action	○	○	○		○				○	○	○				○	8
5	Functionality	○													○		2
6	Interactivity				○			○				○			○	○	5
7	Performance				○					○	○	○				○	5
9	Intangibility				○	○				○			○				4
12	Take over														○		1
13	State-change	○					○	○							○		4
15	Providing	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	15
17	Provider (Person)														○		1
19	Provider (Structure)														○		1
25	Receiver (Person)														○		1
26	Receiver (Customer)				○	○		○			○		○				5
28	fulfillment of expectation	○													○		2
31	providing value/profit		○	○				○	○		○	○	○	○	○		10
34	Mutual benefit								○								1
37	Agreement		○	○			○		○								4
38	Explicit implementation guarantee		○	○													2
39	Otherness	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	15
40	Ability		○								○	○					3
41	Value equivalency	○					○				○			○			4
42	Non-ownership										○			○			2
43	Pattern		○														1
44	Resource								○					○			2
45	Commitment		○	○										○			3

Looking at the derived concepts (*process*, *provision*, and *value*), we see considerable similarity between services and product performance functions. For example, the relaxing function of a massage machine is related to a process to relax the muscles of the user and is provided from the massage machine to the user. And, the value of the massage machine lies in this function.

The concepts of services and product functions have the same conceptual structure. We define the product function concept as "a result of teleological interpretation of a behavior (i.e., state-changes) of the operand(s) under an intended goal" [20]. The relation that the product brings about state-changes in the operand corresponds to the *provision* and *process* in the fundamental concepts of services. Moreover, the *value* of product functions and services corresponds to each other because they both are based on some purpose such as a request. From these correspondence relationships, we can say that services and product functions have the same conceptual structure.

Yoshikawa and Shimomura et al. have already pointed out the similarity between services and product functions. In particular, Yoshikawa asserted that "a service is manifested function" [18] and this is an essentiality of services. These suggest the validity of comparing services and product functions.

2.2 Problems with the Characteristics and the Existing Definitions of Services

As mentioned above, existing characteristics and definitions of services are insufficient in terms of the distinction between product and services. Here, we point out the problems through an analysis of some familiar examples.

Intangibility, heterogeneity, inseparability, and perishability (IHIP) focus on the process aspect of services and the physical aspect of products. Intangibility denotes the services are intangible because they are processes as temporal changes of states, thus do not have physical shape. Next, inseparability denotes that the production and consumption processes of services occur at the same time. For perishability, a process only exists during its performance. And heterogeneity denotes the quality of services are uneven because, unlike product, it is impossible to check the quality of services before use due to the inseparability. Thus, IHIP is not the exclusive characteristic of services but the characteristics common to processes.

These characteristics are derived focusing only on the physical aspect of products. Strictly speaking, however, a product is composed of both product as a physical thing and that as product functionality. The product functionality is one of the essential properties in the product concept. For example, a chair as a product has a person-support function. If a chair leg breaks, the chair is not able to perform that function. Then, the chair will no longer be recognized as a product. Thus, the comparison between services as processes and products as physical objects is insufficient in order to understand the essential characteristics of services. We have to compare services with product functions.

In fact, the existing definitions of services cannot differentiate between services and product functions. For example, Zeithaml et al. define services as "*deeds, processes and performance provided or coproduced by an entity or person for another entity or person*" [19]. This definition cannot differentiate services from product functions, because a product function is a process or performance, and is provided by a product as an entity for another entity or person. In Section 5, we discuss a comparison among our definition and the existing definitions in detail.

As we see thus far, the distinction between services and product functions has not been revealed yet. In the next section, we propose a definition of services that can differentiate services from product functions.

3 Our Definition and Essential Characteristics of Services

3.1 Our Definition of Services

We define services as follow.

Definition:

A service is an execution-environmentally situated[A-1] *function detached from the function performer from user (customer)'s point of view*[B-1]*. (By function, we here mean any goal-oriented effect-giving operation performed by any kind of agent)*

Supplements:

(1) A service provider (a) guarantees and advertises the quality of the services[C]*, (b) designs the services contents and trains the service performers, and (c) designs execution-environment to maximize the value of the resulting effects.*[A-2] *Thus, the service provider sells the right to use/access to such a function that is expected to be nicely executed in the predesigned environment (that is, "an execution-environmentally situated function").*[A-3] *Customers are interested primarily in the quality of the function rather than the function performer, and hence the detachment of function from the function performer is realized.*[B-2]

(2) There exists a multiple-layered structure of services where a service at the higher layer enables a service/function at the lower layer. The bottom layer corresponds to daily events in which customers usually participate. It can be a services or a (product) function.

(3) When the service is intended by the service provider, then it is an essential service, otherwise an accidental service.

In our definition, services are regarded as a special type of functions in a broad sense above. This is the answer to the question: "are services functions?" and the conditions described in the definitions shows characteristics specific to service as a special type of function. Our definition is based on a model of service systems and the two main characteristics that differentiate between services and product functions: the *designability of the environment* and the *detachment of the function from the function performer*. The phrases of underline [A] are based on the former, and the phrases of underline [B] are based on the latter. The supplements and some terms such as "*service provider*" and *"function performer"* and so on are based on our model of service systems. Based on these characteristics, our definition can distinguish services from product functions, which are "functions" in a narrow sense and another special type of the "function" in a broad sense above.

In Section 3.2, we explain our model of service systems. In Sections 3.3, 3.4 and 3.5 we explain those essential characteristics of services.

3.2 A Model for Comparing between Services and Product Functions

In order to compare some concepts correctly, it is important to clarify perspectives to capture them. We clarify our perspective to services and product functions in the way to develop a general model that represents services and product functions. By using this model shown in Fig. 1, we can compare them from a consistent perspective.

This model is composed of *function* [1], *function performer, operand, provider*, *beneficiary*, *and environment*. It is an extension of Kotler's Service Marketing Triangle [21]. The Kotler's model is composed of *firm*, *employee* and *customer*: *firm, employee and customer* correspond to *provider*, *function performer* and *beneficiary/operand* in our model, respectively.

The *function* consists of a state-change of the *operand* and a goal, and it is based on our definition of function [20] as mentioned in Section 2.2. The *function performer* is an agent to perform functions. Humans and products can be function performers. The *operand* is a target of the function. The *provider* prepares *function performer* and *environment* where the function is performed. Our model has a multiple-layered structure of functions, which is called *meta-base layer*. The *beneficiary* is an agent who gains some benefit from the performance of function, and the *provider* advertises and guarantees the quality of the function to the *beneficiary*. The underlined phrase[(C)] in the supplement (1) captures this.

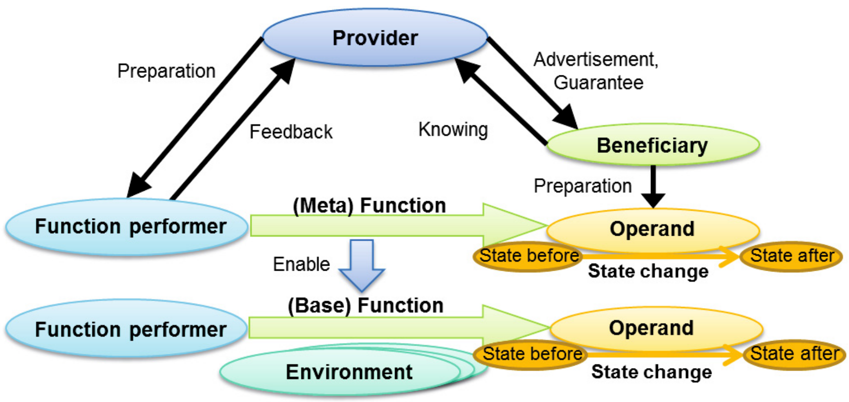

Fig. 1. The general model of service systems and product function systems

The meta-base layer represents the relationship that a function enables to perform another function. A function that enables others to work is called a meta-function. A function that enables no function to work is called a base-function. Base-functions are demanded by beneficiary directly or indirectly, and are performed in daily events in which customers usually participate. For example, the case of the massage salon services,

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[1] By "function", we here mean the goal-oriented effect that includes the product function and performance of services by humans and products.

the base-function is the massage-relaxation function performed by the massager and the meta-function is taking a reservation of the massager prior to giving a massage. The supplement (2) in our definition captures this.

We can explain service systems based on this model. Service companies are regarded as providers, and each of them is called a service provider. The service providers prepare the function performers: employees or equipment in the services (e.g. hiring and training employees, installing equipment, and designing service environment). The underlined phrases (A-1, A-2) in the definition is based on this. They also advertise and guarantee their services to customers, which are the beneficiary in this model. The operand depends on services; in a massage service, customers themselves are regarded as beneficiaries and in a laundry service, their clothes are regarded as operands. The underlined phrase (C) in the definition captures this.

Similarly, we can explain how product functions are represented by this model. The function of a product becomes available to a user once the maker (or sales outlet, regarded here as an integrated function performer) sells the product to the user. Consequently, we can regard a product function as a base-function and sales function as a meta-function. We use the proposed model to capture a product function. Here, because a product performs a product function, the product is regarded as a function performer and the maker that designs and manufactures the product as a provider. The user of the product enjoys the product function. So the user is regarded as a beneficiary. We can then regard the target of a product function as an operand.

Compared with Kotler's model, our model divides the customer concept defined in Kotler's models into two parts: beneficiary and operand. By dividing the customer concept into two objects, the semantics of the model become clearer. For example, in modeling a laundry service based on the Kotler's model, we cannot identify the target of the laundry service whether clothes or customers of the laundry, while based on proposed model, we identify more clearly the clothes as the operands and the customers as the beneficiaries. Furthermore, based on studies about function [20], this model can express delivering services in more detail. The most significant value of this model exists in the introduction of the meta-base layer.

3.3 Non-ownership

To begin with, we consider some differences between services and product functions through some examples: services of massage salon as typical services, sales services of products, use of the products, rent-a-car services and use of the cars.

Table 1 shows their meta-base structures and some significant attributes such as ownership, time, and place. In Section 3.2, we have already mentioned the meta-base layers of massage salons services and sales services. In the case of the car rent-a-car services, the meta-functions are the functions of lending the customer a car, and the base-functions are the car's functions which is performed when the user drive the car. These meta-functions are apparently services. On the other hand, in the base-layers of them, while the base-functions of massage salon are services, the ones of sales services are product functions, and the ones of car rental seem to be intermediate between services and product functions.

Table 2. The restrictions caused by ownerships of function performers(FP) on uses functions in services and product functions

		Typical Services (e.g. Massage salon)	Rental Services (e.g. Car rental)	Sales Services (e.g. Massage machine sales)
Meta-layer	Meta-function	Transferring temporary use rights of base-FP (Taking a reservation)	Transferring temporal use rights of base-FP (Lending a car)	Transferring ownership of products as base-FP (Selling a massage machine)
	Owner of FP (FP)	Providers (Receptionists)	Providers (Clerks)	Providers (Salespersons)
	Time	Restricted (In the business hours)	Restricted (In the business hours)	Restricted (In the business hours)
	Place	Providers' side (In the salon)	Providers' side (In the shop)	Providers' side (In the shop)
Base-layer	Base-function	(Massaging)	(Carrying something)	(Massaging)
	Owner of FP (FP)	Providers (Massager)	Providers (Rented car)	Beneficiaries (Massage machine)
	Time	Restricted (Period of a massage service)	Restricted (Lending period)	Unrestricted (Anytime customers like)
	Place	Providers' side (In the salon)	Beneficiaries' side (Anywhere customers like)	Beneficiaries' side (Users' room)

There is a difference with respect to ownerships of function performers in these cases. In the cases of product functions, users as beneficiaries can use the functions of the products whenever and wherever they want, because they have ownership of the products. In the case of services, unlike product functions, customers as beneficiaries cannot use the services of service performers freely, because they do not own the service performers. They need some permission to use the services from service providers, who own the service performers. In addition, the service providers usually specify the situations where the services are performed in order to provide the services in the appropriate environments. We call that the beneficiaries do not have ownership of the function performers in services "non-ownership"[2]. The restrictions caused by the non-ownership, which is one of the major differences between services and product functions.

We can explain the difference among the three cases in terms of non-ownership. In their meta-layers, whose functions seem to be services, the beneficiaries do not own the function performers. Thus, the time when the functions are performed is restricted within the business hours, and the place where the functions are performed is restricted to the providers' side. For example, in the case of massage salons, the customers do not have the ownership of the receptionists. Moreover, the customer can make a reservation only in the business hours and at the reception desk in the massage salons. Next, in the base-layer of the massage salons, whose functions seem to be services, the customer also do not have the ownership of the massagers, thus the time

[2] By "ownership" here, we do not mean legal proprietary rights. For example, if a person obtains a loan to purchase a product, he may not have legal proprietary rights of the product until he pays off the loan. Even before paying off the loan, when he actually uses the product, he can do so as if he owned it. Consequently, "ownership" here means he can use the product freely like an owner anytime and anywhere—regardless of legal propriety rights—as if it was his own possession.

is restricted to the period of a massage, and the place is restricted to the massage salons. On the other hand, in the case of the shop that sells products such as massage machine, the base-functions are the uses of the massage machine at home and are regarded as product functions. The users own the massage machine, thus can use it anytime and anywhere as they want. Hence, the time and place are not restricted. In the base-layer of the car rental shops, while the time when the customers can use the car is restricted to the lending period, the place is not restricted but anywhere they want. That is the reason why these base-functions seem to be intermediate between services and product functions. Consequently, we regard the non-ownership as one of the essential differences between services and product functions, because it derives some essential characteristics of services as discussed below.

3.4 Detachment of the Function from the Function Performer

We explain differences related to the beneficiaries' recognition of function and function performer.

In the case of services, customers are interested mainly in the quality of function as services rather than the function performer. If the quality of a function fulfills the conditions of guaranteed quality of the services, the function can be a service regardless of who performs it. Let us take a fast-food restaurant as an example. If the employees can work according to the stipulated guidelines in the manual, the function performed by them is accepted as the guaranteed services regardless of who are in charge. Due to the anonymousness of function performers in services, the customers have a stronger awareness of the function than that of the function performers. Thus, they recognize that the function has become detached from the function performer[3]. In the case of product function, the users as beneficiaries own the products as function performers in which functions are embedded. So, to user, the function performer is not anonymous contrary to the services. Consequently, the users tend to be strongly aware of the function performers. This awareness of the relation between function performers and function is called the *detachment of the function from the function performer*. The underlined phrase [(B-1)] in our definition captures this. As can be seen from the above, this characteristic is derived from non-ownership.

Section 2 describes how the IHIP characteristics do not contribute to identifying the differences between services and product functions. That is because those characteristics are common to both. We need to identify the difference between services and product functions. The idea of the detachment of function from its performer nicely explains how they are different and why service providers can sell services like conventional products. Such a detachment is realized, in the case of services, by customers' strong awareness to function (especially, the aspect of process of function) rather than the function performer because of the anonymousness of function performers. In the case of product function, on the other hand, the user owns the product as function performer. So, he/she is strongly aware of the function performer. Due to this, there are an emphasis on and awareness of the physical characteristic of function performers. They are clearly derived from the non-ownership as fundamental natures of services.

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[3] Of course, in services, the function performer is an important element to the customer, because the quality of services often depends on it. That is, however, a different issue.

Thus, we conclude that the (execution-environmentally situated) functions detached from the function performer are regarded as services, because, based on this characteristic, we can explain the occurrence of IHIP, which many researchers regard as characteristics of services. In addition, we should characterize services based on not IHIP but this characteristic, because this is more essential than IHIP for distinction between services and product functions.

3.5 Designability of Environment

Within services design, in order to enhance the result of the services, service providers design the environment where the services are performed. For example, in restaurants, the designers might design such a nice environment that the customers can enjoy the meals. In the case of product design, on the other hand, the designers of products can consider the environments where the users use the products, but cannot design them. We call this *designability of environment*. The underlined phrases (A-1, A-2, A-3) in our definition capture this characteristic.

3.6 Essential Services and Accidental Services

In the supplement (3) in our definition, the *essential services* and the *accidental services* represent the difference between providers' perspective for the services and beneficiaries' one. The essential services are intended by the service providers and the accidental services are intended not by the provider but by the beneficiaries. For example, in the case of coffee shops, a provider intends to provide the services which customers can drink coffee. However, if some customer uses the space for his/her meeting, the coffee shop unintentionally provides the services of the meeting space in the perspective on the customer. The distinction between the essential and the accidental is based on our studies about function [22].

4 Some Examples

In this section, we demonstrate that our definition can distinguish services from product function, and that our definition fits successfully some examples of services.

4.1 Services and Product Functions of Massage

To begin with, we look at massage services as a typical example to exemplify our definition and look at a product function of a massage machine to show the distinction between services and product functions.

The massage functions (or services) are to eliminate the fatigues of the customers with massages. The massage services have the designability of environment, because massage salons as service providers usually design the environment of the massage salon in where the massage services are performed. The massage services satisfy the underlined phrases (A-1, 2, 3) in our definition, which are based on this characteristic. The massage services also have the detachment of the function from the function performer. If the masseurs can perform the services of which the quality fulfills the guarantee of massage services, the customers tend not to pay much attention to the masseurs as function performers, and the anonymousness causes the detachment of the function from the function performer. This detachment is also caused in the case that automatic massage machines, which are products, perform the massage services. Because, the customers recognize the similar anonymousness, since the qualities of services that the massage machines perform are very even. Thus, the massage services satisfy the underlined phrases (B-1, 2) based on this. The massage salons as service providers usually guarantee and advertise the quality of services. Thus, the underlined phrase (C) is satisfied. Here, we can explain the massage services satisfy our definition and supplement (1). We have already explained about the supplement (2) in Section 3.2. The last is the supplement (3). The essential service in the massage salons is the massage service because the intention of massage service provider is to massage customers. The accidental services is depends on each a customer. If a customer uses the massage salon in order to have a nap, then the accidental services is the services to give a space where he can have a nap. As stated above, the massage services satisfy our definition.

Next, in order to show that our definition can differentiate services from product functions, we consider the two characteristics: the designability of environment and detachment of the function from the function performer, through an example of the use of a massage machine at the user's home. This case does not satisfy the designability of environment because the designers of massage machines cannot design the environment where the users use the massage machine. And this case does not satisfy the detachment of the function from the function performer. The user owns the massage machine, hence the massage machine as function performer is specific not anonymous for user as with services. Consequently, the user is strongly aware of the massage machine. If the same massage machine is, however, used in a massage salon, those characteristics are satisfied as discussed above and thus the massage machine provides services.

Here, we showed that massage services, typical services, satisfy our definition, as well as that our definition can differentiate services from product functions.

4.2 Automobile Sales and Use

The next examples are the services of selling automobiles and using automobiles as product functions. The sales services of automobile enables that the users of the automobiles can use them. This relation is regarded as a meta-base relation as discussed in Sections 3.1 and 3.2.

The function of the sales services is to provide the ownership of the product with the customers in exchange for money. The environments of sales shops including automobile sellers are usually designed for convenience of the customers. Sales services have the designability of environment and satisfy the underlined phrases (A-1, 2, 3). And, sales services have the detachment of the function from the function performer, because the main purpose of the customers is the possession of the products, whose quality does not depend on the salespersons as function performers. The customers are not strongly aware of who is salesperson and then the salespersons are anonymous for the customers. Thus, the sales services satisfy the underlined phrases (B-1, 2) based on this. And, the underlined phrase (C) is satisfied because the sales shops usually guarantee and advertise the quality of service sales services satisfy the supplement (2). The meta-base layer is mentioned in Section 3.2. On the supplement (3), if a customer uses the test-driving services of an automobile seller to play driving a newest model car, the automobile seller provides the accidental services lending the customer the newest model car. As stated above, sales services of automobile satisfy our definition.

In the same way as Section 4.1, in the case of using an automobile as example of product function, we consider the designability of environment and detachment of the function from the function performer. This case does not satisfy the designability of environment because the designers of automobiles cannot design the environment surrounding the automobiles. Likewise, this case does not satisfy the detachment of the function from the function performer because the automobile as function performer is not anonymous but specific for user due to the user's possession of the automobile.

As discussed above, in the examples of automobile sales and using automobiles, our definition of services can correctly differentiate services and product functions

4.3 Web Services

Our definition of services can explain the web services, such as an Internet search engines. Web services satisfy the detachment of the function from the function performer and satisfy the underlined phrases (B-1, 2). The server computers, which host such web services as function performer, are anonymous for the users, especially in the cloud-computing environment. The users are not aware of which server provides the services. The underlined phrase (C) is satisfied because the web services providers usually guarantee and advertise the quality of the web services. Next, web services satisfy the supplement (2). The base-layer is the web services itself and the meta-layer is the services that the providers enable users to access the web services. On the supplement (3), if a customer uses the web services to confirm the connection to the Internet, the web services provide the accidental services enabling the users to confirm the connection. As stated above, web services satisfy our definition.

5 Discussion

In this section, we discuss the novelty of our definition shown in Section 3.1 with the comparison to some other existing definitions.

Shimomura et al. define the services as follow: "*Service is defined as a deed between a service provider and a service receiver to change the state of the receiver.*"[5] This definition is essentially the same as the definition of function [20] as described in Section 2.2. The *provider* is regarded as the function performer, and the receiver is regarded as the operand of function. The change of state of the receiver is regarded as the behavior (i.e. state-change). Thus, this definition is not the definition of the notion of "services" but the definition of the notion of "function" that is the general notion including "services" and "product function". Our definition can make the distinction between services and product functions. In addition, our definition contains the new concepts that the existing definitions do not have, such as the meta-base structure of services and the essential/accidental services.

IBM defines the services as follow: "*A service is a provider/client interaction that creates and captures value.*"[11] We suspect it mainly focuses on consulting services. It, however, also cannot differentiate the services from product functions in the same way as the definition of IBM. For example, the using a laundry machine fits this definition. When the user is using the laundry machine, there are some interactions between the laundry machine and the user, such as the user's operation of the laundry machine. And the interaction brings in the value of the cleaned clothes. By comparison with our definition, the definition of IBM also fails to differentiate between services and function

Ferrario and Guarino define the services from a viewpoint of ontology engineering as follow: "*A service is present at a time t and location l iff, at time t, an agent is explicitly committed to guarantee the execution of some type of action at location l, on the occurrence of a certain triggering event, in the interest of another agent and upon prior agreement, in a certain way.*" [7] This definition also has the same problem about the distinction between services and product functions. Obviously, product functions are in the interest of user. Most of product functions embedded in products are sold along with the quality guarantee. In the product guarantee, the location where the product performs its function normally and a certain triggering event of performing functions such as pressing a run-button are described. In addition, we conceptualize the guarantee and the triggering events as the meta-services, which has the higher generality than the concepts of Ferrario et al. Moreover, Ferrario et al. take into account only the providers' perspective, on the other hand, we take into account the both perspectives of the providers and the customers.

Consequently, our definition is advanced over the existing ones with respect to the distinction between services and product functions and the new concepts that represent various services and perspectives, such as the meta-base structure of services and the essential/accidental services.

6 Conclusion

The purpose of our research is to clarify the essential natures of services that are important in the both academic and practical viewpoints. From the academic viewpoint, essentialities of services are one of the fundamentals of uniqueness of the service research. From the practical viewpoint, they are also the core elements of models and ontologies of services, which are important in the design and knowledge management of services. However, all the existing definitions of the notion of services have a problem in is the distinction between services and other related concepts: especially product functions. For example, the IHIP is not the exclusive characteristics of services but common to processes, which are aspects of functions. Thus, existing definition of services cannot answer the question: "are services functions?"

In this paper, we proposed a definition of services through the comparison of services and product functions using a general model. In our definition, services are the special type of functions. The functions are general concepts that include not only product functions but also those performed by humans. Then, we clarified the two main differences: the designablity of environment and the detachment of the function from the function performer, which are regarded as essential natures of services. Based on them, we defined the notion of services and showed its advantages.

Based on the conceptual elements of services grasped through this research, we are currently building a services ontology and clarifying formal definitions and relationships between concepts. Then, we will describe service models that represent specific service structures and characteristics based on that ontology. We believe this can be achieved by expanding a functional modeling tool named OntoloGear [23].

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Modeling an Emergency Service System for a Hospital Network

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Abstract. In this paper we describe a service modeling project done at an IT department that provides IT services to a network of state owned healthcare providers in the state of Vaud in Switzerland. The goal of the project is to understand how to maintain business continuity in the case of a disaster affecting the IT department's data center. We analyze how to precisely relate the business requirements to the IT operation requirements with the help of the SEAM Enterprise Architecture method. The results are refined service levels and the identification of the required technical architecture.

Keywords: Service System, Business Continuity, Service Modeling, IT Infrastructure, Healthcare, SEAM.

1 Introduction

FHV (www.fhv.ch) is the organization that coordinates most regional hospitals in the state of Vaud, Switzerland. It includes 12 hospitals (among them: hospitals providing emergency services, psychiatric hospitals, and hospitals specialized in re-adaption and in convalescence). In 2010, FHV provided 600K days of care.

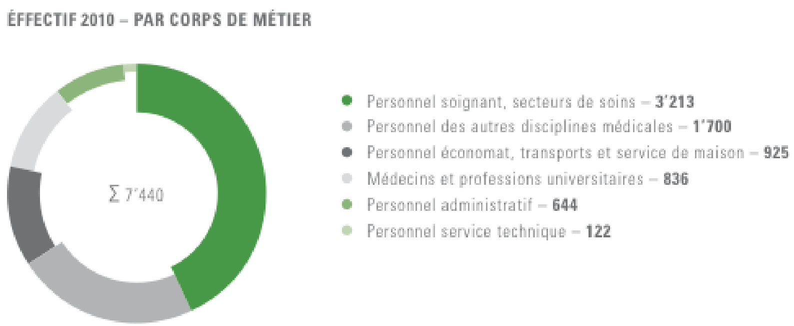

Fig. 1. FHV Employee Distribution

M. Snene (Ed.): IESS 2012, LNBIP 103, pp. 73–86, 2012.

FHVi (www.fhvi.ch) is the internal IT provider of FHV. FHVi manages a centrally located data center that provides its services across the state of Vaud. FHVi also manages the IT infrastructures located in the 12 hospitals, spread all around the state. FHVi has about 50 employees (25 in application management and 25 in IT infrastructure and support). They manage 300 servers (physical and virtual) and 3500 workstations spread in the FHV hospitals. FHVi provides 80 IT services to the hospitals.

FHVi works with external vendors that supply it with IT applications; these vendors provide executable code, documentation and, sometimes, IT services. Application managers are responsible to understand the user requirements, to manage the developments made by these vendors and to define a strategy for the application or service under their responsibility. Infrastructure managers are responsible for the execution, storage and communication infrastructure that host the applications. Infrastructure managers can specialize in a specific kind of infrastructure category e.g. virtual machines, storage, or network.

In their risk analysis, FHVi identified that their single data center was a significant risk. If data center were to be damaged (by e.g., fire or flood), the services to the hospitals would be impacted very significantly for a very long period of time (months). For this reason, FHVi started a project for creating a backup data center located somewhere else in the state. The project was named psico ("plan secours informatique et de continuité").

Prior to the psico project, FHVi already defined their IT service catalog. As a result, they identified 4 IT services that they provide, which are considered to be critical to the functioning of the FHV hospitals. These IT services must be provided even if the data center is damaged. These services are: medical imaging, patient medical management, patient administrative management, and laboratory management. The medical imaging service is supported by two applications: image processing application and radiology records application.

FHVi defined three operational modes in connection with the risk of damage to the main data center:

- **Normal Mode -** The data center runs properly. The hospitals can rely on its services for the services they provide to their stakeholders.
- **Disconnected Mode -** This is a degraded mode that immediately follows an incident that brings down the data center. In this mode, the hospital is not connected to the data center anymore but can run autonomously (i.e. the hospital's local infrastructure is not affected by the incident). For, example, if the data center is down, hospitals can still do radiology exams and look up for images in a one-year archive. In the disconnected mode, the hospital's medical imaging systems run stand-alone. This means that they are not connected to the patient administrative management (so information has to be keyed in by hand in the imaging device before doing an exam) or to the radiology records application (so no radiology diagnostics record can be entered or accessed). In the negotiation between hospitals and FHVi, this level of service was considered as acceptable for 24 hours but not for longer.
- **Psico Mode -** In this mode the four critical IT services are provided in whole or part. For the medical imaging service, both applications (images and

records) must be available. The hospitals can work for weeks in this mode. The FHVi is in psico mode as soon as the backup data center takes over from the downed main data center. In this mode, the hospitals' systems are not disconnected anymore but are connected to the backup data center.

Initially, the psico project encompassed two subprojects: The *backup site selection and equipment* project and the *IT Service Continuity* (ITSCM) project. The initial goals of the ITSCM project were

1. To bring together application managers with infrastructure managers so as to agree on a common understanding of the complete service delivered by the IT.
2. To define the requirements for the reduced operation mode for the critical services described above. More specifically, in which sequence the IT systems are to be resumed when the FHVi will switch from the main data center to the backup data center.
3. To define the architecture necessary to support the requirements.

In this project, we did not analyze other risks (such as a disaster affecting the hospitals). These risks are analyzed in the standard risk management process of FHV and FHVi.

Following a presentation of the SEAM Enterprise Architecture method [2,3,13,16,17] given by the first author in an industry conference, FHVi invited him to help with the ITSCM project. A core concept of SEAM is the modeling and alignment of services. The services provided by an organization to its stakeholders are modeled and aligned with the services provided by the IT to stakeholders. SEAM was therefore found to be suitable for the ITSCM project.

The ITSCM project was divided in two parts: a first series of 3 workshops was planned before the official kick-off of the project with the goal of scoping the project. A second series of 4 workshops was planned; workshops in which the business requirements were refined, the existing architecture was modeled, problems with the existing infrastructure were identified and the architecture of a solution was drafted. All workshops lasted half a day each and brought together between 5 and 10 people.

The paper is organized as follows: In Section 2 we very briefly introduce ITSCM as described by the IT Infrastructure Library (ITIL) as well as SEAM. In Section 3 we explain the workshops we have run at FHVi and sketch the models created in these workshops. In Section 4 we discuss the findings and draw key learning points on service design. In Section 5 we briefly talk about related methods to SEAM. In Section 6 we summarize the work done and describe the next steps for this project.

2 IT Service Continuity Management and SEAM

ITSCM is defined in ITIL [9] as "The Process responsible for managing Risks that could seriously affect IT Services." ITIL further states that ITSCM depends on a broader process called Business Continuity Management (BCM). ITIL [9] describes a broad process for ITSCM; based on the assumption that most organizations either do not have a BCM process or that it is not really focused. This broad ITSCM process comprises the following activities:

- Initiation (Policy Setting, reference terms and scope, resource allocation, project organization, project and quality planning)
- Requirements and strategy (Business Impact Analysis, risk analysis, IT service continuity strategy)
- Implementation (Recovery planning, testing)

In ITIL, the Initiation and Requirements activities are part of BCM. ITSCM is only involved in these activities if they have not been done at all or not in enough detail so as to permit a good enough ITSCM.

Two of the main issues to be defined in BCM are called the Recovery Point Objective and the Recovery Time Objective. The Recovery Point Objective defines "the point [in time] to which data will be restored after recovery of an IT Service." [10]. This defines in essence the maximum amount of hours of operation in which data that can be lost. [10] gives the example that with daily backups up to 24 hours of data can be lost. The Recovery Time Objective "describes the maximum time allowed for recovery of an IT service following an interruption. The Service Level to be provided may be less than normal Service Level Targets." [10].

Most of the work in this project consisted in understanding how the application managers, and infrastructure managers were architecting their systems and to what extent this architecture was compliant with the requirements of psico. One important result was a refined Recovery Time Objective. It turned out to be a fairly complicated curve, which reflects the architectural considerations (what can be implemented or not by technology).

SEAM [15,16] is an Enterprise Architecture method designed from the ground up to model services and their implementation. SEAM was applied to the analysis and design of services in e.g. [2,3,13]. A SEAM model is typically made of several organizational levels, beginning with an organization providing a service to a set of beneficiaries. At this top-most organizational level, the organization is modeled as a whole (a black box) with just the service it offers visible to its beneficiaries. In the next organizational level the organization is viewed as a composite (white box). This level shows how the service is implemented. A succession of black boxes and white boxes can be represented until an organizational level that is meaningful to the stakeholders is reached. Through this hierarchy of service specifications and implementations, it is possible to relate the stakeholder's views. In this paper, the SEAM model spans from the representation of the service provided by a hospital to the general population down to the virtual machines, storage and network infrastructure. SEAM is based on a simplified UML representation in which only a handful of concepts have been kept (e.g. a class, an activity, a relationship). We augment these concepts with pictograms that represent systems (e.g. boxed arrow, UML components, UML stickman, etc.). The same concepts are used across all organizational levels to model the service offering and service implementation. Thus, the modelers only need to learn these very few graphical representations to model business and IT systems. This uniform representation also helps to validate whether the business and the IT are aligned. SEAM has a specific way of modeling organizations as service systems. A service system is said in [15] to "make use of its own resources and the resources of others to improve its circumstance and that of others."

In the next section we describe the workshops and the models that were created including the way service systems are modeled with SEAM.

3 Workshops and Models

As mentioned in the introduction, the seven workshops that were run during this project were divided in two parts: The project scoping and the analysis.

3.1 Project Scoping Workshops

The project scoping workshops were run with the head of FHVi, his direct reports and the key people who were foreseen as project managers for this project to implement the continuity strategy. The three scoping workshops took a total of 9 hours with approx. 9 people in each workshop. These workshops helped scoping the project and defining that should be part of the ITSCM project team.

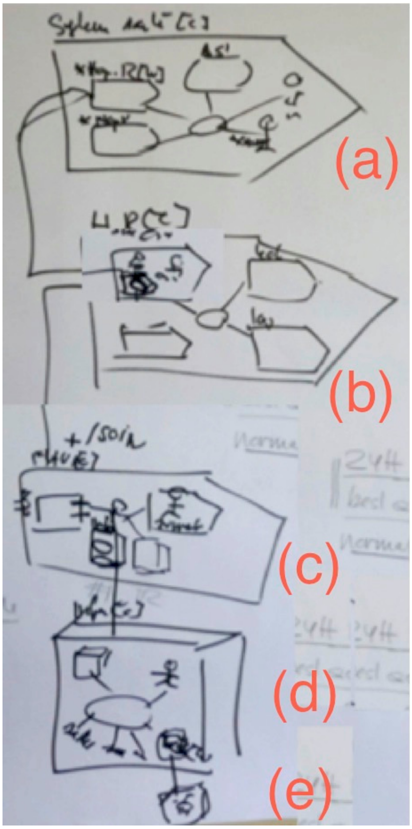

Fig. 2. first sketch of service hierarchy (original workshop diagram): (a) service provided by hospital to population, (b) services provided by FHVi and doctors to implement hospital's service, (c) services of applications, help desk and infrastructure to implement FHVi 's services, (d and e) services provided by technical components to provide infrastructure services.

In the first workshop we developed a SEAM model with 4 organizational levels. Figure 2 illustrates the model sketched during the first workshop. We modeled the services provided at each level. These are:

- Services provided by an FHV hospital to the population (a in Figure 2),
- Services provided by FHVi and the medical staff to implement the services provided by the FHV hospital (b in Figure 2),
- Services provided by the applications and the infrastructure to implement the services provided by FHVi (c in Figure 2),
- Services provided by IT technical components to implement the services provided by the infrastructure (d and e in Figure 2).

The benefit of this session was to build a common understanding in the team of these levels of systems that implement services. This was crucial to divide responsibilities later on. After the first workshop, the model was cleaned up and drawn on a flipchart.

In the second workshop, this flipchart was used as canvas. The management team used post-it notes to populate the model. Yellow post-it notes represented existing elements. Pink post-it notes represented the change. The benefit of this workshop was a shared understanding of the project ‘scope.

In the third workshop, the FHVi director and his staff agreed on the composition of the project team that will participate in the technical workshops, on deadlines for these workshops and on the deliverables. Figure 3 shows the model as developed during the second and third workshops. The model was then cleaned by the project leader and used to represent the project during the kick-off (March 2011).

3.2 Technical Workshops

The goal for the second series of workshops was to understand how to precisely relate the business requirements to the IT operations requirements, more precisely, the definition of the sequence in which the applications are to be resumed after the switch to the backup data center. We focused on the medical imaging service, which is considered to be one of the most complex services. The participants were mainly application managers and infrastructure managers. The manager of the psico project, the manager in charge of the backup center and the quality manager attended all workshops.

Four half-day workshops were run between May and July 2011. Overall the workshops lasted a total of approximately 12 hours with an average participation of 8 people.

The result of the four workshops is a model consisting of 4 organizational levels of services:

- FHVi and medical staff to implement services provided by FHV hospital,
- IT infrastructure and applications to implement FHVi services,
- Virtual machines and storage devices to implement IT infrastructure services,
- Physical servers and OS to implement virtual machines services as well as network equipment to implement network services.

The first three levels are the same as those used in the scoping workshops. The last one was introduced in the technical workshops. These four levels were modeled three times, one for each operation mode, i.e. normal, disconnected, psico. The psico model shows what needed to be developed for the psico mode.

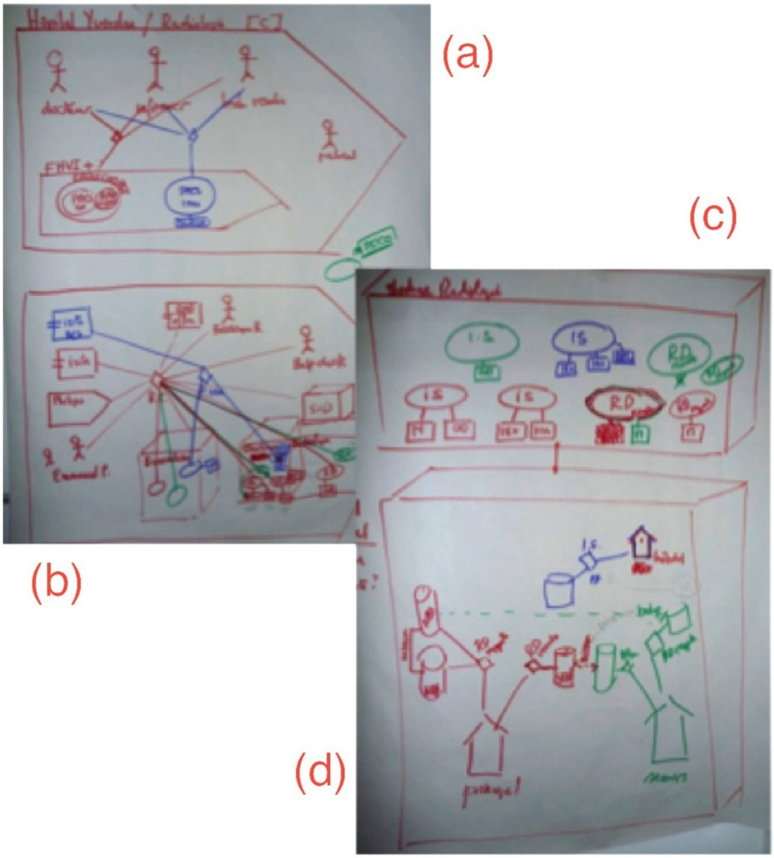

Fig. 3. first technical workshop model (original workshop diagram). Part (a) describes the business processes and IT service. Part (b) describes the application and infrastructure services combined in IT processes. Part (c) describes the services provided by the storage infrastructure, it is a zoomed version of the bottom right model element in Part (b). Part (d) represents the implementation of the storage infrastructure.

The first technical workshop was held with 10 participants, mostly IT infrastructure people. We analyzed the sequence of transition between the normal, disconnected and reduced operation modes across the first three organizational levels. Figure 3 illustrates this model. The part (a) of the diagram represents the service (ellipse in diagram) provided by FHVi to the doctors and how these services are combined in the business process (diamond in diagram). The color represents the modes (red = normal, blue = disconnected and green = psico). In the diagram, (b) represents how the services are implemented by combining applications and infrastructures in processes. Part (c) of Figure 3 represents the services provided by the storage infrastructure, it is actually a detail of the lower right elements in (b). Part (d) represents the technical processes inside the storage infrastructure.

The second technical workshop was held with application managers and a few infrastructure managers. During this meeting, we improved the models by better identifying the business roles of the service users. We also understood how the applications work together and the need to be able to access the medical and the administrative records in psico mode. We eventually added to the model, as a special kind of infrastructure, the middleware necessary to connect all these applications.

The third technical workshop was organized with the infrastructure managers. We made explicit that two broad kinds of storage techniques are used: databases in virtual machines, and dedicated storage devices SAN or NAS. The way data migrates between the main data center and the backup data center is done differently for each kind of storage technique. This leads to inconsistencies in the data after a switch to the backup data center. An architectural principle needs to be defined for the use of these storage techniques in a way that is compatible with the psico requirements. This also made us realize that the virtual machine strategy and the storage strategy could not be analyzed separately. This changed the structure of the SEAM models that were developed previously. The two separate systems: execution infrastructure and storage infrastructure had to be merged into one model element called storage and execution infrastructure.

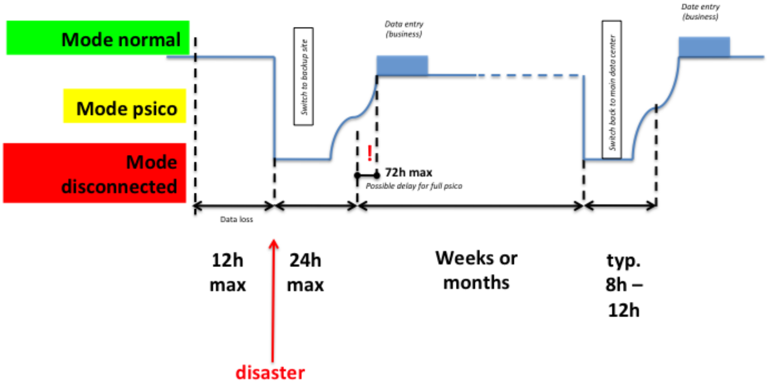

Fig. 4. Diagram that illustrates the planned Recovery Time Objective

The last technical workshop brought together the application managers and the infrastructure managers for an overall review. We analyzed the time constraints related to the transition between operation modes: normal-disconnected, disconnected-reduced operation, reduced operation-normal. We made explicit that the levels of service was more complex than expected as shown in Figure 4. For example, the disconnected mode will also be used in the transition back from the backup site to the main data center (when returning to normal). We identified that data can be lost for up to 12 hours before the disaster occurrence (Recovery Point Objective). We also confirmed that the reduced mode of operation could last from several weeks to several months. This led us to decide that additional services (such computer assisted diagnostics) should be added to the reduced operation mode – even if they were not explicitly present in the list of critical services.

Overall we developed and reviewed 9 diagrams as illustrated in Figure 5: recovery time objective, 3 diagrams of FHVi / doctor level (green = normal mode; yellow = psico mode; red = disconnected mode), 3 diagrams of application / infrastructure level, 1 diagram of storage and infrastructure (3 modes combined), 1 diagram of physical servers and 1 diagram of network devices.

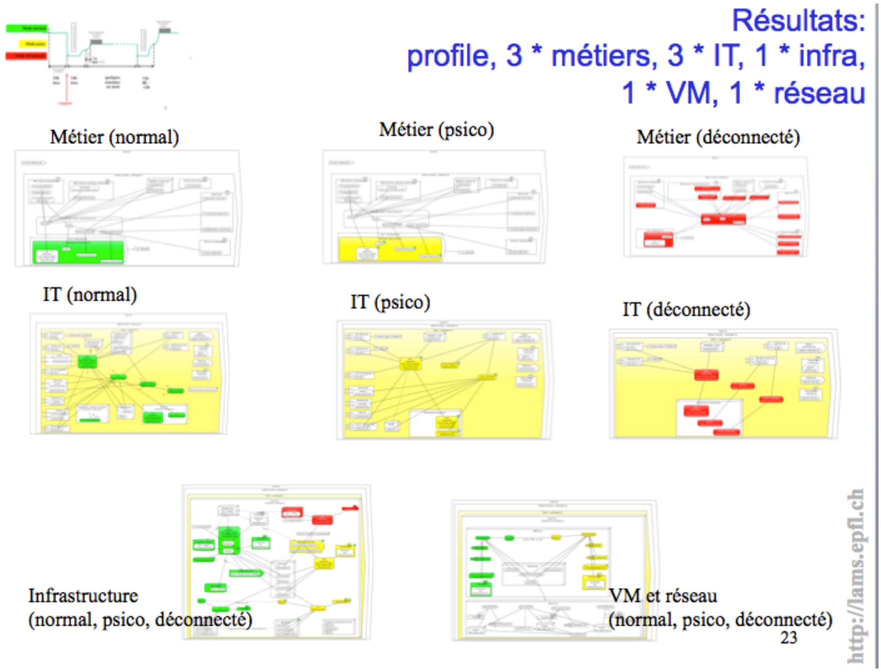

Fig. 5. Bird's eye view of the models developed during the workshops (original cleaned-up diagrams)

We present in Figure 6 a simplified version of the models developed. It illustrates how SEAM models are built. This figure is drawn by hand because most models in the workshops were made by hand as well. This is important to give to the workshops participants the feeling that the diagrams capture work in progress. Otherwise, people tend to get locked in a "modeling stall" in a quest for the perfect model.

The service systems are visible in two organizational levels. For example, FHVi+ is represented as a whole in FHV hospital and as a composite in the next level. When a system is represented as a whole, its name is followed by "[w]", as composite by "[c]". When represented as a whole, a service system provides a service to its beneficiaries. When represented as a composite, we can model how the service is implemented with a process.

In the models, we use color to show the different modes: green = Normal; yellow = Psico and Red = disconnected. We also added the letters "N", "P", "D" for readers who have black and white pictures. These modes correspond to different functionalities (or number of functions provided). In the developed models, the functionality is described by properties (represented as rectangles) associated to the service. In the model, some elements are marked with "+". This indicates that this is an element to develop with the project.

The first organizational level shows the business roles that benefits from the services provided by FHVi+. There is no difference visible between the three modes except that in the disconnected mode, paper has to be used for storing patient information instead of using the patient administrative management. In the real model, the details are visible (by showing the details of the services offered).

The second organizational level shows how, within FHVi+, the service is implemented by combining applications and infrastructure. We can also notice the help desk, and the supplier (S) that provides the applications. We represent the suppliers, as they are instrumental in providing the applications (FHVi outsources the development of applications). The "+" after the service system name (e.g. "FHVi+") reminds the workshop participants that the actors necessary to implement the service should be added to the system, even if they do not belong to the organization.

The third organizational level shows how the storage and execution infrastructure provides its service. We represent databases, buildings, a supplier and a virtual machine (VM) infrastructure. The buildings are marked "H" for hospital site, "M" for main site and "B" for backup site. There is a supplier that participates in the normal mode and the psico mode. In the normal mode, it acquires images for long-term image backup. In the psico mode, it provides access to the backup data and stores the new images generated. This illustrates that suppliers can be instrumental in providing a service and this is why they are visible in the diagram.

The last organizational level represents the VM system service that includes physical machines, the OS and the site in which the machines are located.

It is interesting to analyze how the concept of operation mode (normal, disconnected, psico) appears in each organizational level. In the upper level, services are clearly differentiated depending on the operation mode and location information is visible. In the execution and storage, the different modes cannot be as clearly separated. The implementations of the different mode use the same kind of infrastructure; locations become important. For example, the database stored in the hospital is used in the three modes. In the virtual machine level, location of the equipment is critical. This illustrates one of the challenges of working in business and IT alignment. Without understanding the evolution of the service offering between levels, it is very tempting to use implementation details to reference service levels. For example, before doing the workshops, it was common for the IT people to speak about the "backup site" when describing the service internally or to the business people. After the workshop, people talk about disconnected or psico mode. This is a better way to describe the service, as it is independent from the service implementation.

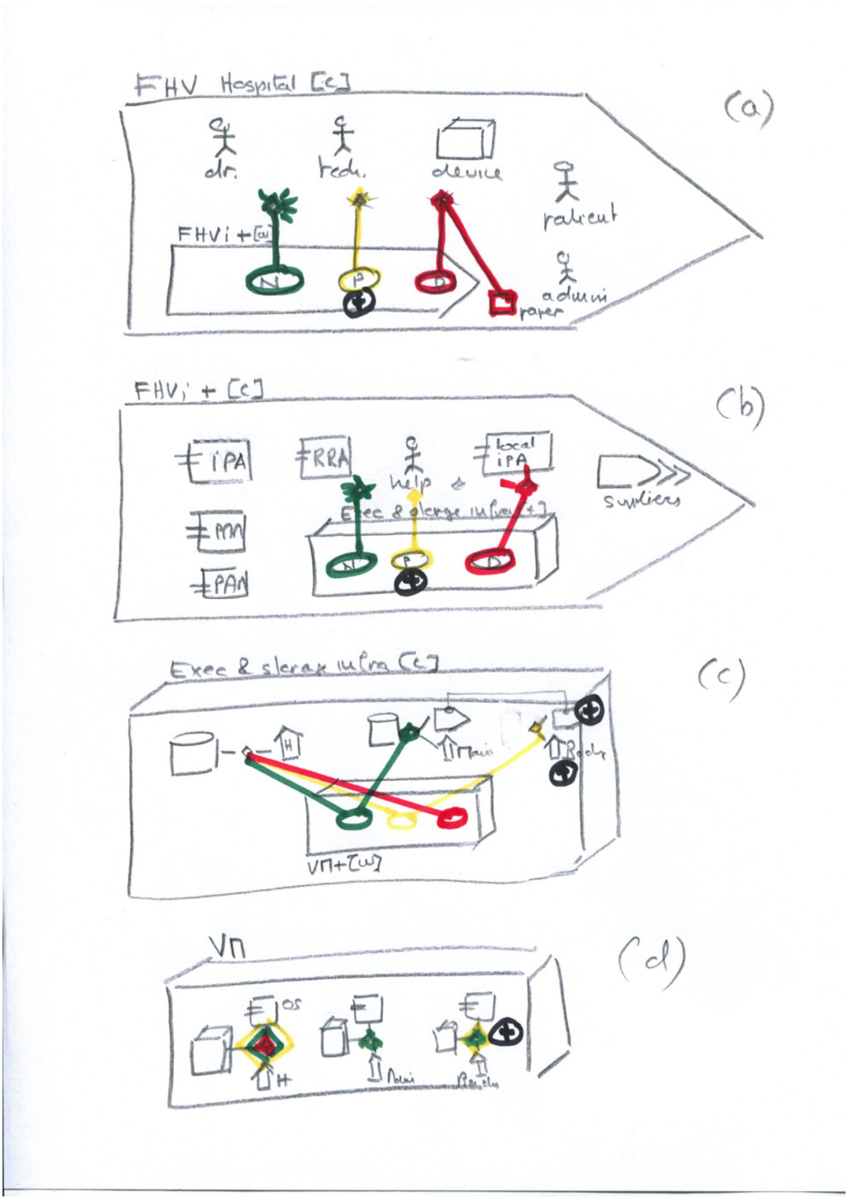

Fig. 6. Structure of the SEAM model (simplified)

Once the models were developed, we had a wrap-up session to decide what needs to be done next. We decided that: (1) the models developed in the workshops will not be maintained and that the application documentation provided by the suppliers need to include some of this information, (2) an architecture group needs to be created to define the architectural principles for the IT systems. This group should issue a document that would capture these principles and the structuring assumptions concerning the IT systems. These assumptions are closely related to the way the SEAM model is structured (for example, merge of execution and storage infrastructure). The document will have an overview similar to Figure 6 (yet to be developed).

4 Discussion

This Section captures the findings and key learning points for the FHVi. They are broad enough to apply to any organization of similar scale. They are all based on the impact of a service view of the organization.

4.1 Service Oriented Modeling to Focus on Delivery Rather than Structure

It is always tempting in this kind of projects, to create models that follow organizational boundaries and reporting structures in which the modelers represent the organization as a suite of departments within departments. An important difference between a service model and an organizational model is the structuration as service systems as opposed to departments. A service system provides value to a stakeholder, which is outside the system. The beneficiary of what the department provides is less clearly identified and hence its value proposition is unclear. When we model service system, we have to include people, technology, suppliers, and any other resource necessary to implement the service within the system. Compare this with an organizational model, which usually doesn't include suppliers because they are not formally part of the organization. Also, in an organizational model, technology and people are often modeled separately and the department usually shows only the people because a department is related to a line of management.

4.2 Service Oriented Analysis to Reduce Complexity

Service models have several advantages:

- They minimize the impact of the organizational structure. People are grouped by service provided and not by line of management. This improves team spirit.
- The role of the suppliers is made highly visible. This is useful to make the organization and the supplier understand that the supplier is an instrumental component of the service supply.
- Potential conflicts of interests can be made visible. For example, a person might be inside a service system as provider of the service and outside the service system as beneficiary of the system.
- By focusing on a specific service, the complexity of the model is reduced as we can represent only one service at a time.

4.3 Service Oriented Analysis to Understand Architecture Requirements

The initial question was "what in which sequence the services need to be resumed when switching from the main data center to the backup one". After analysis, it appears that this sequence is important for the IT people but not really for the business people. It also appeared that the people managing the virtual machines know how to resume the execution in the backup data center. They work with logical groups of virtual machines that need to be started in a given sequence (for example, network related VM such as DHCP servers need to start first). What appeared clearly is that this strategy works only if some key architectural principles, such as a consistent management of the data storage between applications, are respected (and communicated to all relevant parties – such as the suppliers). This makes visible the architecture challenges requirements that the organization needs to comply with.

The workshops also showed that one of the main challenges is the alignment between the applications and the IT infrastructure. IT infrastructure is evolving considerably with the new execution, storage and networking technologies. As a consequence, having an architecture that supports alignment between the applications and the infrastructure is key to guarantee the expected service levels. In the past, the alignment had to be made between business and IT. Now, it is between business and applications as well as between applications and infrastructure.

The workshop also captured significant clarification of the curve related to **Recovery Time Objective,** which were not available prior to the project. These clarifications are also direct consequences of the architectural choices taken.

5 Related Work

SEAM belongs to the Enterprise Architecture family. A distinct property of all these methods is their representation of organizations in hierarchical levels. Zachman founded the Enterprise Architecture discipline in the late 1980s with the so-called Zachman Framework [18]. The Zachman Framework and Urba-EA [5] are Enterprise Architecture methods that are used predominantly to model the landscape of the IT in a given organization. More recent Enterprise Architecture frameworks, e.g. TOGAF [14] and ArchiMate [4], encompass more the notion of service. ArchiMate models organizations and services as a succession of external and internal views [4]. Value is captured in the external view and implementation in the internal view.. ArchiMate has three levels of analysis, the business layer, Application layer and Technology layer. The SEAM models we have developed in this project span all these three layers. Just like SEAM, ArchiMate uses a subset of UML. The business layer, in most Enterprise Architecture methods, does not have the concepts necessary to model the service strategy of the organization with its stakeholders. An effort is under way [1] to augment ArchiMate with the Business Model Canvas [11] to fill this need.

The concept of service system was recently introduced in Service Science, e.g. in [8 and 15]. Early work in service system modeling is available in [6, 7 and 12].

6 Conclusions and Future Work

In this paper we presented an on-going ITSCM project at an IT department that serves a federation of hospitals in the southwest part of Switzerland. The project is aimed at defining the service levels that the IT can provide to the hospitals in the event of a major incident (e.g. fire or flood) and aligning these levels with an appropriate architecture. We have shown the role played by service modeling with the SEAM

Enterprise Architecture method in the understanding of these service levels and the resulting IT architecture. Now that the service modeling is completed, this project continues with the aim of harmonizing all the applications so that the overall service provided by the backup site conforms to the service levels defined previously.

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The Challenges of Deliberative Decision Process: An Italian Case

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Abstract. The potential impact of new ICT on efforts to enhance citizen engagement in the policy process is now widely recognized, but the academic research on design, use and evaluation of e-engagement tools is still in its infancy. Through the use of an explorative case study, the aim of this paper is to consider how new ICT tools can be used to reinforce e-democracy and how the design of technology can facilitate citizen engagement. To this intent, we apply a new framework to evaluate the efficacy of some electronic tools used by a specific e-democracy project that involve, with different results, eight Italian Administrations. We have assessed the level of e-democracy developments based on four different dimensions: transparency, interactivity, usability and web site maturity.

Keywords: E-democracy, Transparency, Interactivity, Usability, Web Site Maturity .

1 Introduction

The impact of Information and Communication Technologies (ICT) on Public Administration has rapidly risen since governments worldwide embraced emerging technologies as a mean to redesign and modernize archaic bureaucratic procedures [1]. In recent times, in fact, the public sector's conservative approach to ICT began to change and the organizational management started to recognize the benefits of putting into operation innovative technologies as an approach to change the traditional organization dimensions [2]. In this perspective, the potential impact of new ICT on efforts to enhance citizen engagement in the policy process is now widely recognized. Researchers emphasize how Internet is particularly effective for establishing and maintaining the "weak" ties to sustain civic engagement [3, 4] and Scott [5] argues that municipal government Web sites clearly have the potential to enhance and inform local public-initiatives, whether online or conventional.

However, enthusiastic ideas and projects often failed to produce the expected results as technology is only the basis for new forms of organization and interaction. Some scholars are quite skeptical of the real potential of Web-based public involvement. Golding [6] and Wilhelm [7] suggest that Web sites will do little to overcome

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limited participation among the disaffected, even if access to the Internet continues to increase. Others authors [8] argue that improved access to information will make governments more transparent, but if citizens are deficient in knowledge of or strong commitment to the political process, they will be overwhelmed by the quantity of information. Nie and Erbing [9] worry that heavy Internet use will reinforce social isolation and encumber civic involvement. Chadwick and May [10] conclude that e-governance initiatives in the United States, Britain and Europe have thus far generally reinforced managerialism and do little to open important opportunities for citizens to participate in public debate. Governments need to adapt structures and decision-making processes to ensure that the results of online consultations are analyzed, disseminated and used. Given the special nature of public choice and the special problems that arise in Public Administration, adequate decision requires that public organizations and citizens create a particular model of shared decision making - one that we refer to as inclusive decision making.

Despite the fundamental role that ICT plays in this process, the academic research on design, use and evaluation of e-engagement tools is still in its infancy. Through the use of an explorative case study, the overall aim of this paper is to consider how new ICT tools can be used to reinforce representative democracy and how the design of technology can facilitate citizen engagement. To this intent, we apply a new framework to evaluate the efficacy of some electronic tools used by a specific e-government project that involve, with different results, eight Italian Administrations. In particular, our analysis is focused on the DE.CI.DI. Project case, that aims at promoting e-democracy at a Provincial Administration level. The project involves eight Italian provinces (Genoa, Alessandria, Ascoli-Piceno, La Spezia, Lecce, Pesaro-Urbino, Piacenza and Savona) governing a total of 3.5 million citizens.

The paper is organized as follows: after an introduction to relevant concepts and literature (Section 2), Section 3 introduces the case and the methods used. Section 4 provides an evaluation of the e-democracy process. On the basis of this analysis, some critical reflections are offered in Section 5.

2 Literature Review

The origin of theoretical standings which are at the basis of public participation in the decision making processes of Public Administrations can be traced back to the period falling between the Sixties and Seventies. In that decade, there was a tendency to improve the democratization and legitimacy of public policy [11] through participation, particularly for the decisions regarding the local policies involving all stakeholders. These stakeholders may be defined as “organizations and individuals whose interests are affected by the policy under discussion” [12]. The definition, in other terms, also includes common citizens, that is to say, those “not holding office or administrative positions in government” [13].

In the last decade, a growing number of contributions [14, 15, 16] have repurposed the theoretical debate concerning the participation of stakeholders in public decisions introducing the concept of deliberative democracy [17]. The term refers to the decision-making process which is characterized by two peculiar aspects: the deliberative aspect and democratic aspect (or inclusive one).

The aspect of deliberation refers to the fact that the decision-making process is founded on impartial judgments based on common welfare. In other terms, in the above mentioned context, "deliberation" recalls the argumentative process through which decisions are taken, rather than the final outcome through which the decision becomes a formal act. On the other hand, the democratic aspect of the process, is given by the fact that there is a form of participation, at a level of equality, of the representatives of all the parties involved in the consequences of that same decision [15, 18].

The condition that makes the deliberation a democratic one, involves the participation of all the parties concerned in the outcome of the deliberation itself. The question is then how to include the opinion of ordinary citizens and support the local policy decision making process. To capture the meanings that various authors have given to the concept of deliberative democracy we can compare three different types of democratic theory: representative, pluralist and direct democracy. According to Delli Carpini et. al [19], representative theory focuses on the operation of the democratic political system as a whole and is grounded in the facts of present-day political attitudes and behavior as revealed by sociological investigation. In the theory, "democracy" refers to a political method or set of institutional arrangements at a national level. The characteristically democratic element in the method is the competition of leaders (élites) for votes of the people at periodic, free elections. "Political equality" in the theory refers to universal suffrage and to the existence of equality of opportunity of access to channels of influence over leaders. Finally, "participation", so far as the majority is concerned, is participation in the choice of decision-makers [20].

Direct democracy theory - sometimes referred to as deliberative democracy [21] or strong democracy [22] - sees periodic elections as necessary but insufficient for contemporary democracy. So, it is based on the normative assumption that citizens should have equal opportunities to participate in the making of major political decisions and that participants should have equal influence over the outcome of this process.

Technology brings a new element into this conceptual field. From a representative perspective ICT can improve representation by helping citizens to evaluate the records of governments and elected official and by providing way for citizens to interact directly with officials. For Pluralist theorists ICT reduce the cost of information and facilitate the multiplication of interest groups. Finally, for Direct Democracy theorists ICT can reengage citizens that are dissatisfied and detached. E-democracy can overcome space and time constraints on public involvement.

In other words, developments in ICT, and particularly the increasing spreading of Internet, suggest that ICT could be used to widen the spectrum of participants in policy making process [23]. Holden describes the evolution of integrated networks as a series of three stages. Public managers first began utilizing information technologies in the 1960s with the Management of Information System (MIS), which focused on automation and efficiency. In the 1970s, the Information Resource Management (IRM) became the first technology, typified by accessibility and integration. In this decade, citizens would be linking to computers to get free public information. But these visions were viewed utopian; with few people believed that widespread citizen access to computers was plausible [24]. Since the 1990s, information and communication technologies contribute to the emergence of a different type of democratic governance, i.e. democratic e-Governance [24, 25]. The concept of democratic e-Governance can be used as an umbrella concept that combines three different perspectives about the utilization of ICT in government's policies:

- the first point of view is named e-Government. It is about all political-administrative operations of governments in which ICT are utilized;
- the second point of view is named e-Governance. It is about managing and routing multi-sector stakeholder relations with the help of ICT. The purpose is that of taking care of policy, service and development functions of government;
- the last is named e-Democracy. The concept refers to democratic structures and processes in which ICT are utilized. In other words, e-Democracy combines two fundamental elements, technological mediation tools and institutional arrangements that can be said to be democratic [25].

By combining these three perspectives we can say that one important factor, which characterizes democratic e-Governance, is the participation of the citizens in digital democracy initiatives. This is accomplished by engaging in online discussion forums and participating in inclusive decision process in order to share a basis of understanding as common ground from which to mediate consensus [26]. Different approaches have been proposed in the field of e-democracy. Gross proposes to build public-life information systems based on widespread Internet services [25], such as email, newsgroups, and the WWW. Shires and Craig recognize the limitation of a unidirectional flow of information from governments to individuals and propose an application, called Minutes-n-Motion, which allows citizens to define customized view of the public-life information [22]. Watson and Mundy [8] propose a three-phase, dual-pronged strategy for implementing e-democracy. The three phases are: initiation, infusion and customization. The first phase, initiation, providing citizens with a single point of access to government information and Web-enabling government payments are the critical initial goals. In the second phase, infusion, online review and payment applications are widely installed. Citizens can make most government payment via the Web and electronic bill presentment is the standard. On the effectiveness side, political decision-making becomes increasingly transparent. Citizens can drill into the process and discover how a particular piece of legislation is being modeled. In the last phase, customization, e-democracy implements a one-to one relationship between citizen and government.

With regard to the access to public-life information, Doctor and Ankem [27] propose an interesting system taxonomy based on three dimensions. The first dimension concerns the subject of the information (e.g., government, education, social services, etc.); the second dimension distinguishes the type of provided help (e.g., interactive, informational, advice, etc.), while the last dimension is related to socio-economical identifiers of accessing people (e.g., age, gender, education, income, etc.).

Within e-democracy initiatives, it is common to distinguish between two areas: one addressing e-voting and the other addressing e-engagement or e-participation [28].

Despite the manifest interest in e-voting, in the second part of this paper, we will be focusing our attention on e-participation. Scholars who are interested in e-democracy define e-participation in varying terms. For example, some scholars use the word e-participation to refer to the use of ICT in supporting the information, consultation and participation of citizens. In other words, they argue that the entire public participation process may be considered as a global collaborative writing process where anonymous citizens try to draw up, not one, but as many documents are necessary to express their different point of view.

3 Research Methodology

In order to build a framework that can help to evaluate the design and the implementation of the e-democracy projects, we perform an in-depth case study [29]. We analyzed the web sites of the Italian regional governments who have agreed to take part in the De.Ci.Di. project which aims to try e-democracy in Public Administrations. The De.Ci.Di. project aims to promote and increase the participation of citizens in public decisions.

According to the literature presented above, we build our framework to evaluate the level of e-democracy developments, based on four different dimensions: transparency, interactivity, usability and web site maturity.

In order to evaluate the features related to transparency and interactivity, we adopt the Web Site Attribute Evaluation System (WAES) methodology developed by the Cyberspace Policy Research Group [30]. In order to evaluate the features related to usability and web site we adopt the items introduced by Pina, Torres and Royo [20] (see table 1). Transparency on web sites refers to the extent to which an organization makes information about internal works, decision processes and procedures available. Interactivity is a measure of the level of convenience, degree of immediate feedback and development of interactive e-services. Usability refers to the ease with which users can access information and navigate the web portal [2]. The features included in this section are multiple language access for visitors unable to speak or read the language of the host country; glossaries of technical or difficult term; a 'what's new' section, a sitemap, an A to Z index, a FAQs section, search engines, specialized databases and a uniform layout. Web site maturity embraces those aspects that indicate a high degree of web site sophistication: no broken links, the provision of audio or video files, content arranged according to life events/business episodes, credit card payments, use of digital signatures for transactions, live broadcast of important speeches or events, and the use of the web site for some kind of citizen consultation [20].

The indicators of transparency may be grouped into five categories: 1) ownership (level of commitment shown by the government, through its agencies, in management and internet site-building capabilities: the government can hand over web-site management tasks to internal or external agencies and, in that, it is reducing transparency; 2) contacts and reachability (the level of reachability of the government); 3) organizational information (the quantity and selection of information concerning the organization and the structure of government which is available to the website owner; 4) issue information (the presence of information concerning the campaigns conducted by the government within the website); 5) citizen consequences and responses (if and to what extent, a citizen is required to provide indications and responses or undertake actions; what can be done with the information provided by the website).

The indicators of interactivity may also be grouped into five categories: 1) security and privacy (the more the website is accessible, the less the visiting citizen is compelled to provide personal information in order to download data from the website or to upload it); 2) contact and reachability (to what extent does the organization and structure of the website explicitly allow a specific person to write, for example its own representatives; 3) organizational information (the possibility to directly contact those found in government structure and organization); 4) issue information (the possibility for the citizen who is visiting the website to attain information on how government is handling the policies regarding the context; it may be a personalized response that the citizen can receive from the site; 5) citizen consequences and responses (how easy is it for the citizen, visiting the website, to track the efforts of the organization through the use of technical support that available).

The interaction between these two dimensions, transparency and interactivity, reflect the institution's degree of openness [30].

Table 1. Table of dimensions

Transparency	**Interactivity**
Ownership	Security and privacy
Contacts and reachability	Contact and reachability
Organizational information	Organizational information
Issue information	Issue information
Citizen consequences and responses	Citizen consequences and responses
Usability	**Web site maturity**
Languages	No broken links
Glossary	Audio/video files
What's new section	Life events or business episodes
Sitemap	Digital signatures
A-Z index	Live broadcast of speeches/ events
FAQ	Citizen consultation
Search Engine	
Databases	
Homogeneity of different subpages	
Text only or accessible version	
Audio access for visually impaired	

The scores shown in table 2 and in table 3, show the value zero when the item analyzed doesn't appear on the web site and the value 1 when the items analyzed appear on the web site. The global scores in transparency, interactivity, usability and web site maturity have been obtained by adding up the individual scores for every relevant item in each dimension.

4 The De.Ci.Di. Project: Evaluation of the E-Democracy Process

The De.Ci.Di. Project (acronym for Democrazia per la Cittadinanza Digitale – Democracy for Digital Citizenship) aims at implementing e-democracy at a Provincial Administration level. The project, coordinated by the Province of Genoa, groups seven other provinces (Alessandria, Ascoli-Piceno, La Spezia, Lecce, Pesaro-Urbino, Piacenza e Savona) governing a total population of 3.5 million citizens. The project was initiated in 2006 to promote the participation of citizens in the decision-making process of Public Administrations, through the use of ICT.

In the development phase, De.Ci.Di. lay down a number of strategic objectives. Firstly, the implementation of ICT tools to promote social integration and the analysis of the decision making process. Secondly, the development of a flexible system capable of questioning the public and its choices in order to stimulate active participation via internet to public life, with an emphasis on the expression of indications and suggestions concerning public expenditure.

The tool chosen for the investigation was the "informed research", that allows the direct participation of the citizen through the expression of a double view point or opinion of the target groups, chosen on the basis of statistical criteria. At first, the participants expressed their view point on a specific matter without receiving any additional and precise information about the topic under enquiry; at a latter phase, the same target group of citizens was again required to express their opinion on the same matter after having received detailed information concerning other groups who had a completely different view point concerning the matter under enquiry/discussion. The website dedicated to the project (www.decidi.it) has been developed to support this collaborative writing model to public participation. It allows citizens to ask questions to relevant official entities and to browse through the documents essential to forming an informed opinion.

The information provided to the citizens is not managed exclusively by an institutional body, or the administration that is meant to take the decision, but also by other subjects who have a different position or interest in the matter.

Since October 2006, citizens may access the website either as "guests" or as full registered participants. "Guests" may only view the information but cannot really participate. In order to become full registered participants, the citizens could subscribe to the website dedicated to the project indicating their personal data and their personal ID number. The main purpose of registration is to allow traceability between contributions and authors, which is fundamental to conducting the collaborative authoring process and to the endorsement mechanism. In any case, all contributions will be presented publicly, without any reference to their authors. The subscription allowed citizens to access the website environment pages, which were subdivided as follows: a detailed questionnaire (generally made up of multiple choice questions), which asked citizens about a specific matter; informative material and the position of participating associations holding different opinions and interests; a forum, where users interacted and made comments about the documentation which had been made available. A wide variety of topics were taken into consideration and each province had the opportunity to choose its own depending on ongoing activities or strategies that had already been implemented. Normally, the choice fell on topics which had a direct impact on citizenship: the environment, employment and security measures: culture and integration; tourism; youth and schools etc..

A second phase of the De.Ci.Di. project, began in 2008, still receives the important contribution of two partners who guarantee a functional and scientific validity to the participation process as a whole: Microsoft Italia and the Department of Mathematics of the University of Genoa. The role Microsoft Italia is that of providing complete support for the planning and development of the architectural structure of the technology used which is necessary in order to guarantee an effective and valuable participation of citizens.

The Department of Mathematics of the University of Genoa, on the other hand, defines the methodology for the statistical findings and the accreditation of opinions as to provide to the project, the truthfulness and full legitimacy of citizen viewpoints which are to be the expression of a true representation and share of the population of those local governmental bodies participating in the project.

From the case description, it is clear that the De.Ci.Di. project has introduced significant modification to the relation between the Public Administrations involved and its citizens. The case of De.Ci.Di. demonstrates how a Public Administration unleashes the capabilities of Internet to craft a robust e-democracy architecture that acts as a common denominator between the public administrator and the citizens.

To evaluate the efficacy of the tools used, we apply our framework to the analysis of the project results. All the eight provinces involved, agreed to participate in the De.Ci.Di. project allows to obtain key information about the transparency and interactivity of the provinces under enquiry and thus the true opportunities offered to the citizens participating in public decision making. From a first examination of sites the level maturity of websites is immediately noticeable. The analysis of the websites of the eight Public Administrations are presented. The websites of the provinces of Alessandria, Ascoli-Piceno, Lecce and Savona contain a list of topics that will be subject to voting by citizens, but are lacking, at least at this phase, of informative documentation about the topics dealt with. Furthermore, in the provinces of Lecce, Alessandria and Piacenza, no contact person is mentioned within the website to whom the citizen can refer to in order to obtain information about the project. The situation is slightly different in the websites of provinces of Pesaro-Urbino. In these websites, besides the listing of the topics subject to public opinion, (Choices for the future, Youths and Europe; participation and communication; Taking action for the young), detailed informative material relating to the themes is available and accessible.

Table 2. The Transparency: Web site scores

Items	Transparency Score:	Genoa	Pesaro LaSpezia Piacenza	Alessandria Ascoli, Lecce, Savona
Ownership /Security and Privacy (Interactivity)	T1a Agency involvement with site	1	1	1
	T1b Webmaster appears to be different from the one running the government page	1	0	0
	T1c Provides obvious tailoring indicating agency itself has ownership of site content	0	0	0
	T1d provides published date	0	1	0
Contacts	T2a Provides central agency non-email addresses	0	0	0
	T2b Provides phone numbers or postal addresses for employees within agency beyond most senior officials	1	1	0
	T2c Provides e-mail address to responsible for content and technical support	0	1	0
	T2d Provides e-mail address to someone solely responsible for technical support	0	0	0
Organizational information	T3a Provides details on senior official's experiences or vision of future for institute	0	0	0
	T3b Provides mission statement and various activities of agency	1	0	0
	T3c Provides organizational structure in graphic form	0	0	0
Issue information	T4a Provides issue-related addresses for other government agencies	1	1	0
	T4b Provides non-issue-related addresses for other government agencies	1	0	0
	T4c Provides issue-related addresses for other NON-government information sources	1	0	0
	T4d Provides a searchable index for archived newsletters, laws, regulations, and requirements	0	0	0
	T4e provides link to or text of public information law or regulation	0	0	0
Responses/ Citizen consequences (Interactivity)	T5a Provides in depth explanations of requirements imposed on citizens resulting	1	0	0
	T5b Provides instructions for appeal process for decisions or address of an ombudsman inside agency	1	0	0
Total scores	**Transparency**	9/18	5/18	1/18

Table 3. Interactivity: Web site scores

Items	Interactivity	Genoa	Pesaro La Spezia Piacenza	Alessandria, Ascoli, Lecce, Savona
Ownership /Security and Privacy (Interactivity)	I1a Does NOT require personal information (beyond return e-mail address) to communicate with agency	1	1	1
	I1b Security access method, such as password or secure server use, is associated with transaction with agency or access to personal information	1	1	1
Contacts	I2a Provides e-mail link to webmaster	0	0	0
	I2b Provides e-mail link to senior agency official	1	1	0
	I2c Provides e-mail link to a number of agency employees	1	1	0
	I2d Provides an online issue-related forum for outsider participation such as chat lines, and list serves	1	0	0
Organizational information	I3a Provides link to listed sub-elements within agency	0	0	0
	I3b Provides automatic update announcement or newsletter via subscription	0	0	0
Issue information	I4a provides link to outside issue-related government addresses	1	0	0
	I4b provides link to outside non-issue-related government addresses	1	0	0
	I4c provides link to outside issue-related non-government information sources	1	0-1	0
Responses/ Citizen consequences (Interactivity)	I5a Provides link to regulation information	1	0	0
	I5b Provides online form completion and submission	1	1	0-1
	I5c Provides link to appeal process for decisions and/or an ombudsman			
	I5d Provides other language access to site for visitors unable to speak or read the language of the host country	0	0	0
	I5e Provides iconographic access to site for visitors	1	0	0
Tot scores	**Interactivity**	**11/15**	**5-6/15**	**2-3/15**

As highlighted by the synoptic tables 2 and 3, the items which showed the best results in both dimensions (transparency and interactivity) are those referring to Ownership and Security as well as Privacy; Issue Information, Responses and Citizen consequences. The dimension that showed the worst results is that referring, once again, the two dimensions, of “organization and information”. As for transparency, the lowest score may be assigned to the eleventh item “contacts”. From the overall analysis of the table it is clear that the De.Ci.Di. project is to be considered a good example of e-democracy, even though wide areas of improvement still exist, particularly in reference to transparency. Another finding to be highlighted is that only the web site of Genoa show clear sign of openness. Openness is made up of two components: transparency and interactivity. Citizens would not be able to hold their government decisions and they had no channel for interact [20].

As can be seen from table 4, similar results can be found in the usability and web maturity dimensions that we present only for the Genoa’s website, since the website of province of Genoa is the only one reporting a quantity of information which allows for its evaluation in terms of usability and web site accessibility.

Usability shows a good degree of development in technical items such as search engine and homogeneity of sub-pages, but a worst development in those items which are able to enhance the accessibility of web sites and to bring about social inclusion, such as audio access for the visually impaired; different languages or compliance with international accessibility standards; glossary of technical or difficult terms; A-Z index. Likewise, the group of “web maturity”, which contains items related to innovation, such as the digital signature and live broadcast of speeches or events, shows the value zero.

Table 4. Usability and web site maturity: web site scores by Genoa

Items	Usability	Score	Web site maturity	Score
	U1 – Languages	0	W1 - No broken links	1
	U2 - Glossary	0	W2 - Audio/video files	1
	U3 - What’s new section	1	W3 - Life events or business episodes	1
	U4 - Sitemap	1		
	U5 - A-Z index	0	W4 - Digital signatures	0
	U6 - FAQ	1	W5 - Live broadcast of speeches/ events	1
	U7 - Search Engine	1		
	U8 - Databases	0	W6 - Citizen consultation	1
	U9 - Homogeneity of different subpages	1		
	U10 - Text only or accessible version	0		
	U11 - Audio access for visually impaired	0		
Total Scores		5/11		5/6

5 Limitations and Conclusion

The aim of this paper is to consider how new ICT tools can be used to reinforce representative democracy and how the design of technology can facilitate citizen engagement. To this intent, we apply a new framework to evaluate the efficacy of some electronic tools used by a specific e-government project, the DE.CI.DI. Project. As we have characterized it, inclusive decision processes imposes the identification of critical stakeholders and for this reason it may not be an appropriate model for all kinds of problems. Additionally, this paper highlights the importance of citizen participation (e-participation) to inform such initiatives and to measure citizen perspectives on the development and deployment of e-democracy.

However, as we have explained, there are several important distinguishing types of problems that strongly suggest that public administrators and citizens in this context should strive to realize this model of inclusive decision making.

In emphasizing e-democracy, we have not meant to deny the importance of other efforts to respond to the problem of inadequate participation of citizens to the public decisions.

E-democracy has enormous potential to encourage a more direct citizen engagement and to change in the area of public decision making but those expectations have not been fully met yet. In order to increase the contributions of web sites in order to raise the number of inclusive decision processes, governments and policy-makers would do well to reinforce the transparency, the interactivity, the usability and the web site maturity of their web sites.

The findings and the proposed framework in this study may also bear important managerial implications. In fact, it can be gathered that e-participation is an essential step in changing the often rigid and uncompetitive nature of bureaucratic Public Administrations by revolutionizing the relationships between the organization and its citizens. Moreover, the competitive boundary to be obtained from any e-participation strategy is intricately tied to the degree of connectivity between the organization and its citizens. Additionally, Public Administrations can use our framework, even, to review the completeness of their Web Site and determine which functionalities need to be added to their site to enhance e-democracy and e-participation.

The findings of our research suffer from the usual limitations of interpretive case studies, in terms of generalization. As with any empirical investigation, weakness in the methodology and data will be present, and this study is no different. Two limitations, in particular, should be mentioned.

Firstly, the data used in this study were collected exclusively from web site of Public Administrations operating in Italy. Secondly, the sample of case study doesn't provide a complete and extensive survey on the Italian enhancement toward e-democracy but focuses on eight provinces in Italy. Nevertheless, as clarified by Yin [29], the generalizing properties of a case differ from quantitative studies because survey research relies on statistical generalization, whereas case study rely on analytical generalization. In analytical generalization, the investigator is "striving to generalize a particular set of results to some broader theory" [39, p. 36]. Taken in this light, our analysis could provide a vocabulary that researchers and practitioners could employ in the identification of similar components in other Public Administrations, so that future project to the enhancement of e-democracy can be compared and benchmarked.

For future studies on the subject, we identify one specific area of research that may effectively enhance our comprehension of e-participation projects. Studies of a similar nature, as recommended by Yin (1994), should be replicated to affirm the findings and validate our proposed theory. Finally, it is important for subsequent studies to understand that municipal governments are not the only actors that can facilitate civic engagement through web site services. As we investigate the role of local governments in facilitating deliberation and participation in local public issues, it is important to monitor and debate the complementary functions that these and other actors may play in the process.

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A Conceptual Analysis about the Organizational Impact of Compliance on Information Security Policy

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Abstract. Protection of data and information security are crucial to business processes and include technical, sociological and organizational aspects. The purpose of this paper is to explore the importance of information security policy and organizational compliance within a socio-technical framework. Citing come of the major compliance acts in the United States, this paper examines how the need arose for information security compliance and the antecedents that made compliance mandatory for organizations. This would apply to any organization, in whichever other country, within its legal compliance framework. A discussion follows to help shed light on how both individual employees and the organization as a whole often fail to implement a satisfactory compliance initiative. Finally, the research presents a set of key factors that influence successful implementation of information system security Compliance into the information security policy (ISP), along with what actions should be taken to make compliance a competitive advantage for the organization, taking advantage of the particular relationship between compliance and ISP.

Keywords: Compliance, information security policy, ISP, information systems security, ISS.

1 Introduction

Organizations continually experience losses, financial and otherwise, due to non-complaint behavior [1]. Executing leadership in agreement with IT security policy and compliance is emerging as a challenge as manager must balance the task of motivating employees to compliance without mandating it counter-productive punishment for non-compliant behavior [2]. Compliance in an organization is part of the policy component and ultimately can be an integral part of the competitive advantage enjoyed by the company [3-5]. Information systems security (hereafter ISS) is an essential feature in most organizations today and compliance is one method to gain visibility to processes and controls that ensure digital security, and the organizational aspect of it is explicit in the information security policy (ISP). The purpose of this paper is to discuss the importance of ISP and compliance using a socio-technical framework [6-7]. Citing common compliance behaviors, the origins of compliance are discussed followed by a discussion of how individual employees and the organization

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as a whole contribute to compliance failure [8]. The present research presents as discussion a set of key factors that influence successful implementation of information security compliance into ISP, along with the identification of what actions are necessary to ensure compliance, appropriate ISP and sustained competitive advantage for the organization.

2 Objectives and Scope

Compliance is a conceptual area, which focuses on satisfying the requirement of various laws and regulations (at a global level), mandates and policy frameworks (at local). Most of these mandates have also the intent of improving security, including information security. Compliance has a variety of definitions, all pertaining to regulatory and prescription, also addressing audit matters in order to assess the implementation of those regulations; i.e. *"[is] either a state of being in accordance with established guidelines, specifications, or legislation or the process of becoming so"* [9]. Primly those regulations and prescriptions come from legislation (i.e. SOX, HIPAA, GLB *et altrii*), and only secondarily from best practices [10-11]; only at the latter level there can be organization's own specific guidelines derived from internal practices or experience, while legal rules are not negotiable. An important point is to assure that legislation is ahead and keeping up with best practices.

Within the organization the information security policy (hereafter ISP) is the major source of regulation. As the result from the exogenous drive, organizations create ISPs to provide employees with guidelines [12].

In terms of impact the organizational relationship between Compliance rules (exogenous) and ISP (endogenous) can be observed as a threefold: IT operations, Security and Audit [13].

One question would be: how would the ISPs be if there were no Compliance acts? It is clear enough that in many cases there wouldn't even be an ISP either [14-15].

Keeping the importance of information security and its relevance in today's markets and market space in mind, this paper aims to define the key success factor in the implementation of information security compliance on an organization's existing information security policy. In the attempt to answer hidden and non-salient facets of compliance and ISP [16], a series of four relevant questions, propositions, and issues guide the remainder of the discussion:

1. How did compliance emerge as an essential component of ISP and what best practices do organizations followed to ensure secure information systems? What major polices are currently in place to adhere to compliance rules?
2. What are the reasons behind organizations constantly infusing money into their compliance budgets? What advantages are realized from this infusion?
3. What are the factors that lead to ignorance of compliance policies within organizations both from employees' and the managers' points of view?
4. What standardized framework of how companies should approach compliance can organization's implement to maximize benefits and minimize risks and costs of compliance/non-compliance?

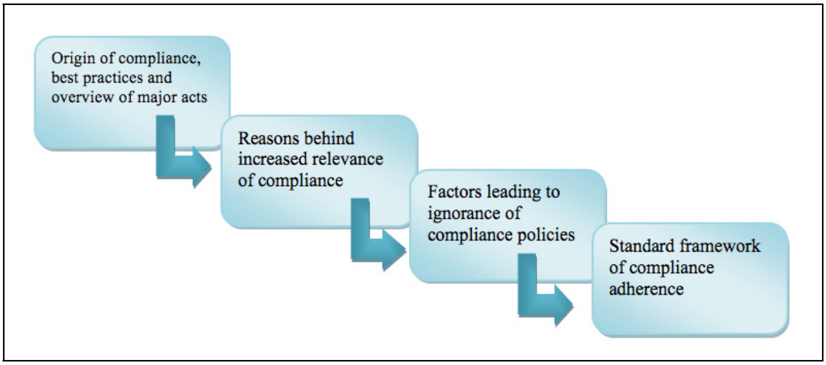

Fig. 1. Research steps

Regardless of where an organization is on the compliance/non-compliance spectrum [17], the framework discussed in this paper has the potential to reveal those cracks through which the important aspects of compliance fall, the nature of non-compliant employees [8], and those aspects that jeopardize security and, ultimately, competitive advantage [18-20]. The revelation of those aspects can help managers put employees and the organization on a track to universal compliance and a more desirable state of systems security [21].

From a socio-technical standpoint, some aspects that are necessary for compliance include workplace culture, attitudes/behaviors of employees [6, 22], and shortcomings in the planning process that naturally lead to non-compliance and a more vulnerable information system [23-25]. The paper examines the subtle differences that exist between the actual and the expected, and suggests measures to overcome a faulty compliance plan. This information can be used by any sector or organization as a guide to secure its assets, information, and business operations from digital threats [26].

3 Information System Security and Compliance

ISS is the name given to all processes and activities aimed at protecting information from tampering, corruption, theft, and/or unauthorized use or access [27]. The prime objective of ISS is to securely make information available to its intended users [28].

3.1 ISS

In recent decades, electronic means of communication, data sharing, and dissemination of electronic information has gained considerable momentum. Private and potentially sensitive information is transmitted with lightening speed across both private and public networks inviting the possibility of information theft, leakage, and unauthorized access to information centers. In the early information system years, it was believed that self-sufficiency and adhering to the best practices in ISS would suffice for information protection [23, 29]. Over time, information sensitive sectors like healthcare, finance, and education developed policies to provide a systematic approach to the ISS process [30-31].

However, increased security breaches during the last decade forced regulators to realize that conventional methods of securing digital information may no longer be applicable, which initiated the need for successful compliance programs that are proactive in avoiding the risks of security breaches [32], which are showing a growing rate of presence [33-35]. Consequently, an organization's overall security strategy must integrate a sound compliance program that covers all departments and departmental activities [36]. Decentralized approaches have been difficult to implement and monitor [37], thus the need for a unified approach where information trickles down to various levels of the organization that is easy to monitor and whose benefits are quantifiable right from the beginning of implementation [38-39].

3.2 Security Compliance Dimensions

The biggest obstacle of security compliance is the maintenance of secure environments and the protection of valuable and sensitive data such as credit card information, health records, and student records, the loss of which could result in financial, legal, moral, and other risks [40-41].

Siponen suggests that about compliance, irrespective of the level of information systems security, the following questions are most salient [29]:

- How should information be protected from unauthorized access in a completely virtual environment?
- How can it be ensured that administrative responsibilities are adhering to the compliance norms?
- How will systems that are isolated from one other share the same information?

Reviewing past and widely accepted activities when it comes to ISS, the following are the best practices that serve to protect both virtual information and the physical systems that deliver that information.

– Platform hardening. Platform hardening is the name given to proper management of both the infrastructure and administrative layers of an information system [42]. It reduces risk of unauthorized access to a network and is comprised of virtual switches, computer hardware, and other systems. Platform hardening also includes deployment of the latest software patches and configuration of networks with the latest and securest settings .
– Change and configuration management. IT administrators spend a significant amount of time upgrading virtual networks to new standards and profiles [43]. During such upgrades, it is necessary that systems changes and configurations are extended when needed [44]. In organizations using rich data, it is often unknown specifically who is using the data and from where the data are being accessed. In addition, it is understood that the data is available to many, rather than a single person [45]. In implementing change management, it is essential to be vigilant when applying security techniques, resources, and infrastructure to not only implement changes quickly but to implement the right changes so those accessing the data can do so quickly, efficiently, and without any major interruptions in service.

- Access control on administrative duties. Another important practice to be observed is the clear segregation and maintenance of administrative duties, roles, and responsibilities to ensure that none of the management executives or administrators are in a position to take advantage of access to sensitive or confidential information [46]. Access controls enhance the effects of the fiduciary responsibilities of administrators to protect not only the data but also the administrators themselves from accusations [47].
- Segmentation and security of network. Securing a network though segmentation, can be achieved by extending and replicating the physical systems and infrastructure since, ultimately, it is the computers themselves that store information [48]. Compliance is followed when computers are separate from each other, leaving no scope of information being stored or passing through a machine where it is not needed ([49-50].
- Audit logging. An audit log is a database and record of the activities and processes that have taken place on virtual system. It often happens that leakage of information occurs after a user exits the system and another person maliciously retrieves the information stored in the logs [51-52]. Thus, there must be proper provision of monitoring and tracking of the logs and their storage destination. Moreover, administrators should be mandated to report their actions on safe handling of logs [53].

From the exposed well know U.S. best practices, yet far from being widely and correctly implemented, we shall analyze the major traits of the major U.S. Authority acts and laws, which oblige organizations, companies and government agencies to abide to rules about Information Systems Security.

3.3 Overview of Major U.S. Security Compliance Acts

The Sarbanes-Oxley (SOX) act was enacted in 2002 as a US Federal Law to establish accounting and financial reporting standards and ethics to prevent scandals. In response to the Enron and WorldCom accounting scandals, the act placed stringent penalties on Chief Executive Officers and Chief Financial Officers in the event the people holding these positions breached the required trust and reporting mandates. The act was put in place to secure the benefits and trust of stakeholders and investors [54]. Sections 302 and 404 of the act specifically describe the roles and duties of the Chief Information Officer and auditor and spell out the provisions of both internal security and accuracy of financial data.

Alter conducted a survey to learn more about how companies perceive the SOX act and its perceived benefits to their businesses, value, and compliance [55]. Most of the companies agreed that they experienced business benefits from SOX compliance and that it does not distract them from their routine business work. Moreover, compliance with SOX improved their business processes, management, and accuracy of financial information and reporting systems.

The Health Insurance Portability and Accountability Act (HIPAA) was enacted by the U.S. Congress in 1996 to safeguard the health interests of workers and their families in the event of job loss or change. The act requires health care providers, health care clearing houses, and health insurance agents to observe physical, technical, and administrative duties and responsibilities while handling clients' private, confidential electronic data [56]. In 2009 the Subtitle D of the Health Information Technology for Economic and Clinical Health Act (HITECH Act) enacted as part of the American Recovery and Reinvestment Act of 2009, addresses more privacy and security issues with respect to the electronic transmission of health information [57].

The Gramm-Leach-Bliley act [58] act came into existence in 1999 from the U.S. Congress. It prohibits the ability of insurance companies, investment companies, and commercial banks from merging into a single conglomerate. Moreover, it requires financial institutions such as mortgage lenders, debt collection agencies, and settlement services providers to protect the financial and non-public information of investors from unauthorized access, disclosure, and use. Alter reports that organizations perceive benefits from both the HIPAA and the GLB acts even though IT spending has increased [59-60].

3.4 Growing Importance and Impact of Compliance

For organizations that implement any kind of data security measures, compliance is often a major component that must encompass not only breaches to security but compliance with privacy laws and policies. In fact, the budget for compliance often exceeds the budget for programs [61-62]. The importance of such compliance is underscored by the fact that internal data are often more valuable to an organization than its external transactions [63-64]. No well-run organization would risk non-compliance with laws thereby jeopardizing its trade and business secrets. If an organization is judicious, flexible, and consistent enough in monitoring and reviewing its compliance policies, it is likely to subject data and secrets to lower risk thereby decreasing security and compliance budgets over time.

IT infrastructure is a term comprised of processes, staff, relations, technologies, and systems. When compliance includes all of these areas of an organization's IT infrastructure, the organization enjoys the following advantages:

- Manual handling of data often results in errors and omissions. Automation and enforcement of security standards and compliance rules ensures responsiveness, speedy delivery, and secure actions [65].
- IS security is a continuous process and enforcing compliance standards allows IT managers to configure, change, improve, monitor, and upgrade security policies more easily. Compliance enhances this responsiveness and requires that the measurement of IS security is both possible and timely [32, 66].
- Resources such as time, money, effort, and information on personal, operations, and financial fronts can be optimized and saved from severe repercussions through a sound compliance policy [37, 46, 61].
- Compliance allows an organization to efficiently remedy non-complaint events. According to Alter, the growing significance of compliance in organizations is clear; compliance budgets doubled in just one year between 2005 and 2006 while organizations continually favor enforcement of the SOX and other acts [67].

4 Analyzing Compliance Behaviors in Organizations

Extant literature suggests that most of an organization's information security threats arise from the careless and negligent attitudes and behaviors of employees [23, 68-70]. When evaluating the behaviors of employees who choose either to comply or not comply with information security policies and procedures, there are several pertinent issues to consider [1, 71]. Attitude denotes an individual employee's motivation and affect toward complying with security policy [72]. These are determined by his/her positive and/or negative feelings about the individual and organizational consequences of non-compliance. If an employee is motivated and possesses the willingness and ability to carry out specific compliance behaviors, the chances are greater that he/she will actually execute those behaviors [73-77].

Delving a bit deeper into the threats arising from non-compliant behavior, recent research suggests that it is mostly the negligent attitudes of employees that places the organization in serious risk of security breaches (78-79). These attitudes are the result of favorable or unfavorable employee perceptions toward employers or the organization as a whole; favorable perceptions lead to fewer instances of non-compliance [21-80].

According to Poneman's 2009 study of security policies and employee compliance behaviors, most of the attrition in complying with security policies occurs when the organization fails to provide adequate training to employees [27]. This is a major drawback to when companies invest enormous amounts of money in planning policies and deploying infrastructure and technologies but fail to train the human asset that actually executes the organization's plans and strategies through employee expertise and knowledge. A second issue arises from policies being ineffective where organizations plan and record strategies on paper with no serious thought about actual execution. This is one reason why employees overlook the security norms and perform carelessly at times leading to ineffective policies and breaches in compliance that go unreported.

Other reasons where organizations are at fault in making security compliance an enterprise wide campaign occur when rules, policies, and regulations are too complex to be understood by employees [1]. Employees not able to grasp the real meaning and reason behind a compliance policy do not comply with, ignore, and/or violate the rules [55]. Adding to the inefficiencies, organizations often fail to enforce strictly the policies that protect information systems; they are much too lenient in executing and then governing the policies with which employees are already relaxed about complying [16]. The employees often find ways to avoid penalties or punishments because the policies are not stringent enough and management, therefore, cannot enforce them [2, 30).

Most employees are generally unaware that policies pertaining to security and compliance even exist within the organization [14, 39]. This is another major setback for the organization that aims to gain information security capabilities through compliance but fails at the preliminary step of communicating the policies to all channels of the organization.

The Securities and Exchange Commission failed to resolve, as far as year 2008, 12 over 20 information security weaknesses previously reported by the United States Government Accountability Office audit [81]. When we observe that in particular SEC failed to fully implement its Information Security Program (*ivi*, pages 12–14), given the importance in terms of World's securities market stability, the pressure and the high attention from authorities and banks on the matter, we cannot think of any other organization on the planet to be able to completely and easily succeed in implementing ISPs.

5 Discussion

As demonstrated, both employees and employers contribute to failed implementation of compliance policies administered by the organization [82]. Security compliance is not often made a critical function in most organizations because policy rather than the cognitions and behaviors of the employee are at the forefront of ensuring secure information systems [8, 32, 83) and resources allocated for end user security awareness training are still inadequate in more then 50% of organizations, accordingly to a recent survey [84]. Taking this point as the foundation for the current state of information security compliance in organizations, the following research findings and recommendations are offered in order to appreciate the relationship between Compliance and ISP, where the two play reciprocally the drive and the dependent variable between each other. The research findings can be summarized as follows.

- Compliance has shown the trait of a cultural force within the organization that has to be followed, naturally, by each and every level, even temporary employees. To have this be made effective, it's appropriate making use of leadership within the organization [85].
- One of the biggest setbacks to compliance occurs when a new technology enters the market and the organization searches for appropriate policies and compliance standards covering issues respective of the technology. Compliance policies work well, then, only if they are enough flexible and easily communicated to employees and managers, without losing control. This also means that, even when compliance is documented, non-compliance has to be clearly reported and recorded with accountability and penalties levied when necessary. With this in mind compliance and data protection shall influence ISP to be an organization-wide initiative to make employees aware of training activities and the consequences of non-compliance [39].
- Compliance can be compared to the organization's security policy immune system. Without a structured and well-defined framework set up for guiding the compliance process, ISP can never contribute to the organization's success. The compliance drive has to be made integral to the business processes and should pass down as an integral part of management strategies and governance programs [86].

In this regard, the present research results show the following propositions of the critical success factor and components of a compliance program.

- Proposition 1. After identification of applicable policies is complete, an appropriate, thorough, and judiciously-devised compliance plan should be drafted. This ISP then serves as a guide to the future actions, schedules, roles, duties, tasks, and milestones to be achieved. Identification of available resources is also carried out while preparing the plan. In a compliance program, there are numerous roles and responsibilities to handle from the grass root level to the executive level. To ensure that ISP diffuses through the managerial levels, it is of utmost importance to assign duties to relevant organizational officers. The board of directors, steering committees, and audit executives are some of the positions that should accomplish the tasks of policy planning and actual implementation.

- Proposition 2. Information assets are often the most important organizational resource to maintain competitive advantages [18-19] and it is in the organization's best interest [87-88] to enact an appropriate compliance policy to protect information system's availability, confidentiality, and integrity [21]. Consequently, it is essential to determine which information and to what extent that information should be available to various process owners. This will result in effective identity authentication and avoidance of accidental or unintended repudiation of information to those who need it.
- Proposition 3. To avoid risks, it is essential that organizations take on a proactive approach when assessing the magnitude of and risk probability of threat occurrence that includes impact analysis. This helps determine the intensity of loss or damage that could occur if employees and managers do not comply with ISP. Risk assessment and impact analysis strengthen the urgency of adhering to the compliance program. While analyzing risk, three categories emanate from the literature: physical risk including protection of media, hardware, facilities, and tangible components; technical risk involving vulnerability to configuration and network architecture; and administrative risk arising from effectiveness in management, governance of policies, and procedures and efforts to comply with the existing standards [38, 41, 56].
- Proposition 4. Control measures should be in place to judge how much of the road to compliance has been traversed and how much is left. In addition, performance scales, shortcomings, and what can be done to improve on the compliance policy should be considered at regular intervals. These control measures must be updated to stay in line with current IT practices and ahead of expected, near-future changes. Failure to comply with established rules and policies can occur if knowledge about staff, employees, and managers implementing the security policy is unknown. In such situations, only pre-planning can save the organization through appropriate education and training imparted to those responsible for information security compliance. If everyone is abreast of the latest compliance trends, they can encourage others to follow them.
- Proposition 5. Security and compliance are ongoing rather than static programs and keeping in mind the ever changing nature of technology, it is obvious that many of the additions and changes to ISP will end up as ineffective over time. Consequently, organizations must perform frequent monitoring of current practices, assess suitability of the security policy with the current practice, and implement modifications.

6 Limitations

A limitation of this work is related primarily to the methodology used, i.e. conceptual analysis and no empirical data analysis. This research concludes with the theoretical foundation and hypothesis for an eventual empirical research. Conceptual analysis defined by Järvinen [89-90] is, although, acceptable for IS research. The objective and the general questions have been then approached with the mentioned conceptual analysis and the hermeneutic circle, both used to infer a meaning not explicitly expressed in the original literature [91-92]. Some authors like Cole and Avison [93] commented about hermeneutics in IS research, as *“hermeneutics is neither well accepted nor much practiced in IS research”*, while others, like Siponen [29] are quite favorable.

It is foreseen a further empirical investigations and data analysis to validate conceptual analysis findings of this research.

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Modeling and Bridging the Gap between Different Stakeholders

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Abstract. A perception gap or misunderstanding between different groups/stakeholders is one of the most common reasons for the difficulties in many real world problems, such as multi-organizational coordination, risk communication, and service matching and satisfaction. Before trying to solve such problems, however, it is necessary to focus more on the perception gap itself. In this paper we propose a model based on the concept of mutual belief that describes the perception gap between different stakeholders, as well as a model-based methodology for quantifying and bridging the gap. Using cross-cultural communication between international and Japanese students as a case study, we show the applicability and validity of our proposal. Through the case study, we have confirmed that it is possible to identify different types of gaps using the model, and moreover, that some gaps can be reduced by the proposed method.

Keywords: cross-cultural communication, perception gap, expectation and belief.

1 Introduction

Many difficult real-world problems such as multi-organizational coordination, risk communication, cross cultural communication, and service matching and satisfaction, rely on different stakeholders. A perception gap or misunderstanding between these different stakeholders is considered to be one of the most common reasons that these real world problems are so difficult. To date many studies have addressed such gap problems in a variety of fields. In the service research domain, for example, Zeithmal et al. (1990) proposed a model categorizing four different types of gaps in the service process and developed a method called SERVQUAL to measure service quality in terms of the gap between service expectations and perceptions. There are also many studies on the gaps in medical communication. For example, Awad et al. (2005) identified that undesirable team performance in operating rooms was due to poor communication or gaps in the communication among surgeons, anesthesiologists, and nurses. To improve communication, a dedicated training session using the crew resource management (CRM) principles was conducted and its effectiveness confirmed. These studies have identified where gaps exist in multi-stakeholder processes and provided

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some categories of perception gaps. However, they have not provided any frameworks or formulations for describing the gap itself. Moreover, existing methods to reduce gaps between different stakeholders do not have a theoretical basis, but are based mainly on empirical approaches like CRM. There are therefore two objectives in this study. One is to propose a model to provide a formulation for the gap itself. The concept of mutual belief is adopted as a fundamental assumption to describe the gap between different stakeholders. The other is to propose a method based on the proposed model to bridge the existing gaps between different stakeholders. In the next section, a model based on the concept of mutual belief is proposed. In Section 3, a method to reduce the gap as well as one for quantification and calculation are proposed and tested through a case study of cross-cultural communication. An iterative questionnaire based method for bridging the gap is developed. In quantifying the gap, a Likert scale and fuzzy set theory are adopted. In Section 4, the results obtained in the case study are presented, together with a discussion thereof, followed by the conclusions in Section 5.

2 The Proposed Model

2.1 Mutual Beliefs in Expectation and Belief

The concept of mutual beliefs is introduced here as the foundation of the proposed model. The ability to infer or estimate the status of the mind of others is believed to be innate and essential for our sociality. One of the characteristics of this ability is that we can infer the other person's mind recursively. This recursive characteristic can also be found in generating expectations and beliefs between different persons. We therefore model it using a structure of mutual belief based on the philosophical study of team intention and collective intention (Tuomela and Miller 1987, Bratman 1992). In the dyadic case (Agents A and B), these mental constructs can be formalized as:

EXP(A, φ)/ EXP(B, φ) = A/B's expectation of φ.
BEL(A, φ)/BEL(B, φ) = A/B's belief in φ.
BEL(A, BEL(B, φ))/BEL(B, BEL(A, φ)) = A/B's belief in BEL(B, φ)/BEL(A, φ).

...

Mutual beliefs are hierarchically justifiable such as those between the second and third BEL. A mutual belief is theoretically ad infinitum; however, in actual practice only two or three may be sufficient. In this article, therefore, we describe a model with a maximum of three levels. In the above, A and B represent stakeholders and φ represents the target of the expectation. EXP and BEL denote, respectively, the expectation and belief. When more than one stakeholder is involved, a gap or conflict emerges between the corresponding mental constructs, such as between EXP(A, φ) and BEL(B, EXP(A, φ)) as shown in Table 1. In this formulation, the self-expectation of oneself can also be described as EXP(A, A) or EXP(B, B).

Table 1. Relationship between Expectation and Belief

Expectation	Target φ	Target φ
A	-	Exp(*A*, φ)
B	EXP(*B*, φ)	-

Belief	To A	To B
A	-	BEL(*A*, EXP (*B*, φ))
B	BEL(*B*, EXP (*A*, φ))	-

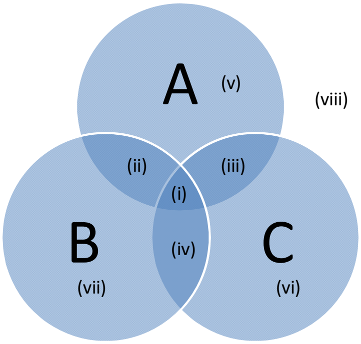
2.2 Will and Should Expectations

Boulding et al. (1993) suggested that there are two different types of expectations: should and will expectations. According to their definition, will expectations are formed by customers about what will happen at their next service encounter. This is consistent with the expectations-as-predictions standard often used in customer service literature, with the expectation mostly affected by past service experiences. Should expectations, on the other hand, are formed by customers about what should happen at their next service encounter; in other words, what customers feel they deserve. The model in this study incorporates the idea of these different classes of expectations. However, we have modified the definitions to fit in with this study, which does not focus only on the service industry.

2.3 Mental Constructs of the Proposed Model

Given below is a complete formalization of the proposed model, created by integrating the two theories discussed above. For later application and analysis, the formalization of each mental construct is provided in the form of a proposition.

- $EXP_{Will}(\alpha, A, B)$: α is a will expectation of stakeholder *A* with respect to stakeholder *B*.
- $EXP_{Should}(\beta, A, B)$: β is a should expectation of stakeholder *A* with respect to stakeholder *B*.
- BEL(*A*, EXP_{Will} (α, *B, A*)): stakeholder *A* holds the belief that stakeholder *B* has a will expectation α of him/her.
- BEL(*A*, EXP_{Should}(β, *B, A*)): stakeholder *A* holds the belief that stakeholder *B* has a should expectation β of him/her.
- $EXP_{Will}(\alpha, A, A)$: α is a will self-expectation stakeholder *A* has of him/herself.
- $EXP_{Should}(\beta, A, A)$: β is a should self-expectation stakeholder *A* has of him/herself.



$A = \{a_i | EXP(a_i, x, x) = true\}$
$B = \{b_j | EXP(b_j, y, x) = true\}$
$C = \{c_k | BEL(x, EXP(c_k, y, x)) = true\}$

(i)	$A \cap B \cap C$	(v)	$A \cap \neg B \cap \neg C$
(ii)	$A \cap B \cap \neg C$	(vi)	$\neg A \cap \neg B \cap C$
(iii)	$A \cap \neg B \cap C$	(vii)	$\neg A \cap B \cap \neg C$
(iv)	$\neg A \cap B \cap C$	(viii)	$\neg A \cap \neg B \cap \neg C$

Fig. 1. Different Modes of Gaps

Table 2. Contextual Meaning of Each Gap Type

No.	Situation	Possible Perception Gap
(i)	Subject is aware of the expectation of a different stakeholder, and has the intention of responding to it.	No perception gap.
(ii)	Subject is not aware of the expectation of a different stakeholder, but feels obligated to comply.	Implicit effort.
(iii)	Subject expects him/herself to respond to a non-real expectation of a different stakeholder.	Being a busybody.
(iv)	Subject is aware of the expectation of a different stakeholder, but does not feel obligated to comply.	Have different opinions and cannot reach an agreement.
(v)	Subject knows he/she is not expected to comply, however, feels he/she should do so.	Has a high standard of self-discipline.
(vi)	Subject believes there is an expectation of a different stakeholder, although this is not so. He/she does not, however, feel obligated to comply.	Misunderstanding.
(vii)	Subject is not aware of a different stakeholder's expectation, and does not feel obligated to comply.	Unrequited love.
(viii)	No expectation exists, subject does not consider there to be an expectation of him/her, and does not feel obligated to comply.	No gap.

3 Case Study

We used the perception gaps in cross-cultural communication between international and Japanese students at a Japanese university as a case study to apply the proposed model and methods. A series of questionnaires was developed to elicit each group's expectations of the other group. The questionnaires are iterative in that they comprise two rounds, where the results of the first round are released in the second round. An overview of this process is illustrated in Figure 2. To analyze the collected answer data, a method to quantify and calculate the gap has also been developed. In the following subsections, further details are given about each questionnaire and the methods.

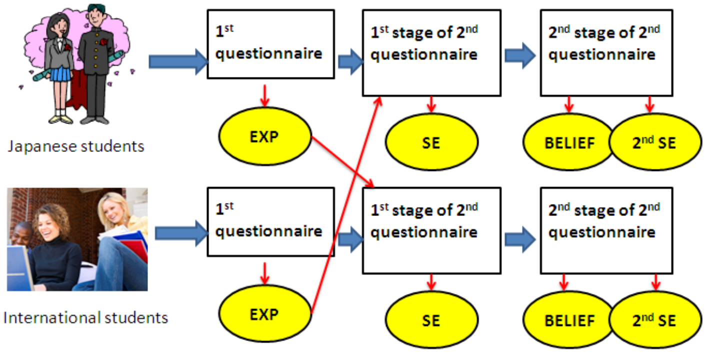


Fig. 2. Overview of the Series of Questionnaires

3.1 The First Questionnaire

The purpose of this questionnaire is to collect the expectations of both international and Japanese students of each other. The questionnaire begins with an open question asking each subject to list five expectations he/she has of the other group. Then each subject is asked to answer the two questions below about each expectation:

1. To what extent do you think international/Japanese students WILL do this?
2. To what extent do you think international/Japanese students SHOULD do this?

The subjects are asked to answer the above questions according to the Likert-scale, where 0 denotes "totally disagree" and 10 "totally agree". These questions are used to distinguish different classes of expectations. In the first round, 21 international and 20 Japanese students participated.

3.2 The Second Questionnaire

The purpose of the second questionnaire is to inform international/Japanese students what is expected of them by their counterparts, as well as to evaluate the will and should expectations of the other group. First, the answers collected in the first questionnaire are summarized into various items; 20 ($\alpha_i, 1 \le i \le 20$) and 21 ($\beta_i, 1 \le i \le 21$) were summarized as the expectations of Japanese and international students, respectively. Second, the following two stages are undertaken. In the second round questionnaire, 55 international and 56 Japanese students participated.

Stage 1
The questionnaire is presented in the form of a table. In this stage, the subjects are told that the items listed in the table are merely possible expectations of their counterparts. Then they are asked to answer the following two questions about each expectation according to the previously defined Likert-scale.

3. To what extent do you think you WILL do this?
4. To what extent do you think you SHOULD do this?

The Second Stage

After the first stage, the subjects are informed that the items listed are actual expectations of their counterparts. In this stage, the averages of the degree of will and should expectations obtained in the first questionnaire are also presented with the list. The subjects are then asked to answer the following three questions:

5. How surprised were you when seeing the average score of your counterparts for “to what extent do you think they WILL do it”?
6. How surprised were you when seeing the average score of your counterparts for “to what extent do you think they SHOULD do it”?
7. After reading the opinions of your counterparts, please answer again “to what extent do you think you WILL do it?”

3.3 Quantification and Calculation

Each mental construct elicited by the above seven questions was quantified between 0 and 10 on the Likert scale. This value can be assumed to be the degree of belongingness ([0, 1.0] to the corresponding mental construct. Once the value is obtained, we can apply fuzzy set theory to calculate the belongingness of each item to the gap types listed in Figure 1 and Table 2. In other words, we can infer which gap type is most probable for each expectation. All the mental constructs obtained by the questions are summarized in Table 3.

Table 3. Mental Constructs Elicited by Each Question

Question No.	Mental Constructs	Details
1	$EXP_{Will}(\alpha, A, B)$	1st round will expectation
2	$EXP_{Shold}(\alpha, A, B)$	1st round should expectation
3	$EXP_{Will}(\alpha, A, A)$	1st round will self-expectation
4	$EXP_{Shold}(\alpha, A, A)$	1st round should self-expectation
5	$BEL(A, EXP_{Will}(\beta, B, A))$	1st round belief on will expectation
6	$BEL(A, EXP_{Should}(\beta, B, A))$	1st round belief on should expectation
7	$EXP_{Will}(\alpha, A, A)$	2nd round will self-expectation

Gap Calculation

It is reasonable to assume that if there is a lesser perception gap between two agents or stakeholders, the degree of belongingness of each mental construct to the center region (i) increases. To assess this similarity, we calculated the norm of the vector $I = \{a_0, a_1, ..., a_i\}$, where a_i is the degree of belongingness of a mental construct to $A \cap B \cap C$. This norm is expected to represent the similarity or agreement in expectations and beliefs between two agents/stakeholders, which means that the bigger the norm is, the lower is the possibility that a perception gap exists. It is also expected that the two agents/stakeholders with the biggest norm toward each other are the best match. This calculation can be applied to different units of stakeholders like individual-individual, individual-group, or group-group, if corresponding questions are prepared. In this paper, however, only the individual-group gap was calculated to demonstrate the matching process.

4 Results and Discussion

In this section, several results obtained through the case study are presented and discussed.

4.1 Gap Quantification

Figure 3 shows the calculated values of the expectation of the Japanese students toward international students, to "study Japanese culture and understand it". This value is the average of all the participants, that is, it represents the group-group gap. In this case the value (0.77) in region (i) is the highest, which suggests that this expectation is highly acknowledged by both international and Japanese students. The regions with the lowest value (0.16) indicate that these types of gap are not likely to occur for this expectation. In general, the results of the gap quantification seem consistent with empirical predictions such as the case shown in Figure 3. One interesting finding is that both Japanese and international students had higher should expectations than will expectations, which could mean that both sides are better matched in their ideal model, and less in reality.

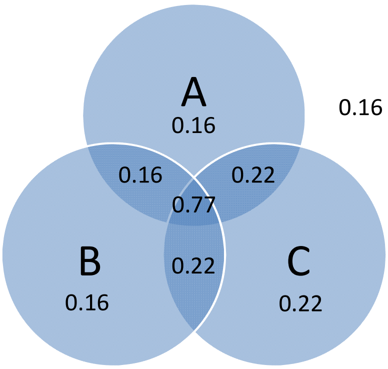


Fig. 3. Example of Gap Quantification

4.2 Modification of Self-expectation

By comparing the will self-expectation in the first round and that in the second round, we assessed whether there was a modification in the students' attitude to cross-cultural interaction. We evaluated the difference in the average values of each item between the first and second rounds, and confirmed that there was a significant difference ($p = 0.018 < 0.05$) in the attitude of Japanese students, although no significant difference ($p = 0.78$) was found in that of international students. One reason for this could be that the average of the first round self-expectation of international students is already high enough and there is not much room for improvement. On the other hand, Japanese students could be less confident in responding to the expectations of international students in the first round, before being informed of the actual expectations. In the second round, however, they were inspired to modify their self-expectations to meet the expectations of their counterparts. This result suggests that the iterative questionnaire is effective, at least with respect to Japanese students, in bridging the perception gap between the student groups.

4.3 Best Matching

Table 4 shows the best matched student with respect to the other group from the viewpoint of different types of expectations. It can be said that those for will expectations are practically best and more typical, while those for should expectations are ideally best. The results show that there is no overlap in the best results for will and should expectations, which implies that there is a gap between the ideal and real expectations of the participants in this case study. It also turns out that Subjects #20_J and #37_J have rich experiences of living overseas (#20_J: 2 years in UK; #37_J: 5 years in UK, 8 years in France and 1 year in US). This provides a partial proof of the validity of the method.

Table 4. Results of Matching

	Best int'l student for JPN students	Best JPN student for int'l students
Will Expectation	#25_I	#20_J
Should Expectation	#42_I	#37_J
Will Expectation (2nd round)	#40_I	#8_J

4.4 Comments from the Participants

Many of the participants found this questionnaire interesting and quite different from other similar surveys. Furthermore, many international students mentioned that this questionnaire gave them a good opportunity to reflect on what Japanese students expected of them, which they had never thought about before. An international student said after the questionnaire: "*When I first came to Japan, I was full of enthusiasm and was eager to make Japanese friends. After a while, however, I started to hold back little by little, maybe it was because of the cold response I got time to time, or it was simply because I got tired. Your questionnaire made me think for the first time what they want from us, and I started to do some introspection. Now I want to try to put in more effort to make friends with them again.*"

These comments confirm that this method is not only a questionnaire to elicit the perception gap, but also an effective support in reconsidering relationships with other parties and pursuing better mutual interaction.

4.5 Application in the Service Industry

The results presented in this paper were obtained within the context of cross-cultural communication between international and Japanese students. Nevertheless, both this model and method are expected to be applicable to other contexts in different domains, because the essential structure of the gap problem is common and universal. One of the possible application domains is the service industry. In the service industry, there are mainly three different stakeholders; an employer, employees, and customers, with various problems between them. For example, an employer would want to know whether the employees really understand the meaninig of his/her directives and share the same vision about the service. In another case, for smooth team cooperation and task allocation within a company, it is believed to be necessary to establish a shared mental model about the service and team work between employers (Kanno et al. 2011). Moreover, it is absolutely crucial to know the customers‘ visions and expectations about the service and reduce the gap between the actual service in order to enhance the productivity of the service. One of the advantanges of our model is that each different kind of perception gap can be placed in the model shown in Figure 1 and more detailed explanations about the current situtaion can be provided. For example, gap (iii) in Table 2 means that the efforts of the company are useless and may be wasteful of energy and resources.

Gap (vi) means that the customers' needs have gone unheard and it is very likely that the customers will turn to other service providers. Gap (v) represents the type of service provider that offers a high quality of service and is more likely to be successful. If the gap falls into type (iv), it means that the service provider and customer are totally mismatched; such a customer is not the service provider's target and the service provider cannot satisfy the customer at all.

5 Conclusions

In this study, we proposed a model to describe the perception gaps between different groups/stakeholders in terms of expectations and beliefs. We also proposed a model-based method for identifying and bridging the gap, that is, an iterative questionnaire that repeats elicitation and presentation of expectations and beliefs of the other party. This method was applied to a case study of cross-cultural communication between international and Japanese students at a Japanese university. The case study confirmed that the method is applicable to and easy to use in an actual problem. A comparison of the first and second round results in self-expectation suggests that the iterative process is effective in modifying the attitude toward the expectations of the other party. It is also suggested by the comments of the participants that the proposed method encouraged them to see themselves from the viewpoint of their counterparts and thus is effective in bridging the gap. Further investigation is expected to show the validity and reliability of the proposed model and method; however, the results of the case study are promising and our proposal is expected to contribute to solving the problems arising from the perception gap between different groups/stakeholders.

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Integrating Value Modelling into ArchiMate

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Abstract. Present day enterprises often become service-oriented enterprises, which are comprised of a dynamic network of organisations that collectively provide services. These services express stakeholders' needs, and can be viewed from different perspectives. In this paper, we consider value web and enterprise architecture perspectives. Specifically, we present a step-wise mapping approach that integrates the value modelling technique e^{3}value into the enterprise architecture language ArchiMate. The main contribution of this paper is twofold. First, we present our initial arrays into how to bridge between e^3value and ArchiMate and, in doing so, we show how these modelling techniques complement one another. Second, by reflecting on the bridging between e^3value and ArchiMate, we discuss the limitations of our integration, which provides useful input for future efforts into model integration. We illustrate our approach by means of a case in the insurance domain.

Keywords: enterprise architecture, value web, ArchiMate, e^{3}value, model integration.

1 Introduction

Enterprises need to negotiate many challenges, such as changes in the economic climate, mergers, acquisitions, novel technologies, et cetera. As a result, enterprises need to be agile to improve their chances of survival. Moreover, the shift towards a services oriented economy makes it even more important for enterprises to adopt themselves to changes. Present day enterprises often become service-oriented enterprises, which are comprised of a dynamic network of organisations that collectively provide services [1].

Dealing with such changes requires a good steering instrument. Such a steering instrument should provide enterprises with the ability to analyse the current state of the enterprise, identify and describe alternative future states, guard the cohesion and alignment between the different aspects of an enterprise such as business processes and their ICT (Information and communications technology) support. Enterprise architecture is generally considered to provide such a mechanism for cohesive steering [2,3,4]. It aims to provide management with appropriate indicators and controls to steer the transformation of an enterprise

M. Snene (Ed.): IESS 2012, LNBIP 103, pp. 125–139, 2012.

into the desired direction. As such, enterprise architecture is concerned with the enterprise as a whole and not just enterprise-wide ICT architecture.

Although the value of architecture has been recognized by many organisations, mostly separate architectures are constructed for various organisational domains which remain unspecified or implicit [5]. In general, business models focus on the service value generated by a business, whereas enterprise architecture models show how a business realizes these services [5]. Ensuring integration between the conceptual models representing the different stakeholder perspectives is a research problem. First and foremost, such a model integration is needed to *ensure consistency*. Different modelling techniques emphasize different perspectives on the *same system*, and so should be in line with one another [6]. As such, model integration fosters *traceability*. For example, considering parts of an organisation modelled in one perspective, such as from a value perspective the actors exchanging value, it may return in another perspective, such as, from an ICT perspective, the actors exchanging messages.

In this paper we present our first arrays into integrating, on a syntactic level, two conceptual models: e^3*value*, for modelling a value perspective on the business at hand, and ArchiMate, for modelling business operationalization (such as business processes and the underlying ICT realizing the business collaboration). It makes sense to look specifically at integrating e^3*value* into ArchiMate: ArchiMate has recently been adopted by the Open Group[1] as a standard for modelling enterprise architectures, but, as we shall see in this paper, lacks expressivity for modelling an enterprise from a value perspective.

To the best of our knowledge, only [5] have so far considered specifically the integration of e^3*value* and ArchiMate. However, while [5] do argue that ArchiMate complements e^3*value* in terms of profitability calculations, little effort is made to show exactly *how* to bridge the two modelling techniques, and what the limitations in such a mapping are. More specifically, while [5, p.8] do provide a mapping between the e^3*value* and ArchiMate metamodels, they leave implicit the actual use of this mapping to translate an e^3*value* model into ArchiMate and vice versa. Worse still, [5] fail to discuss the conceptual differences between the e^3*value* and ArchiMate metamodels, thus leaving for example implicit that e^3*value* and ArchiMate interpret the concept of an "Actor" differently. However, ArchiMate concepts sometimes have no place in a e^3*value* model and vice versa. For example: an IT-department that is not profit-and-loss responsible may be modelled as an Actor in ArchiMate but, because it is not interesting from a value perspective, should not be present in an e^3*value* model.

Note that in this paper, we present an *initial* mapping of e^3*value* and ArchiMate on a *syntactical level*. As such, the contribution of this work is twofold: (1) to provide an initial mapping between the value modelling technique e^3*value* and the enterprise modelling technique ArchiMate. In this mapping, we show *how* e^3*value* and ArchiMate complement one another. and (2) following up on that initial mapping, to point out differences between the two modelling techniques from both syntactic and semantic levels, which provides useful input for

[1] http://www.opengroup.org/archimate/

further model integration. We use a running example of an insurance scenario to illustrate our ideas.

The remainder of this paper is organized as follows. Section 2 introduces the insurance case study. In section 3, we discuss the integration of ArchiMate and e^3*value* models. In particular, we show how ArchiMate operationalizes a value web modelled in e^3*value*, and how e^3*value* can be used for profitability calculations of an operationalization modelled in ArchiMate. Section 4 points out the initial mapping of our approach and discuss functionalities and limits of such integration. Section 5 presents related work. Section 6 concludes.

2 The Archinsurance Value Web

For illustration purposes, we present a fictitious but realistic insurance case. This case is inspired by a paper on the economic functions of insurance intermediaries [7], as well the running insurance case that illustrates the ArchiMate language specification [8,9]. In this section, we first use our insurance case to introduce the value modelling technique e^3*value* (Sect. 2.1). Subsequently, in Sect. 2.2, we discuss the particular insurance case scenario that will be used as a running case for the remainder of this paper.

2.1 Modelling the Archinsurance Value Web in e^3*value*

Archinsurance, a large insurance company, offers one of its many products, car insurance, directly to its customers via the internet and its sales representatives. The reason for selling directly to customers is mainly to cut costs that come with an intermediary, such as premiums paid and additional administrative costs. These cost cuttings, in turn, can be passed on to the customer in terms of a lower insurance fee.

We use e^3*value* to model this direct-to-customer sales model. e^3*value* focuses on modelling the value exchanges between actors participating in a value web, depicting what each actor offers to others, and what it receives in return. The principle of economic reciprocity, which states that an offering from an actor should always be compensated, is central to e^3*value*: in other words, one good turn deserves another.

This Archinsurance direct-to-customer business model is depicted in the e^3*value* model in Fig. 1. Here, we see that:

- A customer (modelled as a market segment) provides his 'complete risk profile' to Archinsurance, which is valuable to the Archinsurance (an actor) since it defines the basis for the offered insurance package and its associated fees.
- Archinsurance transforms the risk profile in an insurance offering via 'Contracting' (a value activity), and the customer receives a car insurance from Archinsurance in return.

Observe here the economic reciprocity, as modelled by a value interface in e^3*value*: Archinsurance only provides its car insurance if it receives in return another valuable object: a complete risk profile.

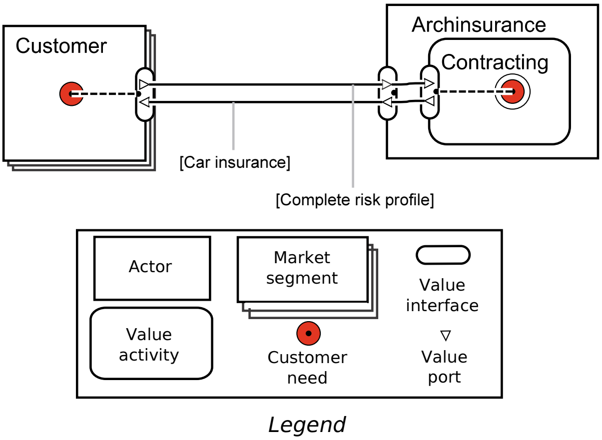

Fig. 1. Value model of direct sales of car insurance

2.2 Archinsurance: Moving from a Direct-to-Customer to an Intermediary Sales Model

Archinsurance finds that its direct-to-customer model brings with it also the problem of *adverse selection of risk profiles* (cf. [7]). This adverse selection means that Archinsurance offers customers a car insurance against an inappropriate fee, or worse still, offers a customer a package that may in fact not be issued, because of an incomplete or faulty risk profile on the part of the customer. This is mainly due to a problem of information asymmetry: the customer knows more about his risk profile than the insurer does. For instance, customers knows more about their past accidents, or medical history. However, due to a lack of expertise or on purpose, customers do not always provide the necessary risk profile to the insurance provider.

To reduce the risk of receiving incomplete customer profiles, Archinsurance considers moving towards selling insurances via an *intermediary* (see Fig. 4). The rationale for introducing an intermediary, and how this can be beneficial for all parties involved, are explained as follows:

– The customer provides ‘personal information’ to the intermediary, which is valuable to the latter because it allows for the composition of a complete risk profile.
– Using the value activity ‘Create customized insurance package’, the intermediary matches customer information to appropriate offerings, and possibly requests additional customer information. Note that the value model shows only the (high level) value-adding activities: it can be detailed in an operational ArchiMate model afterwards (see Sect. 3.2).

- The intermediary provides Archinsurance with a 'Complete risk profile', which, as discussed, the insurer may use to mitigate adverse selection of risk profiles.
- In return for the profile, Archinsurance pays the intermediary a premium.
- The customer receives a 'Tailored car insurance guarantee' from the intermediary, and the actual 'Car insurance' from Archinsurance in return. This is to depict the advantage that, through intervention of the intermediary, the customer receives an insurance package in line with his profile, against an appropriate fee.

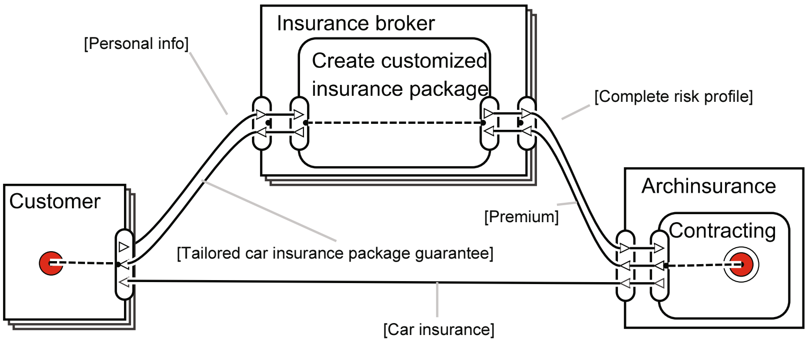

Fig. 2. Value model of car insurance sales via an intermediary

3 Towards Integrating ArchiMate and e^3*value*

We now show our approach for mapping between ArchiMate and e^3*value*, using the baseline e^3*value* models defined thus far as input.

We first briefly introduce the enterprise architecture modelling technique ArchiMate (Sect. 3.1). Thereafter, we discuss how to map a e^3*value* model to an ArchiMate model (Sect. 3.2) and, vice versa, how to map an ArchiMate model to e^3*value*(Sect. 3.3).

3.1 Modelling an Enterprise Architecture in ArchiMate

We rely on the ArchiMate modelling language to model the enterprise architecture of the Archinsurance case. ArchiMate has been transferred to the Open Group, where it is slated to become the standard for architectural description accompanying the Open Group's architecture framework TOGAF [4]. ArchiMate focuses on administrative sector, unlike UPDM (Unified Profile for DoDAF/MODAF) whose main focus is the defense sector [10]. ArchiMate is geared towards "Information processing dominant organisations" such as banks, insurance companies, government agencies, et cetera [11]. In this paper, it offers a coherent description of the enterprise architecture to enable communication among stakeholders, and to guide change processes within Archinsurance.

3.2 e^3*value* to ArchiMate: Operationalization of a Business Scenario

For the direct-to-customer value web in Fig. 1, we provide an enterprise architecture in Fig. 3. From e^3*value* we arrive at this enterprise architecture modelled in ArchiMate in two steps:

1. Concept Inheritance from e^3*value* to ArchiMate: We find that actors and, in particular, business functions, provide a bridge between e^3*value* models and ArchiMate models. *Actors and market segments* in e^3*value* become *actors* in ArchiMate. In the Archinsurance case, the actors 'Customer' and 'Archinsurance' from the e^3*value* model (Fig. 1) become actors in the ArchiMate model (Fig. 3). *Value activities* in e^3*value* become *business functions* in ArchiMate. In the Archinsurance case, the value activity 'Contracting' becomes a business function in the ArchiMate model. Finally, given a e^3*value* model wherein actors execute value activities, we can relate business functions to actors in ArchiMate. In the Archinsurance case, we see that Archinsurance executes the value activity 'Contracting' and so can link in ArchiMate 'Contracting' to the relevant business actor (i.e., Archinsurance).

2. Operationalization of Business Functions in ArchiMate: We find that business functions, which in ArchiMate denote the high-level functions that a company executes, provide an excellent starting point for modelling operational details. For example, we detail exactly what *operational* business process steps realize the business function 'Contracting': the steps 'Registration of customer profile', 'Eligibility check' and 'Estimate monthly customer fee'. Subsequently, we can use these business process steps to model the required ICT support in ArchiMate. For example, the enterprise architecture that realizes the direct-to-customer scenario, we see that the IT service 'Customer administration service' is required for the registration of a customer profile, and that a 'Risk assessment service' is required for the eligibility check and the estimation of the monthly customer fee (see Fig. 3). Finally, note that ArchiMate allows for also modelling the physical ICT infrastructure required to run said ICT-applications. Due to space restrictions however, we do not show this physical infrastructure.

In ArchiMate, a layered view provides a natural way to look at service-oriented models. Services define externalized functionality from one layer that is useful in another layer. This shows the service-orientation of ArchiMate: no matter what changes in a layer (e.g., business or application), the services offered from one layer to another remain the same.

Note that the details discussed regarding the operational business process steps, applications and physical infrastructure are especially useful for cost estimation of an ICT infrastructure (see Sect. 3.3). Moreover, it is important to note here is that value objects, which e^3*value* uses to show the economic rationale for actors to participate in a value web, are not carried over to ArchiMate. We return to this point in our reflection on mapping e^3*value* to ArchiMate (Section 4).

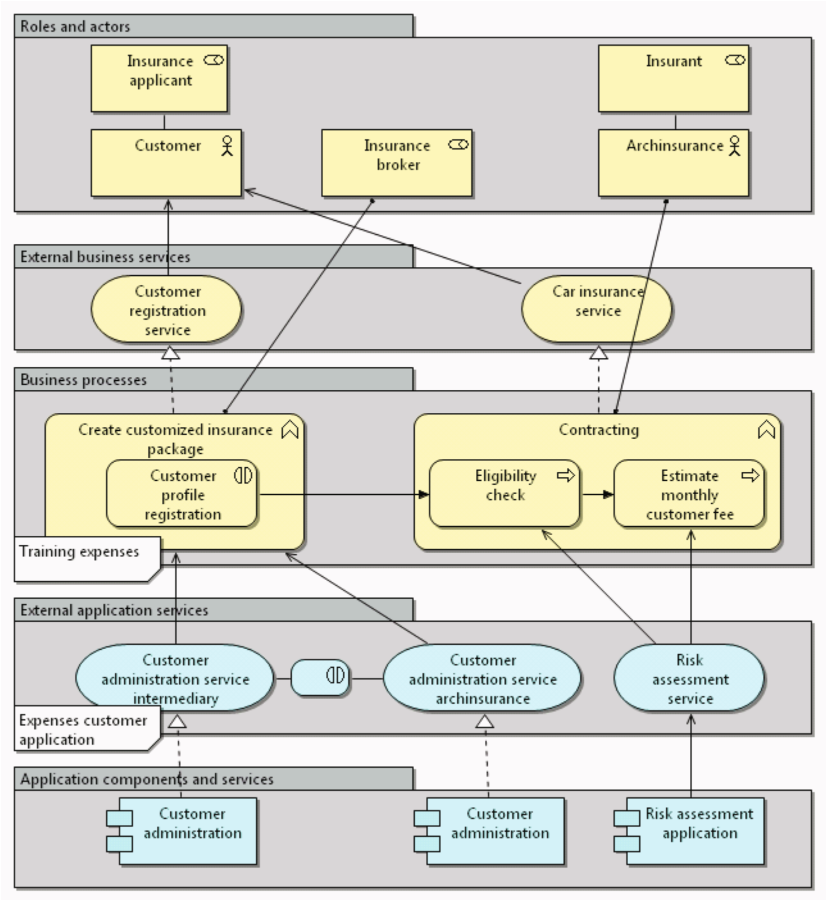

Fig. 3. (Partial) enterprise architecture model: Direct sales of insurance

3.3 ArchiMate to e^3*value*: Profitability of Operationalization

Consider now the ArchiMate model in Fig. 4, which depicts an operationalization in terms of needed business processes and ICT infrastructure for the introduction of an intermediary. From this model, we can derive an e^3*value* model to calculate the profitability of the operationalization modelled in ArchiMate. We do this in three steps:

1. Annotate Expenses in ArchiMate: We can annotate the ArchiMate model that includes an intermediary (Fig. 4) with the required expenses. Examples include expenses for (1) the IT application 'Customer registration' of the intermediary. The intermediary requires this application to enable interoperability with Archinsurance. And (2) the business process step 'Customer profile registration' of the intermediary. The intermediary requires training for this business process step, in particular to know what type of customer data Archinsurance demands for its car insurance. Note that we do not show the actual expenses in the enterprise architecture model because of the fictitious nature of this case.

2. Import Expenses in *e^3value*: As in Sect. 3.2, we use business functions and roles/actors from ArchiMate to make a bridge towards value activities and actors in *e^3value*. For the enterprise architecture of the Archinsurance case with an intermediary in Fig. 4, we arrive at the value web modelled in *e^3value* in Fig. 2 as follows:

(1) *Aggregating ICT-infrastructure expenses and business process expenses onto a business function level.* We can aggregate expenses into a business function because ArchiMate shows exactly what dependencies exist between different layers. For example, the enterprise architecture model in Fig. 4 shows that the business function 'Create customized insurance package' relies upon the business process step 'Customer profile registration', to which - as mentioned - training expenses are attached. In turn, the business process step 'Customer profile registration' is realized by the application 'Customer administration' (via the service customer administration service intermediary), to which installation expenses are attached.

(2) *Translating the business functions and actors/roles in ArchiMate to* e^3value. After having aggregated the expense carriers into business functions in ArchiMate, we can map the enterprise architecture model to *e^3value*(while keeping the costs intact of course for the profitability calculations). For the Archinsurance case, the actors 'Customer', 'Insurance broker' and 'Archinsurance' become actors in *e^3value*. Thereafter, the actor 'Intermediary' receives the value activity 'Create customized insurance package' (from its similarly named business function in ArchiMate), while the actor 'Archinsurance' receives the value activity 'Contracting'. For the intermediary value web, see an example in Fig. 5. We observe that ArchiMate can relate business functions to actors (as for example shown by line between Archinsurance and the business function Contracting). Therefore, we know what actor performs what business function and can import this knowledge into *e^3value*.

3. Perform Profitability Calculations in *e^3value*: With *e^3value*, we can now perform profitability calculations. *e^3value* allows for this by (1) Introducing time series that depict the evolution of a value web over different points in time. Besides the initial Archinsurance value web in Fig. 2, we may model the monthly recurrence of an insurance fee paid by the customer, and (2) Experimenting with variables, and observing the results over a time series. For example, one can calculate profitability from: (1) The initial investments in the initial *e^3value* model, and (2) The model depicting monthly payments by the customer. Hereby, one can experiment with the number of customers, as well as the time period, and see how this will affect the profitability of the service operationalization.

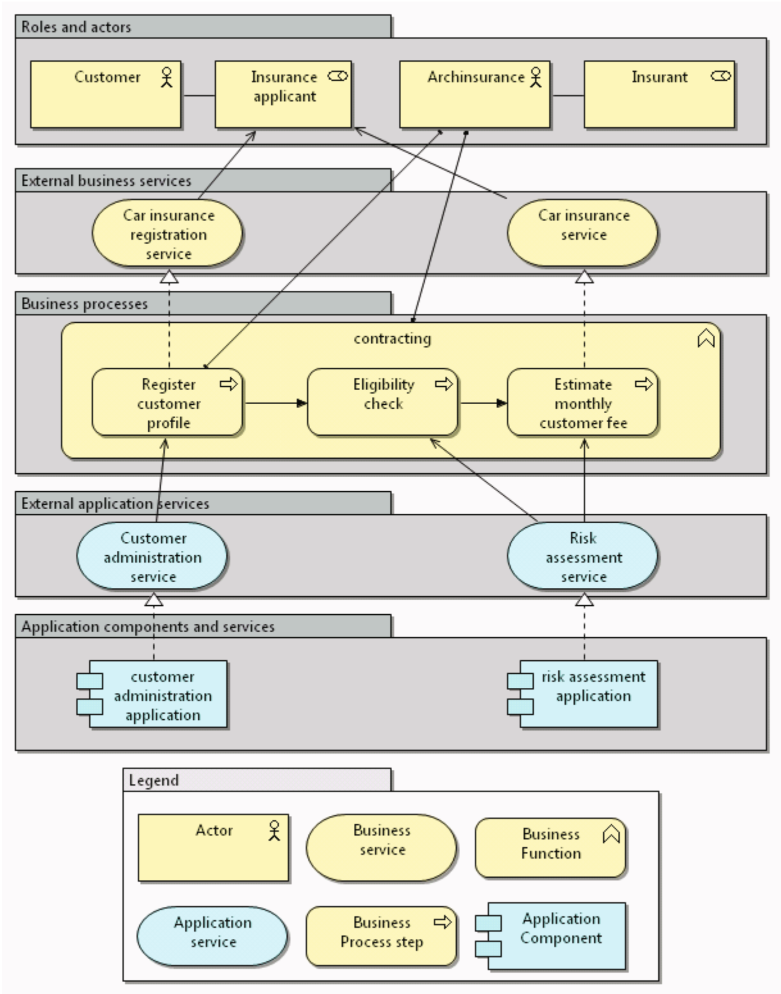

Fig. 4. (Partial) enterprise architecture model including an intermediary

4 Comparison of e^3*value* and ArchiMate Concepts

The mapping discussed so far presents a first step towards integrating e^3*value* and ArchiMate, as well as an illustration of why such model integration is useful. However, as stated in the introduction, this mapping represents only our initial attempt at model integration. As a result the mapping is naive, by for example assuming that the concept of an actor as defined in e^3*value* maps one-to-one to the concept of an actor in ArchiMate.

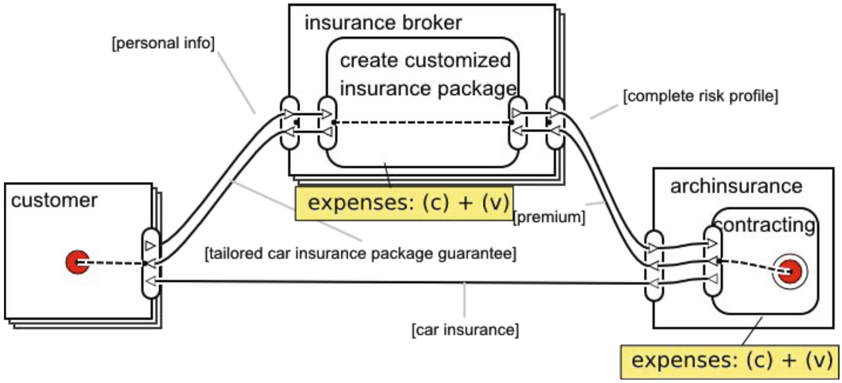

Fig. 5. Expenses in e^3*value*, based upon operationalization modelled in ArchiMate (c = fixed expense, v = variable expense)

To address this naive concept mapping, and thus create input for future efforts towards integrating e^3*value* and ArchiMate, we now discuss conceptual differences between the aforementioned models. We base our discussion on lessons learned from the running ArchiMate case.

Actor Concept. Consider the concepts of actor and market segment in e^3*value*, and actors and roles in ArchiMate. In e^3*value*, the idea of a "profit-and-loss responsible unit" is central to the concepts of actor/market segment (where a market segment can be considered as a "stack" of n actors, with n denoting the market segment's size). In other words, if an object cannot assume financial responsibility on its own, it would not be modelled in e^3*value*. ArchiMate, differently, considers actors as "active entities. . . that perform behaviour such as business processes or functions" [8, p. 5]. Thus, the notion of actors in ArchiMate is broader than that of e^3*value*, where the financial (profit-and-loss responsibility) criterion is not present, but only the criterion that the actor has some function to execute.

To illustrate, consider in the insurance scenario, 'Contracting' from the direct-to-customer Archinsurance model (see Fig. 4). In e^3*value*, it is shown that Archinsurance performs 'Contracting', because Archinsurance can assume its own financial responsibility. However, it may well be that *inside Archinsurance* contracting is performed by different departments. For example, checking the eligibility of an insurance application - as part of contracting - may very well be performed by a separate back office specialized in car insurances. For Archinsurance, the modelling of these different departments may actually be important since they may have an impact on how the ICT support is modelled. However, when converting back to e^3*value*, the modelling of departments as actors in ArchiMate would be problematic since they are not profit-and-loss responsible.

Service Concept. The criterion of what should be considered as a service differs between ArchiMate and e^3*value*. Following the ArchiMate model for the

Archinsurance case, business services are - for the customer - the point of contact with the enterprise, such as 'Car insurance registration service' and 'Car insurance service' (see Fig. 3). More specifically, cf. [8], a service is a unit of functionality that some entity makes available to its environment, and which also has value for some entities in its environment. e^3*value*, differently, considers services on a higher level of granularity. For example, only the fact that the customer receives car insurance would matter, not that there is a contact point service for registration of the car insurance service. The latter happens more on a transactional level.

Seeing that business services are an important concept in both frameworks (in ArchiMate for connecting the different architectural layers, and in e^3*value* given its service orientation in recent work [12]), it seems to be useful to further analyse the concept of a service. Thus, in future research into model integration we should explicitly take into account different levels of granularity: services as a transaction, where one models elementary transactions such as customer registration, and services as business services, where one models commercial services as they exist in the marketplace.

Value Object Concept. The different foci of e^3*value* and ArchiMate are again reflected in the difference between an e^3*value* value object and an ArchiMate business object. As with our previous discussion, the main difference between these two concepts arises from the focus of e^3*value* on modelling an enterprise's value perspective, with e^3*value* maintaining the criterion that "a value object can be a good, service ... or even experience. *The important point here is that a value object is of value to one or more actors*" [13]. ArchiMate, differently, considers business objects to represent the "important informational or conceptual concepts in which the business thinks about a domain"[9], which in ArchiMate models often translates to business objects that have a direct relevance to the underlying business processes and information systems, such as 'invoice' and 'insurance policy'.

On the one hand, this difference in interpretation needs to be accounted for when converting an e^3*value* model to ArchiMate. Consider for example the value object 'Tailored car insurance package guarantee' that the customer receives from the intermediary in the intermediary value web (see Fig. 2). One models this object in e^3*value* because it reflects one of the primary reasons for a customer to consider an intermediary valuable: to find a tailored insurance package that matches his needs. An ArchiMate model, however, would typically not contain this value object because it has no *tangible* impact on the operationalization of the underlying value web (In terms of business processes and information systems).

On the other hand, a business object in ArchiMate does not necessarily translate to a value object in e^3*value*. An invoice is a good example of this: in the Archinsurance case, an invoice may be modelled because it is relevant for the underlying IT implementation of the Archinsurance value web. However, invoices are often operational objects, and therefore often do not show up in a value model.

Value Activity Concept. The concept of a value activity in e^3*value* differs from the concept of a business function in ArchiMate. In the Archinsurance case, we could easily transition from a e^3*value* value activity, such as 'Contracting', to a similarly named business function in ArchiMate. This is because the notion of a value activity is inclusive to the more broadly defined business function concept from ArchiMate, the latter being used to "represent what is most stable about a company in terms of the primary activities it performs" [9, p. 24].

Thus, also here we need to account for the fact that an e^3*value* value activity maintains value as a main criterion, whereas an ArchiMate business function does not.

Economic Reciprocity. As stated in Sect. 2.1, the idea of economic reciprocity is central to e^3*value*. As modelled by the e^3*value* concept of a value interface, actors only offer an object of value to another actor, if they receive compensation in return. For example: in the Archinsurance intermediary value web (Fig. 3), we see that an intermediary offers a 'Complete risk profile' to Archinsurance, and receives the value object 'Premium' as compensation.

ArchiMate, however, does not have a concept to depict economic reciprocity (again, because of its operational nature). So, for example, in ArchiMate one cannot express that a 'Complete risk profile' is only provided by the intermediary to Archinsurance if a 'Premium' is received in return.

Mapping Limitations. We find commonalities between ArchiMate and e^3*value* that allow us to map between these models. In particular, we can map between the e^3*value* concepts 'Actor', 'Market segment' and 'Value activity' on the one hand, and the ArchiMate concepts 'Actor' and 'Business function' on the other.

However, because of the operational, respectively value focus of ArchiMate and e^3*value* we find differences between concepts from the aforementioned models (as shown in this section). In particular, we find differences in: *the actor concept*, which in e^3*value* has a profit-and-loss responsible criterion but not in ArchiMate, *the service concept*, which e^3*value* considers as a commercial service, whereas ArchiMate considers services both on a commercial and transactional level, the *value object* concept, which is usually not modelled in ArchiMate because of ArchiMate's operational nature, *the value activity concept*, which in e^3*value* usually has an external focus (i.e., it is modelled in as far it is relevant in a network of enterprises) whereas the business function in ArchiMate has more of internal focus (ie the focus is on modelling activities within an organisation), and, finally, ArchiMate lacks the notion of economic reciprocity.

5 Related Work

The e^3*alignment* approach provides tools for actually creating business-ICT alignment. It does so by ensuring that conceptual models depicting a strategic, value, process and ICT perspectives respectively on the value web at hand are consistent with one another [14]. However, this approach works only on a syntactic level. For instance, if the concept of an actor in e^3*value* and the concept of a swim lane in an UML activity diagram actually means the same is not a consideration. Derzsi et al. enable profitability calculations of an ICT-infrastructure by providing a meta-model that links an IT infrastructure modelled in UML to e^3*value* [15]. This approach has more formality than e^3*alignment* , yet it focuses on a link between IT and value only. As a result, business processes are not a consideration while these are realistically cost carriers as well.

The Object Management Group (OMG) presented the Unified Modelling Language (UML) (version 2.0) [16], standardized in 2004, which is the backbone of the object oriented software engineering computing paradigm. UML offers comprehensive support for control-flow and data perspectives [17]. However UML techniques provide limited support for modelling organisational or value aspects of business processes. These limitations are common to many other business process modelling formalisms such as the Business Process Modelling Notation (BPMN) and reflect the emphasis that has been placed on the control-flow and data perspectives in contemporary modelling notations [18].

Ontological merging approaches address the semi-automated integration of system models [19]. System models are created in terms of modelling language, which in itself is based on a meta-model. Syntactic and semantic mapping between pairs of meta-models has been facilitated by the application of existing approaches for ontology mapping [20,21]. Ontologies improve not only the semantics of a meta model but also provide a potential way in which these meta models can be bridged with each other to be integrated within a common context [22]. However, ontology mapping approaches such as [20,21] focus on providing an approximation of a mapping between two ontologies. Yet, in our research we require a precise mapping. Since our starting point are ontologies, such as e^3*value*, with relatively few concepts (compared to larger ones such as found in the medical domain), it seems better to perform mapping/integration manually and as such, avoid an approximation of a mapping.

6 Conclusion and Future Directions

In this paper, we provided a step-wise, intuitive, mapping approach for integrating the value modelling technique e^3*value* into the enterprise architecture framework ArchiMate. Following up on this, we discussed the limitations of our step-wise mapping approach as an input for further research. Also, we showed why integration of e^3*value* and ArchiMate is useful. On the one hand, e^3*value* is complementary to ArchiMate in terms of profitability calculations while, one the other hand, ArchiMate is complementary to e^3*value* in terms of operationalizing a proposed business collaboration.

Our goal is to ensure the consistency of different modelling techniques and to foster the notion of model traceability. For future research, we therefore intend to explore techniques that can be used to relate conceptual models beyond naive concept mapping. One such technique is the fact-based modelling technique Object Role Modelling (ORM) [11]. The basic idea behind applying ORM is to create an initial meta model based on the concepts present in ArchiMate, while expanding and adjusting it based on concepts from other ontologies.

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"S-D Logic" Business Model - Backward and Contemporary Perspectives

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Abstract. This paper provides a retrospective view on the development of the field of service science. It reviews how – commencing in the late 1970s – the field started to be developed into the contemporary era where a service-dominant (S-D) logic has gained much scientific attention. The most important developments and debates regarding the (non-) usefulness regarding a differentiation strategy between goods and services in this period are highlighted. In addition, some illustrative examples regarding scientific application of the contemporary S-D logic perspective are given.

Keywords: Service Science, Service Business Models, Service-dominant (S-D) Logic, Goods and Services, Intangibility-Heterogeneity-Inseparability-Perishability (IHIP) Framework, Operand and Operant Resources.

1 Introduction

The term 'service' has been subject to various interpretations during the last four decades. Scientific debates, originally strongly dominated by the marketing discipline [30, 31], have been going on regarding the conceptual borders of services in comparison to goods. Whereas initially services and goods were seen as two different paths of value creation, much attention has been devoted to this distinction, with changed perspectives throughout the years. Recently, Service-Dominant Logic (S-D Logic) has become the dominant way of thinking about goods and services, both in theory and practice.

Thus, this paper attempts to contribute to the literature review by systematically outlining both the historical development of the field of service science, as well as the contemporary situation, in which S-D Logic serves as a leading approach. No work to date has combined these tasks while simultaneously giving an overview of theoretical S-D Logic applications in the recent literature. The main developments are categorized chronologically in Figure 1. In Phase 1, service marketing (science) started to emerge, before services and related subtopics gained more attention in the 1990s (phase 2). The third phase, initiated with the introduction of S-D Logic in 2004, is dominating contemporary ways if thinking in the field of service science. This period has also been called 'the Airborne Phase', and is characterized by internationalization and increased interdisciplinary of the field of Service Science [37].

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The remainder of this paper is built along these phases: first, the historical roots of service science are outlined in Section 2. Next, the IHIP framework, which was mainly used during the second phase is explained, before Section 4 contrasts G-D Logic with the currently dominating S-D Logic view. In this section, an overview is given regarding exemplary S-D Logic applications (case studies). Finally, the paper finishes with a short conclusion and a future outlook.

2 Tracing the Roots of Service Science

The distinction between goods and services has its origin in the discipline of marketing. Berry and Parasuraman [2] concisely describe the chronology of how the discipline of services marketing developed in the period between 1970 and 1990. Tables 1a and 1b show the acceleration factors that contributed to the development of services marketing as they outlined them, divided into important events and important publications. Although others already 'planted the seeds', they describe that 1977 can be considered as a breakthrough year for services marketing. In this year, Lynn Shostack [27] published his article, in which it was first recognized and specified that the intangibility of services posed special challenges for marketing. Fisk and colleagues outlined how some years before in 1969, Johnson already explicitly asked the question 'Are goods and services different?', thereby launching the debate that soon became the roots of an entirely new discipline [8]. In 1983, Christopher Lovelock continued this view by arguing that above the differences between goods and services, services could be divided into five heterogeneous groups, followed by his book on service marketing the year thereafter [15, 16].

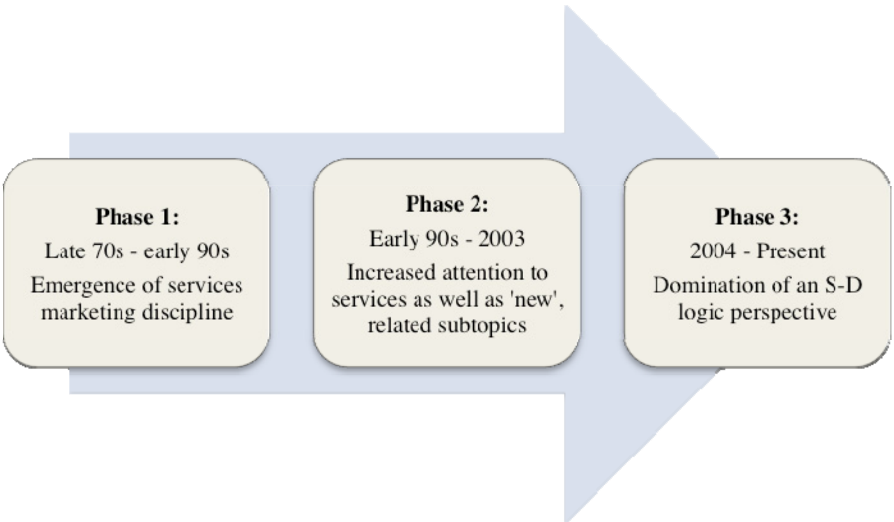

Fig. 1. The trace towards and development of Service-Dominant Logic

Table 1 a. Factors contributing to the development of services marketing discipline: major events (adapted from [2])

Year	Event
1977	Marketing Science Institute established the Consumer Services Marketing Research program and published is first report from the program
1981	American Marketing Association held the first national conference on Services Marketing in Orlando, Florida
1984	American Marketing Association established a separate Services Marketing Division
1985	Arizona State University established the First Interstate Center for Services Marketing
1985	American Marketing Association held is first Faculty Consortium on Services Marketing at Texas A&M University
1988	University of Karlstad, Sweden, hosted the first Quality in Services (QUIS) symposium, a multi-disciplinary, multinational research conference held every other year
1990	Universite d'Aix-Marseille, France, sponsored the first International Research Seminar in Service Management. Researchers from multiple disciplines and countries presented papers on various service-organization issues

One year later, Zeithaml and colleagues published an article, in which they aimed to "... offer a conceptual framework summarizing the unique characteristics of services, the problems stemming from these characteristics, and the strategies suggested as appropriate to overcome the problems" [cf. 36]. In this work, they also introduced and treated the IHIP framework extensively, which will be discussed later on. As described by Fisk et al. [8], in the years thereafter one witnessed an 'explosive growth of books, journal publications, conference proceedings and dissertations' regarding the nature and treatment of services, in which attention was paid to 'new' topics like service quality, service design, customer retention and relationship marketing. Table 2 shows an overview by Fisk et al. [8] of the number of articles about services that were published in the period between 1953 and 1992.

Table 1b. Factors contributing to the development of services marketing discipline: major publications (adapted from [2])

Year	Publication
1974	George & Barksdale: Marketing activities in service industries, *Journal of Marketing*
1976	Levitt: The industrialization of service, *Harvard Business Review*
1977	Kotler & Conner: Marketing professional services, *Journal of Marketing*
1977	Shostack: Breaking free from product marketing, *Journal of Marketing*
1978	Chase: Where does the customer fit in a service operation?, *Harvard Business Review*
1978	Thomas: Strategy is different in service industries, *Harvard Business Review*
1980	Berry: Services marketing is different, *Business*
1981	Levitt: Marketing intangible products and product intangibles, *Harvard Business Review*

Table 1b. (*continued*)

1983	Lovelock: Classifying services to gain strategic marketing insights, *Journal of Marketing*
1985	Parasuraman, Zeithaml & Berry: A conceptual model of service quality and ist implications for future research, *Journal of Marketing*
1985	Solomon et al.: A role theory perspective on dyadic interactions: the service encounter, *Journal of Marketing*
1985	Zeithaml, Parasuraman & Berry: Problems and strategies in services marketing, *Journal of Marketing*
1987	Shostack: Service positioning through structural change, *Journal of Marketing*
1988	Parasuraman, Zeithaml & Berry: SERVQUAL: a multiple-item scale for measuring customer perceptions of service quality, *Journal of Retailing*
1988	Zeithaml, Berry & Parasuraman: Communication and control processes in the delivery of service quality, *Journal of Marketing*

In 2004, Vargo and Lusch [33] proposed to consider all goods as services, and urged scholars and researchers to take a more service-dominant view. Because, in fact, every exchange or economic action fundamentally results in a form of service provision, they recommended abandoning strategies where it is distinguished between services and goods. Despite the fact that this view proved to possess internal consistency as well as to bring about interesting perspectives, Stauss [29] describes this shift as a so-called *Pyrrhic victory*, where an apparent victory (acceptance of the proposed view) might in practice equate a severe loss (the abandoning of a complete, relevant field of research) (see Appendix A for a more detailed definition 'Pyrrhic victory').

Table 2. Overview of "service" articles published in the period between 1953-1992 (adapted from [8])

Source	Number of "service" articles
Journal of Services Marketing	84
International Journal of Service Industry Management	41
Harvard Business Review	34
Service Industries Journal	30
Journal of Marketing	25
Business Horizons	22
Industrial Marketing Management	22
Journal of Retailing	19
Journal of the Academy of Marketing Science	16
European Journal of Marketing	15
Journal of Business Research	15
Journal of Professional Services Marketing	15
Sloan Management Review	15
Journal of Business Strategy	13
Academy of Management Review	10
Quarterly Review of Marketing	6
Journal of Consumer Marketing	5
Journal of Consumer Research	5
Journal of Marketing Research	5

Thus, why broadening the services perspective and abandoning this field's relevant lines of enquiry and research contributions could be necessary is exhibited in the form of six (potentially) problematic implications [29], as follows:

1. the all-embracing, broader definition associated with the view of Vargo and Lusch is undesirable, since such generalizations cause the opposite of additional insights: "A general definition of service that includes virtually everything defines virtually nothing" [cf. 29].
2. since production of physical goods differs manifestly from production of services, characterizing all goods as services simply because customer value is created with goods is highly undesirable, from a theoretical as well as from a practical perspective.
3. there are inseparable services (though not all), where production and consumption necessarily have to take place simultaneously [e.g., 6]. Equating goods and services would imply that this important differentiation opportunity for such services goes unrecognized.
4. the same argumentation counts for the use of the term 'relationship'. Blithely using this term to refer to goods' transactions would deny the specific importance it has in a service context, where relationships with customers are far more than just transactional [29].
5. modern service economy is not solely undergoing a process of 'servicization', but shows trends in opposite direction as well, with production oriented logics being applied to service industries.
6. so-called service specific knowledge developed because services' characteristics were so distinct to those of goods, posing specific challenges. Losing this distinction will therefore imply that dealing with challenges on the basis of relevant recommendations and contributions from the past will no longer be possible [29].

Since both streams that are described above might have put forward valid arguments, the truth might actually be 'somewhere in between'. Facts are that service industries have been rapidly expanding and in recent decades, the economy has been shifting towards a service-based economy [11, 12, 24]. The expressions 'servicizing products' and 'productizing services' illustrate that boundaries between goods and services are blurring indeed. Products are increasingly offered together with value adding services, which indicates that there is a nested relationship between goods and services in which so-called bundled solutions are offered [24]. Hence, differentiating between goods and services becomes increasingly complex.

The next section shows how the IHIP framework was used in order to delineate services from goods, and why so many authors considered this framework from a skeptical point of view.

3 The Intangibility-Heterogeneity-Inseparability-Perishability (IHIP) Framework

As highlighted in the previous section, it is pointed towards crucial distinctions regarding the characteristics of services when defending the field of service research. In the discussions, it was often referred either explicitly or implicitly to the IHIP framework, which is an abbreviation of four typical service characteristics: intangibility, heterogeneity, inseparability and perishability [6, 31]. The next paragraphs will explain this framework in more detail, together with arguments as to why a critical view towards these factors might be important.

3.1 IHIP Characteristics and Its Critics

During the second phase as represented in Fig. 1, it started to become clear that the boundaries between goods and services were blurring. Nevertheless, services kept often being differentiated from goods in the literature. The most important framework in this respect was the IHIP framework. Although it is acknowledged in the literature, that there has never been any scientific justification for its characteristics, the framework has been widely used [11].

The characteristics of the IHIP framework were already mentioned half a century ago, by Regan [26]. In a thorough evaluation regarding the origins of this framework, Lovelock and Gummesson [14] elaborate on how, after various literature reviews and numerous citations, this framework has been accepted as a key source of wisdom in the service (marketing) literature. The framework basically consists of following elements: *intangibility* refers to the fact that services are not like physical goods that can be perceived with basic human senses, implying a high level of experience. Two other characteristics result from this: *perishability*, which implies that services cannot be stored, as well as *inseparability* (earlier in this chapter called 'simultaneity of production and consumption'), which implies that services are produced and consumed at the same time [28]. Finally, a distinct characteristic of services is their *heterogeneity*, which means that services "differ regarding their quality across time, organizations and people" [cf. 28].

The impact of the IHIP framework during the 1980s and 1990s, is emphasized in detail by Edgett and Parkinson. In the introduction of their article in 1993, where they state: "It is now generally accepted that the marketing of services is sufficiently distinctive from the marketing of physical products to deserve separate treatment. … the majority of scholars now accept that the debate is over." [cf. 5]. These words show that, at least in the marketing discipline, consensus existed regarding a separate treatment of goods and services during this time.

Zeithaml *et al.* (1985) and Edgett and Parkinson (1993) review the literature in order to discover what studies addressed the different characteristics from the IHIP framework [5, 36]. Table 3 shows the number of IHIP related studies identified by only Zeithaml *et al.* (1st column), only Edgett & Parkinson (2nd column) and the overlapping findings, mentioned by both of them (3rd column). [*For detailed information regarding their findings please see the original work by both authors*].

Table 3. Synthesis of studies dealing with IHIP between 1963-1993 (adapted from [5, 36])

Period	Number of findings Zeithaml *et al.* (1985)	Number of findings Edgett & Parkinson (1993)	Number of joint findings
1963-1973	1	5	3
1974-1978	6	5	12
1979-1984	11	31	12
1985-1993	-	38	-

A critical attitude towards the validity and applicability of these characteristics again brings us back into the debate that was described above: do goods really differ from services? Lovelock and Gummesson [14] argue that this claim only holds for certain types of services, thereby rejecting the IHIP characteristics as a contemporary valid framework. They call for a critical stance, even skepticism towards the framework, arguing that not all characteristics of the IHIP framework are applicable to all types of services, because there are "sufficient exceptions to discredit the claim of universal generalizability" [cf. 14]. Vargo and Lusch argue that due to the inaccuracy of the IHIP definitions and contradictory implications, the IHIP framework fails to delineate goods and services adequately [31]. They argue that "a strategy of differentiating services from goods should be abandoned" [cf. 31]. Hence, in the remainder of this work it is must be taken into consideration that, whether goods and services can be distinguished, is an underlying discussion that has been an important dispute in the past decades. In this respect, an interesting – but of course also debatable - recommendation seems to be the one by Edvardsson *et al.*, who choose to strike a balance between the different opinions: "We should not generalize the characteristics to all services, but use them for some services when they are relevant and in situations where they are useful and fruitful" [cf. 6].

3.2 Implications for the Definition of Services

As a consequence of the debate above, it follows that defining the term 'service' is a complicated task. Not that there is a lack of definitions, on the contrary. Sixteen experts were asked to come up with a definition of service in the research of Edvardsson *et al.* [6]. Although similarities could be identified in the independent responses, for example the keywords 'performance' and 'processes' were mentioned in about half of the responses, it turned out that all definitions were on an abstract level, open to interpretation at an operational level. In fact, almost all experts responded that it does not make much sense to define services in one or two lines. Some authors referred to services as 'deeds, processes and performances', which, in turn, is maybe the best way to describe services, albeit in a very general way [6]. Maglio and Spohrer follow the definition proposed by Vargo and Lusch, in which services are considered to be the application of resources for the benefit of another" [cf. 21]. Although these definitions might relatively well capture the meaning of services, it remains important to keep in mind that the concept of services is hugely debated, and therefore every definition is subject to interpretation within each respective specific context [31].

The next sections will look at how services have become the basis of a whole new perspective in research and business, as represented with phase 3 in Fig. 1.

4 Service Science Perspectives: Service-Dominant (S-D) vs. Goods-Dominant (G-D) Logic

4.1 Resource-Based Definition of Service Logic

In line with the previously sketched debate regarding the role of services, Lusch and colleagues distinguish two conceptually differing logics that might underlie the field of service science [18]. On one hand, there is a goods-dominant logic ('G-D Logic'), on the other hand there is a service-dominant logic ('S-D Logic'). G-D logic is based on the essence "that economic exchange is fundamentally concerned with units of output that are embedded with value during the manufacturing process" [cf. 32]. In contrast, in S-D logic the focus of value creation "moves from the producer to a collaborative process of co-creation between parties" [cf. 32]. As obvious proponents of the second logic, it must of course be realized that the mentioned authors belong to the group of scholars that propose to adhere to the approach where no differentiation is made between goods and services, as explained earlier. This should be kept in mind while reading the next section, where the main differences between the two logics according to Lusch *et al.* [18] are summarized.

G-D logic is mainly based upon an orientation toward so-called *operand resources*: "Operand resources are those that are acted upon; they are static and usually inert" [cf. 18]. Such resources are typically physical [19]. As a result, the production of (tangible) goods with these resources is the main focus of companies, since producing and selling those goods is how value is created. Customers have to be targeted more or less in a one-way direction, through promotion of these goods. Firms have a relatively static view of the world, with linear supply chains, utility-maximizing consumers and profit-maximizing firms [17, 18].

In contrast, S-D logic presumes an orientation toward *operant resources*: "Operant resources are often intangible (e.g., knowledge and skills) and are capable of acting on operand resources and even other operant resources to create value." [18]. These 'human' resources [19] are not inherently valuable in this perspective, but become valuable after application of operant resources: they have to be turned into benefits. This happens under interaction of firms and customers, which are actively involved in transforming the inputs into value.

In the literature, a threefold hierarchical classification among operant resources has been developed by [19]. First, basic operant resources, like for example the skills and knowledge of individual workers, form the building blocks of higher-order resources. Second, composite operant resources, combine two or more basic operant resources, thereby enabling firms to create market offerings more effectively and/or efficiently. Third, interconnected operant resources are similar to composite operant resources, with the only difference that they are based on lower order resources significantly interacting and reinforcing each other. Such interaction enables then additional positive effects for the organization. The rationale behind the hierarchy in general, is that if one moves up in the hierarchy, resources become increasingly connected as well as more difficult for competitors to acquire or develop, which implies that a firm possesses greater potential for sustainable competitive advantages [19]. Fig. 2 graphically represents the overview of the described resources classification under G-D logic and S-D logic.

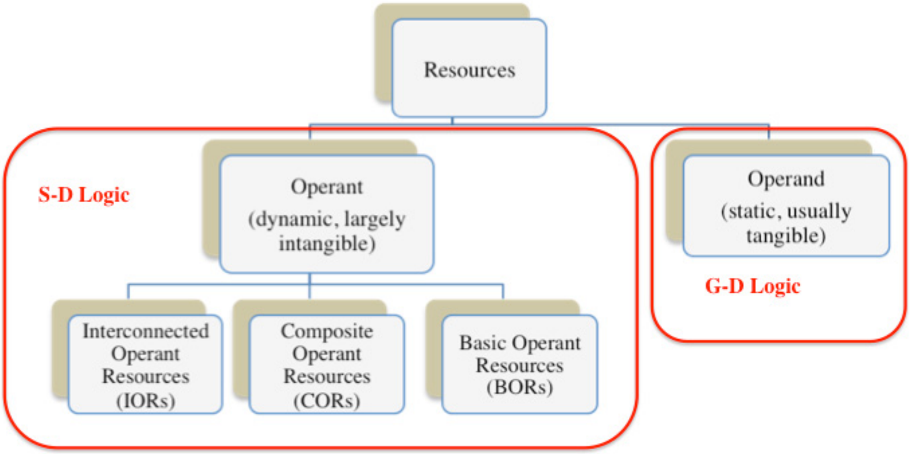

Fig. 2. Schematic representation of the distinction between operant and operand resources (adapted from [19, 33])

Hence, according to S-D logic, the customer is seen as a co-creating collaborative partner of the firm, responsible for the creation of value [17, 18]. Since 2004, S-D logic has become fundamental to service science, serving as its philosophical foundation [20]. Considering the increasing importance of this "emerging revolution in business and economic thinking in the twenty-first century", it is relevant to have a closer look at how this philosophy is used as a foundation in practical research [cf. 21].

4.2 Case Studies of Empirical Applications of S-D Logic

In this section, several examples of empirical applications of S-D logic will be provided. It will become clear that compared to earlier periods, in which service research belonged mainly to the marketing discipline (as emphasized in the introduction), in contemporary science, S-D logic is at the basis of research in a broad variety of disciplines, often synthesizing these disciplines in a creative way [10, 30]. S-D logic and its position and impact within the field of service science are extensively discussed within business and scientific communities, often in a challenging and critical fashion [e.g. 30]. Vargo and Lusch noted 4 years after the initial publication that introduced S-D logic that "there has been a steady stream of special issues, special sessions at leading conferences, dedicated conferences, an edited book with contributions from 50 top scholars, and independent journal articles dealing with various aspects of S-D logic" [cf. 34].

Thus, the remainder of this paper will be finished with a review classifying an exemplary variety of such research that is based on S-D logic, since its foundation was developed in 2004.

4.2.1 S-D Logic, Branding and Networks

Under S-D logic, the function and role of brands might change. Brodie [4] argues that brands are at the basis of value adding processes that are so important in the S-D perspective, thereby contributing to the value perception of the customer. New logic in this field "acknowledges that brand value is co-created between the firm and its stakeholders" [cf. 22]. The brands facilitate and mediate processes that are used for realizing experiences that drive co-creation of value [4]. Hence, branding in this context has to be seen as a dynamic and social process that is stretched over a broad context. As a result, in today's service-based economies, investing into strong branding relationships becomes increasingly important [22].

In general, relationships between social and economic actors are at the basis of networks. Such networks allow for quality interaction (e.g., in the form of high levels of trust), which serves in turn as the key ingredient for successful co-creation of value under S-D logic [9].

4.2.2 S-D Logic and Discontinuous Innovations

S-D logic might also help to explain discontinuous innovations. Michel *et al.* [23] term innovations discontinuous if they (1) change how value is created and (2) significantly affect market size, prices, revenues or market shares. Employing S-D logic to the concept of innovations requires firms to look beyond the traditional focus on value-in-exchange. There are two reasons for this. First, in discontinuous innovations, the role of the customers changes into a co-creator of value. Second, the firm's value creation is changed in the case of discontinuous innovations. Value creation is now based on operant resources (as explained earlier) like skills, knowledge and competencies, whereas the customer acts as an integrator of these resources [23]. Hence, the S-D perspective also influences and changes (conventional) approaches to innovation.

4.2.3 S-D Logic and Coproduced Knowledge

Vargo & Lusch [33, 34] argue that in an S-D perspective, the customer is always co-creating value in an interactional way. At the same time, this jointly created knowledge between companies and customers serves as a fundamental source of competitive advantage [25]. Blazevic and Lievens [3] show how S-D logic can contribute to the management of this knowledge. They investigated the role customers play in knowledge creation, and were able to identify three roles differing in the extent to which knowledge was actively coproduced: customers could act as passive users, active informers or bidirectional creators. Customers are acting as exchange partners for joint knowledge creation in all these three cases, however to a different extent and with different subsequent influences on the innovation tasks and processes [3]. Hence, their research underscores that the coproduction of knowledge, which is typical within an S-D context, occurs in diverse fashions and with dissimilar outcomes. Payne *et al.* therefore stress the importance of knowledge as a key operant resource. A deep understanding of customer experiences and processes is crucial in order to understand the dynamics of successful knowledge co-creation under S-D logic [25].

4.2.4 S-D Logic and Social Construction Theories

Instead of focusing on the value-creation process as such, Edvardsson *et al.* focused on the social setting in which the co-creation of value occurs [7]. In their exploratory study, they applied key concepts from social construction theories to S-D logic. Social construction theories are used to interpret the social world and the behavior of actors within this environment. In the context of S-D logic, this means that by using such theories, understanding about service systems and value creation within these systems can be enhanced [7].

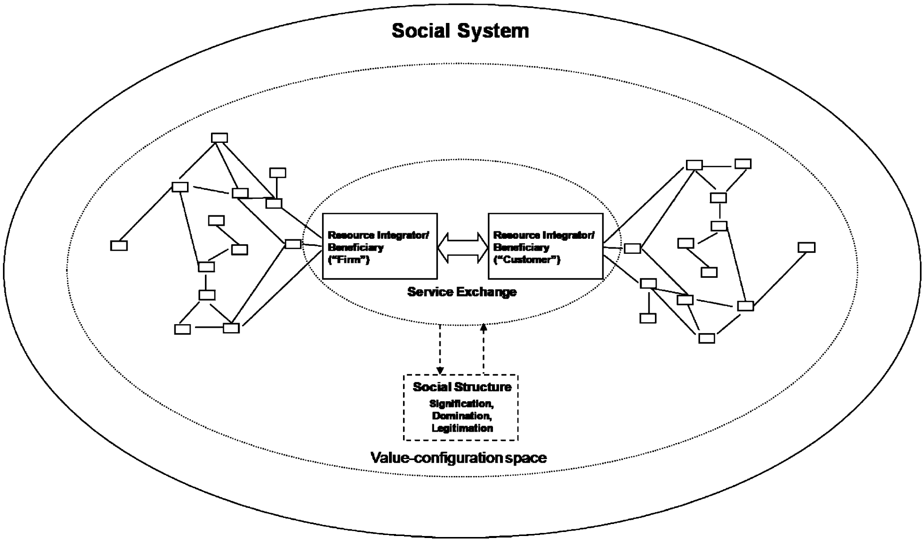

Fig. 3. S-D logic and social construction theories (adapted from [7])

Fig. 3 shows how Edvardsson *et al.* depict this situation. Two actors, the firm and the customer, act as resource integrators that mutually try to create value. Both parties are embedded in wider networks that play an important role in the service exchange, and can be considered as service systems [34]. Because this service exchange takes place within a wider social system, the actors draw upon the rules and resources ('social structures') within this context. Social structures enable and constrain, and hence, influence, the service exchange in an unobservable and implicit way: "Social structures are expressed through the norms, values and ethical standards that guide what is acceptable during interactions between individuals, which has implications for service exchange and value co-creation" [cf. 7]. This shows that consolidating social construction theories with S-D logic might also help to advance knowledge within and understanding of the dynamics associated with service-dominant thinking.

4.2.5 S-D Logic and Logistics Service Value

Successful co-creation of knowledge and mutual development of value propositions, are S-D logic based activities that might help to create logistic service value, according to Yazdanparast *et al.* [35]. The authors specify how, on the basis of S-D logic, logistics practitioners can increase the co-creation of value in such way that it may lead to competitive advantages. It is emphasized that particularly the field of logistics, typically characterized by its dynamically changing service offerings, might benefit from the application of S-D logic theory [35].

4.2.6 S-D Logic and Procurement

In their discussion on the implications of 'servitization' of procurement, Lindberg and Nordin [13] reach a two-sided conclusion when looking at the perspectives of industrial buyers. On the one hand, a clear movement towards S-D logic can be identified, since buyers acknowledge that they are increasingly looking for the purchase of entire solutions rather than only products. On the other hand, a counteractive movement towards objectification of services seems equally apparent: buyers are trying to objectify and (partly) standardize the services they are buying, which is more in line with G-D logic. Hence, regarding the interplay between procurement and S-D logic, they conclude that many buyers are "employing buying behavior that is in line with both kind of logics" [cf. 13].

4.2.7 S-D Logic and Competitive Advantage

Lusch *et al.* [17] also propose to consider economic issues through an S-D lens. They come up with nine propositions about how to achieve competitive advantage on the basis of services. In an environment, in which stakeholders in the market place are viewed as operant resources [17], collaboration and knowledge application are at the ways in which value (and possibly competitive advantage) is created. Value creation is subjective here, and other stakeholders in the market act as co-creators of it. Hence, on the basis of this, they formulate how managers can achieve competitive advantage from an S-D point of view: "…the most fundamental implication is that firms gain competitive advantage by adopting a business philosophy based on the recognition that all entities collaboratively create value by serving each other" [cf. 17] (*for a detailed investigation on operant resources that are important in value creation, see* [19]).

5 Conclusions

S-D logic is posited as an open source evolution [34] that is "always open for further elaboration, refinement and development" [cf. 7] throughout its discourse.

Accordingly, the purpose of this article was to trace back the roots of S-D logic, including the important debate regarding a possible distinction between services and goods, as carried out during the last decades. Subsequently, it was exposed that since 2004, S-D logic has become an emerging foundation in the field of service science.

Besides, the selection of exemplary applications of S-D logic in recent literature given at the end of this work serves as an illustration of how S-D logic is still applied within the field of marketing but also in an increasing amount of other areas.

6 Future Work

Future suggestions and recommendations regarding S-D logic must be grounded in attempts to either *strengthening* its foundations, thereby developing S-D logic as a solid, general theory, or in attempts to *extend* the service-centered mindset, ideally by collecting (further) empirical evidence. The latter advice comprises a sheer endless amount of application areas, as revealed in this paper. To recall, it was already shown that the foundational premises and core assumptions of S-D logic theory were studied in an increasing variety of areas (far beyond marketing), like supply chain management, logistics, (marketing) ethics, procurement, branding, organizational studies, social sciences, policy regulators, etcetera. A complementary shift towards more technical areas like (e.g., e&m-Business, e-Governance, e-Health, IT Service

Systems, Business Services and Processes Management), where co-creation of value plays a central role, might also yield valuable insights. S-D logic possesses the potential to provide a reoriented perspective on the market, for all stakeholders involved [11]. Ultimately, S-D logic might even be able to live up to its extremely ambitious role of, to say it in the words of its creators Vargo and Lusch, "providing a basis for reorienting theories of society and economic science" [cf. 34].

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Appendix A

A Pyrrhic victory is described as 'an objective attained at a too great price' or 'a ruinous goal' [http://combat.ws/S4/MILTERMS/MT-P.HTM, last accessed September 26th, 2011]. The victor reaches the victory at such a devastating cost, that 'it carries the implication that another such victory will ultimately cause defeat' (http://en.wikiped ia.org/wiki/Pyrrhic_victory, last accessed September 26th, 2011]. It refers to the first two battles that King Pyrrhus of Epirus (c. 318 – 272) fought against Roman domination, thereby losing such a large number of men that it ultimately led to a loss – instead of a victory – of the war (http://ancienthistory.about.com/od/pspzterms/g/PyrrhicVictory.htm, last accessed September 26th, 2011].The term Pyrrhic victory is used as an analogy in many fields (e.g. literature, law, politics, business) to describe equally ruinous struggles for the victor (http://en.wikipedia.org/wiki/Pyrrhic_victory, last accessed September 26th, 2011].

Modeling Value Creation and Capture in Service Systems

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Abstract. In service-dominant (S-D) logicvalue is viewed as being co-created between companies, customers, and other actors within a service system. In order to understand how service systems maintain their viability and competitiveness, two fundamental questions should be addressed: "how is value created for and with the customers in service systems?" and, "how is the value captured by the service provider in service systems?". The first question deals with "value creation" while the second addresses "value capture"in the "service value equation". The extant research mainly focuses on the service design from the value creation perspective. Thereby, there has been little discussion about suppliers' value capture and its trade off with value created for and with service customers. In this paper, adapting a holistic perspective, weintroduce a modeling framework that can assist in the understanding and the analysis of value creation and capture and their interplay in service systems. We illustrate the applicability of our framework by conducting a descriptive case study of the value creation and capture in Amazon service system in the period between 1997-2001.

Keywords: Amazon.com,modeling framework, service-dominant (S-D) logic, service systems,value capture, value creation.

1 Introduction

Services are considered as the main source of value creation and growth across global economy, and they are increasingly complex and knowledge-intensive [1, 2]. The introduction of "service-dominant (S-D) logic"[3, 4], can be considered as a recent perspective that attempts to view and extend the concept of service beyond a "particular" kind of intangible good as traditionally viewed in the "goods-dominant (G-D) logic". This new perspective, conceptualizes a firm's offerings not as an output, but as an input for the value-creation process. Thereby, instead of viewing value as being created within companies, value is increasingly viewed as being co-created between companies, customers, and other actors within a service system. The co-creation of value in service systems has recently received increasing attention across several disciplines (e.g. [5-9]).

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In order to understand how service systems maintain their viability and competitiveness, two fundamental questions should be addressed: “how is value created for and with the customers in service systems?” and, “how is the value captured by the service provider in service systems?” (for discussion, see e.g. [5,10-12]). In the search for understanding such questions, the extant research has developed value modeling frameworks such as[7, 8, 13, -16] that provide conceptual tools to support service design. However, such tools and framework mainly address the service design from the service customers’ perspective and thereby there has been little discussion about suppliers’ value capture in the “service value equation”. The same gap can be broadly identified in the service literature in general, where value creation and co-creation issues have been emphasized over value capture. In addition, the interplay between value creation for and with customers and value capture by the suppliers has not been explicitly investigated in the design and analysis of service offering in service systems.

In this study, we propose a holistic approach that takes into account both value creation (for and with customers) and value capture (by service providers) in order to fully understand and model the new logic of service provisioning process in the S-D logic. To this end, our research aims to provide a modeling framework that can assist in the understanding and the analysis of value creation and capture and their interplay in service systems. We illustrate the applicability of our framework by means of a descriptive case study of the value creation and capture in Amazon.com service system.

In a descriptive case study, the researcher pursues to describe a phenomenon of interest that occurs within the data. This type of research begins with an a priori theoretical perspective. Then, a pattern matching to describe the phenomenon in the data in a rigorous way[17]. More specifically, the descriptive case we conduct can be labelled as aninstrumental case study[18], where we aim to illustrate the applicability of the suggested framework. The case study focuses on one of the services offered by Amazon.com, more particularly; the sales of used and new books in Amazon.com over the period 1997-2001.

We have used data triangulation in order to gather rich evidence on Amazon.com, various aspects of its business model and its service offerings over time. We began the data gathering process in January 2009. Since then, a variety of secondary data sources have been accessed, analyzed and synthesized in order to gain an accurate understanding of diverse facets of Amazon.com’s service offerings and implementation in Amazon Marketplace. Such sources include:

- Amazon.com annual reports between 1997 – 2010 [19]; presentations and news releases [20].
- Books published on Amazon.com such as; [21-23], etc.
- Harvard Business Review (HBR) cases published between 2000 and 2010 such as [24, 25]
- Journal articles such as [26], etc.

While the usage of primary sources has generally been seen as advantageous in getting in-depth evidence, there are several advantages in using secondary sources. For instance, in [27] Ambrosini et al.recently suggested that teaching cases are an unexploited and rich source of data that should be used when primary data is not available. They also suggested that reliability of such data is improved when researchers use reputable sources of teaching cases (we mainly use HBR cases here) and combine it with other sources to attain data triangulation. Analyzing multiple sources of objective and subjective evidence has enabled us to combine evidence in a way that gives an overall understanding of the research topic.

The paper is structured as follows. Section 2 provides the theoretical discussions on value creation and capture. In Section 3, after a brief introduction to Amazon.com we represent the value creation and capture in Amazon.com service system from the perspective of our value modeling framework is mapped onto the theoretical discussions in Section 2. Section 4 includes the related work and in section 5, we present the conclusion and the future work.

2 Value Creation and Capture in Service Systems

In this section, we develop a theoretical framework examining value creation and capture in service systems. The underlying logic of the framework is based on the economic approach to value creation and capture [10, 28, 29]. In the following, we first discuss the tenets of customer value creation, followed by how such value creation is organized by the service provider's value network. Then we proceed to examine how the service provider eventually captures value. Throughout this section, the definitions and the relations between the concepts are formally represented.

2.1 Customer Value

Concerning customer value in service offerings, it is intuitive to start the analysis from the customer side, since the customer is the eventual locus and the determining party of the value that is created[5]. Customer value has been examined though several perspectives earlier (see e.g.[30]).

In this study, we utilize the definition of Kotler[29], where value perceived by the customer includes both benefit and cost concepts. The benefits consist of functional and emotional benefits. Customer's costs of receiving the value are divided into four categories: monetary costs; time costs; energy costs and, psychic costs. This categorization goes beyond the traditional economic perspectives wherein monetary costs (the price of the service) are only taken into account. In sum, Kotler [29] suggests that the *net perceived customer* value is determined by the overall perceived value (functional and emotional benefits), subtracted by the total costs of receiving that value (monetary, time, energy and psychic costs):

$$\text{Net perceived customer value} = (\text{service benefits}) - (\text{service costs}) \quad (1)$$

Brandenburger and Stuart [28]use the concept of *willingness-to-pay* to conceptualize customer value. Based on their definition, willingness-to-pay is an economic concept, which reflects the overall financial compensation that the customer is willing to pay for a certain offering. It can be stated that willingness to pay of a customer for a service is proportional to service benefits as defined in Kotler's Framework. In [10] Bowman and Ambrosini use *total monetary value* to refer to the willingness to pay of the customer. They also introduce the concept of "consumer surplus" which is similar to the net perceived customer value in the Kotler's framework. Thereby, we can re-define Equation 1 as follows:

$$\text{Consumer Surplus} = (\text{customer's willingness-to-pay}) - (\text{service costs}) \quad (2)$$

In [10], Bowman & Ambrosini argue that customers choose the service that will deliver to them the largest consumer surplus (i.e. net perceived value). In other words, customers assess consumer surplus relative to competing and/or substitute services. Hence, for the analysis and the design of service-specific customer value it is essential that the value attributes of competing services are also taken into account.

2.2 Customer Value Creation Process

In general, a firm always faces a strategic challenge of managing the fit between what it can do and how it creates customer value [31]. According to the established logic of Resource-Based View of the firm (RBV), firms are heterogeneous from each other in the resources and capabilities they possess[32, 33]. Only in rare cases, is a firm by itself able to provide all the resources and capabilities required to create the service offering. Thus, firms utilize *value networks*, where resources and capabilities of various suppliers and stakeholders are integrated in order to efficiently and effectively organize the activities required to create and deliver the offering to the customer [34, 35].

In practice, not all the resources and capabilities are directly utilized in producing the firm's service offering and therefore only certain resources and capabilities can be linked to or mapped onto[10]. In our framework, we refer to the manifestations of such resources and capabilities as *service components*. Thus, service components are a sub set of the resources and capabilities of the service provider and its value network (see relation 3). Service components only describe the contents of the service and are more of practical concerns for the service provider to organize based on the customer's requirements. Thereby, service components are expressed in service provider's words and vocabulary.

Service components $\subset$ Resources and capabilities (of the service provider and its value network) (3)

Service components create some emergent properties for the service that can be noticed by the customer. We refer to these emergent properties as *service features*. Service features are created by the service provider by means of the service components that are designed and embedded in the service offering. Service features determine the perceived customer value through various value attributes (see[30]). Value attributes are the phrases the customers use to express the perceived benefits and costs of the service. Thus value attributes are expressed in customers' terms.

Service components (of service provider and its value network) $\Rightarrow$ Service features $\Rightarrow$ Service value attributes (of service customer) (4)

For instance, in the case of an e-commerce company such as Amazon.com, "credit card processing" is a service component that creates the service feature "online payment". The customer's perception of the benefit s(he) receives from this service feature is expressed in the value attribute "payment is easy". This value attribute increases net perceived value (i.e. consumer surplus) by reducing the energy and time costs of the service customer who wishes to obtain the service (see Equation 1). More instances are shown in Section 3. By identifying the link between a specific resource and a specific offering, the value can be optimized for both the service provider and the customer [10, 36].

2.3 Service Provider Value Capture

Thus far we have defined customer value and discussed how customer value is created by exploring the link between service components provided by the service provider value network, service features and the value attributes for the customers. In this section, we discuss the economic perspectives on value capture based on[28], where it is suggested that a firm can increase the potential to capture by increasing the price of the service it offers and/or reducing the costs of creating the service. Therefore, it can be stated:

$$\text{Service provider value capture potential} \propto \text{service price} \tag{5}$$

$$\text{Service provider value capture potential} \propto 1/(\text{costs of creating the service}) \tag{6}$$

However, an increase in the price of the service will decrease the net perceived value by the customers or the consumer surplus (see Equations 1, 2) and as a result, the customers may switch to the competing services. Thereby, the service provider can only increase the price when the consumer surplus or the net perceived value of the service remains the same even after the price increase. This can be achieved by elevating the service benefits and thereby the willingness to pay of the customers.

On the other hand, as shown in Equation 6, the price of the service offering is inversely related to the cost of resources and capabilities (i.e. the service components) internally organized by the service provider. We call the costs of the service components provided by the service provider *organizing costs*(see [37, 38]). These costs are comprised of the production costs, related to producing firm's offerings, and the management costs, related to administration, control, monitoring, and incentives in organizing the service components (i.e. resources and capabilities) as defined in[38].

In addition to the organizing costs, the value network includes costs dependent on the suppliers of various independent or jointly provided service components. Following Brandenburger and Stuart[28], we refer to the costs of the service components provided by the suppliers in the service provider value network as *opportunity cost*. Opportunity cost is defined as the financial compensation provided to the suppliers in exchange to the service components they provide to the offering, also taking into account the highest alternative compensation that they could receive from utilizing their resources in other context (ibid.). Thus, the economic rationale of the suppliers involvement in the service system is tied to the opportunity costs of the suppliers in providing certain service components, see Equation 7.

$$\text{Costs of creating the service} = \text{Organizing costs (of the service provider)} + \text{Opportunity costs (of the suppliers in service provider value network)} \tag{7}$$

An important choice for a service provider is to decide which service components to provide itself. This decision is related to the costs and benefits of internal organizing, and has to be balanced against the alternatives of either procuring the same components externally, or executing these activities through partnerships. To sum up, a service provider can increase its potential to create value by reducing the organizing costs and the opportunity costs of providing the service components.

Organizing costs can be decreased by introducing more efficient processes and forms for organizing internal operational and management activities[37, 39]. On the other hand, a service provider can decrease the opportunity cost of the suppliers in its value network by increasing the order size or reducing a supplier's costs of doing business with them [28]. The latter can be achieved through the use of supply chain management systems that facilitate the flow of information between the service provider and the suppliers, as well as increasing the depth and strategic importance of key supplier relationships[40].

3 Modeling Value Creation and Capture in Amazon.com Service System

In July 1995 Amazon.com began as an online bookseller and by September 1995, the company was selling $20,000 per week. After nearly three years as an online bookseller, the company began aggressively diversifying its offerings to include other product categories beyond books, initially adding music, videos, toys, and electronics [21].Such diversifications were followed by the launch of several other stores such as home improvement software and etc. In parallel with such product diversifications, in October 1998, Amazon.com expanded geographically by launching its first international sites Amazon.co.uk and Amazon.de through the acquisition of UK-based online bookstore Bookpages and German-owned Telebook[24]. The rationale behind such diversifications was Amazon.com's strategy of "get big fast" to turn Amazon into the biggest mass merchandiser or E-mall in the online world[22].

Following its evolution from an online bookseller or to an e-tailer by diversifying its product offering through new store openings, Amazon.com extended its business model to become a Third-Party Market Place by launching Amazon Marketplace in November 2000. Marketplace idea was then implemented in Amazon.com's international websites, UK and Germany in 2002, and France, Canada and Japan in 2003.

In the case study analyzed in the paper, we focus on the Amazon.com's evolution from an online bookseller to a third-party Marketplace in the books value segment. From a service perspective, we model the value creation and capture in Amazon.com's transition from selling new books to establishing a partnership with other booksellers to sell used and new books. To this end, first we develop a value model representing the value creation and capture in Amazon.com service systems circa 1997.In order to map our modeling framework to the theoretical discussions in the previous section, and to gain a better understanding of the modeling constructs and notations, we present the model in three parts (that correspond to the three subsections in Section 2) and we explain each part step by step. Finally, we model value creation and capture in Amazon.com service system circa 2001 and we discuss the rationale behind changes in the model in light of the theoretical insights embodied in our modeling framework.

3.1 Modeling Customer Value

The first part of our modeling framework deals with the service value attributes as perceived by the customers. In Figure 2, we have listed a number of value attributes to reflect the perceptions of customers about Amazon.com's online book selling service. While modeling the value properties we always try to preserve the phrases used by the customers, to gain insights to the optimal design of the value creation process.

In Section 2.2 we discussed that a customer assesses a service based on its net perceived value or consumer surplus. The next step is to understand the relative importance of value properties in terms of their impact on the net perceived value (i.e. consumer surplus). As illustrated in Figure 2, we use minuses and pluses to represent the nature of impact (i.e. negative or positive) and its intensity (medium or strong).

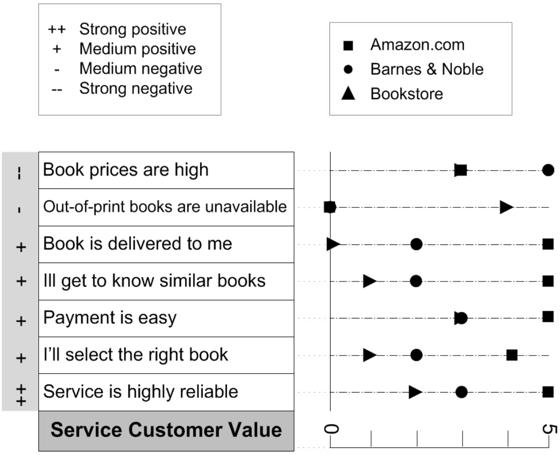

Fig. 1. Modeling customer value

In the case of our example, as it can be seen in Figure 1, the value attributes "payment is easy" and "services are highly reliable" relate to the benefits perceived by Amazon.com customers and are thereby positively linked to the net perceived value. It can also be noted that the impact of the reliability of the services is higher as compared to other value attributes. On the other hand, "book prices are high" and "out-of-print books are unavailable" are linked to the costs and concerns and thus decrease the value perceived by the online book buyers. The intensity can be interpreted in the same manner.

Information on customers' perception and their relative importance can be gathered through direct interaction with customers or customer surveys. Revealed preference methodologies [41] can also be used to understand customer's needs and preferences based on their behavior. In this paper, the information provided on the value attributes the Amazon.com customers perceive and their relative importance has been gathered through the secondary sources outlined in Section 1.

Finally, as already discussed in Section 2.1, it is important to identify the strategic positioning of the service provider by understanding where the provider is standing relative to the competition. Comparing the service to the offerings of the competitors assist the service provider in identifying the service improvement opportunities as well as analyzing whether delivering the perceived value attributes results in a competitive advantage. In our example we compare Amazon.com, Barnes & Noble and the Bookstore with respect to the value attributes listed in the model. By Bookstore we refer to small and independent bookstores that were not a part of the book superstores or chains such as Barnes and Noble or Borders. As illustrated, Bookstores were doing better in the price and availability of out-of-print books. Bookstores superiority in these two value dimensions was mainly due to selling used books.

3.2 Modeling Customer Value Creation Process

The previous section focused on identifying service improvement opportunities through the analysis of value attributes and their impact on net perceived value as well as the strategic positioning of the service. Now, the challenge would be to design the value creation process incorporating the improvement opportunities. This design question is addressed in this section.

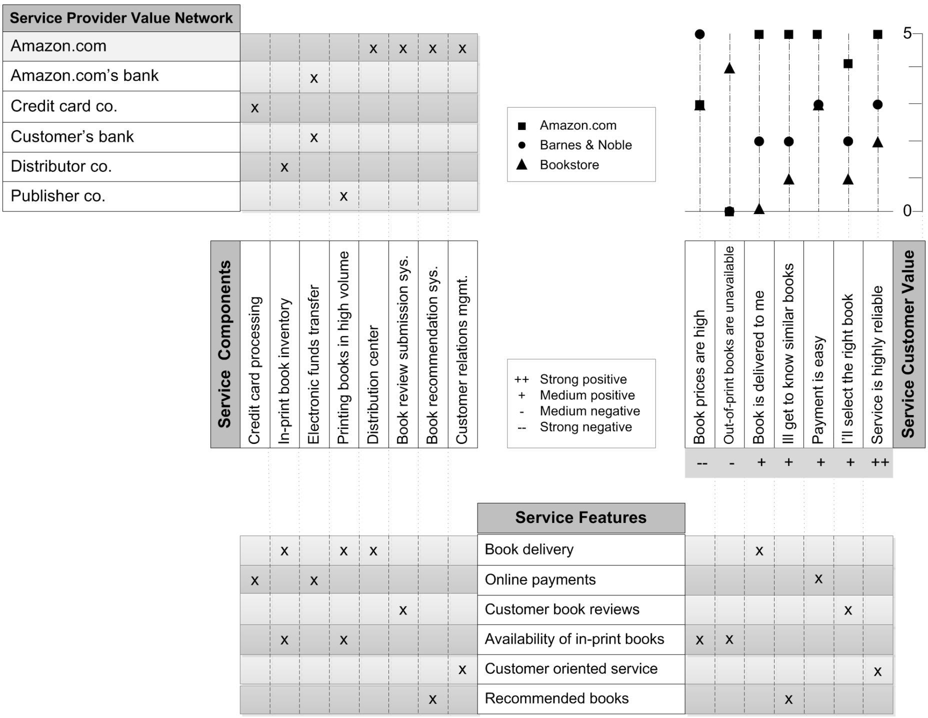

Fig. 2. Modeling customer value creation process

Figure 2 illustrates the value creation process in Amazon.com service system wherein we model the service features created by the service components that are provided by the service provider and its value network and their corresponding value attributes. In the model, we put an X to map the service components to service features and service features to the value attributes. More concretely, we can see that for instance, Amazon.com provides the service component “book recommendation system” which creates the service feature “recommending books” that is linked to the value attribute “I’ll get to know similar books”. Similarly, the Distributor Co. holds an “in-print book inventory” that creates the feature “availability of in-print books” which pertains to the value attribute “the book is delivered to me.”

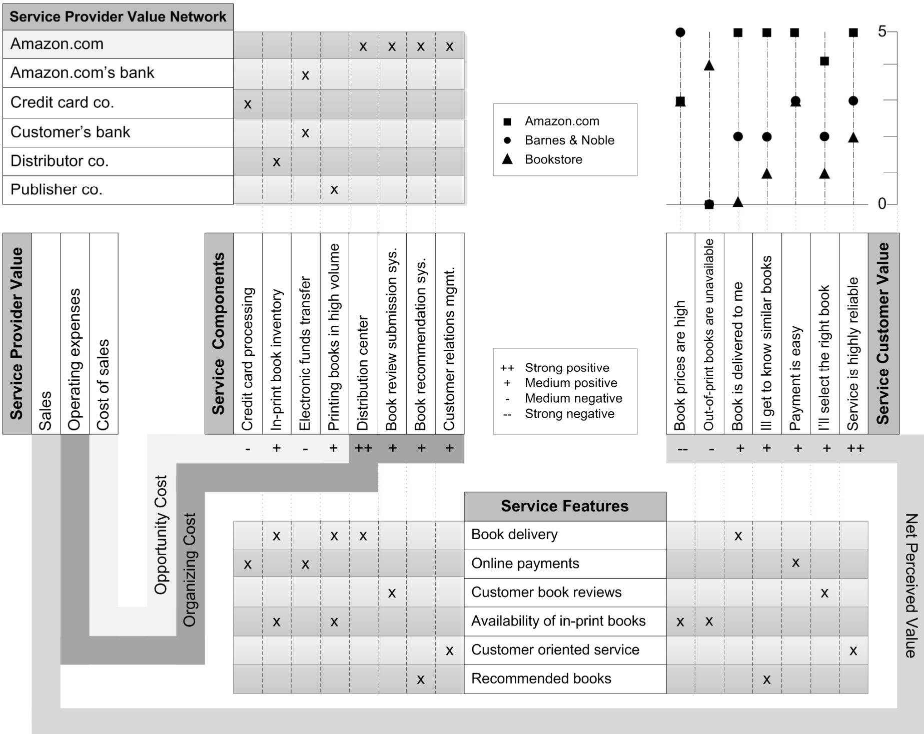

Fig. 3. The overall modeling framework, representing value creation and value capture in Amazon.com service system circa 1997

3.3 Service Provider Value Capture

In Section 2.3 we explored different choices available to service providers to increase their potential of value capture. As discussed service provider’s value capture potential is positively linked to the net perceived value of the customers and negatively correlated with the organizing cost of service provider and the opportunity cost of the suppliers in the value network. To model the *concepts* of net perceived value, opportunity cost and organizing cost we invoked the following three *constructs*: net sales; cost of sales and operating expenses.

We define these three indicators based on the definitions in the Amazon.com's annual reports 1997 – 2010[19]. As our study focuses on the book segment of Amazon.com's business, we modify these definitions to match the scope of our analysis.

- *Net sales* are composed of the selling price of books by Amazon.com, net of returns, as well as outbound shipping and handling charges.
- *Cost of sales* consists of the purchase price of the books sold by Amazon.com, inbound and outbound shipping charges to Amazon.com, packaging supplies, etc.
- *Operating expenses* comprise; marketing and sales expenses (i.e. advertising, promotional and public relations expenditures including the related expenses for personnel engaged in marketing, selling and fulfillment activities. Product development expenses, and general and administrative expenses (i.e. payroll and related expenses).

Figure 3 depicts the overall modeling framework. As illustrated, we link the service components to the cost of sales and the operating expenses. More specifically, to represent the organizing and opportunity costs, the service components provided by Amazon.com are linked to the "operating expenses" and the service components provided by the suppliers in Amazon.com value network are connected to the "cost of sales". On the service customer side, the net perceived value connects to the net sales. Hence, the service components and the service value to the adopter can positively and negatively affect the service supplier value (See Equations 5, 6).

In 1997, books could be acquired from publishers or from a network of distributors. Both the publishers and the distributors had very high opportunity costs. Months before publishing a book, the publishers should determine the number of copies they intend to print. Publishers could not come up with an estimate before negotiating a deal with the booksellers that grant the booksellers the permission to return the unsold books. In 1994 for instance, 35 percent of the 460 million books shipped by the publishers were returned to them. The distributors, on the other hand carried around 500,000 titles in their inventoriesto ensure they met the demand[22]. Moreover, Amazon.com was also suffering from its high organizing costs that were mainly related to managing its huge distribution centers.In November of 1997 Amazon.com opened up its second distribution center. The 200,000-square-foot state-of-the-art Delaware distribution center, the length of three football fields, together with the expansion of its Seattle distribution center, drastically increased the operating expenses.

In the late 1990s, Amazon.com's value capture potential had decreased, mainly due to:high opportunity costs of publishers and distributors; high operating expenses of its operations, and the attributes reducing the net value perceived by its customers (see Figure 3.). This reduction in the value capture potential had placed Amazon.com on the brink of bankruptcy. As a matter of fact, by the summer of 2000, Amazon's stock price had dropped by more thantwo-thirds and by the end of 2000, was down more than 80% of the beginning of 2000. Wall Street speculated that Amazon would file for bankruptcy or that another companywould buy it. Analysts assert that if Amazon had not been able to borrow $680 million in February of 2000, it would have run out of cash and gone bankrupt [24, 25].

3.4 Value Creation and Capture in Amazon.com Service System Circa 2001

In November 2000, Amazon.com introduced its new service offering, Amazon Marketplace. In the online book value segment, Marketplace allows bookstores to sell new, used (including out-of-print books) on the same page that Amazon.com sells its new books. This side-by-side placement dramatically expanded the book selection available to the book buyers by enabling them to choose between new and used books from multiple booksellers including Amazon.com on one single store [22]and thereby, as illustrated in Figure 4, led to an increase in the value perceived by the customers by expanding the titles available.

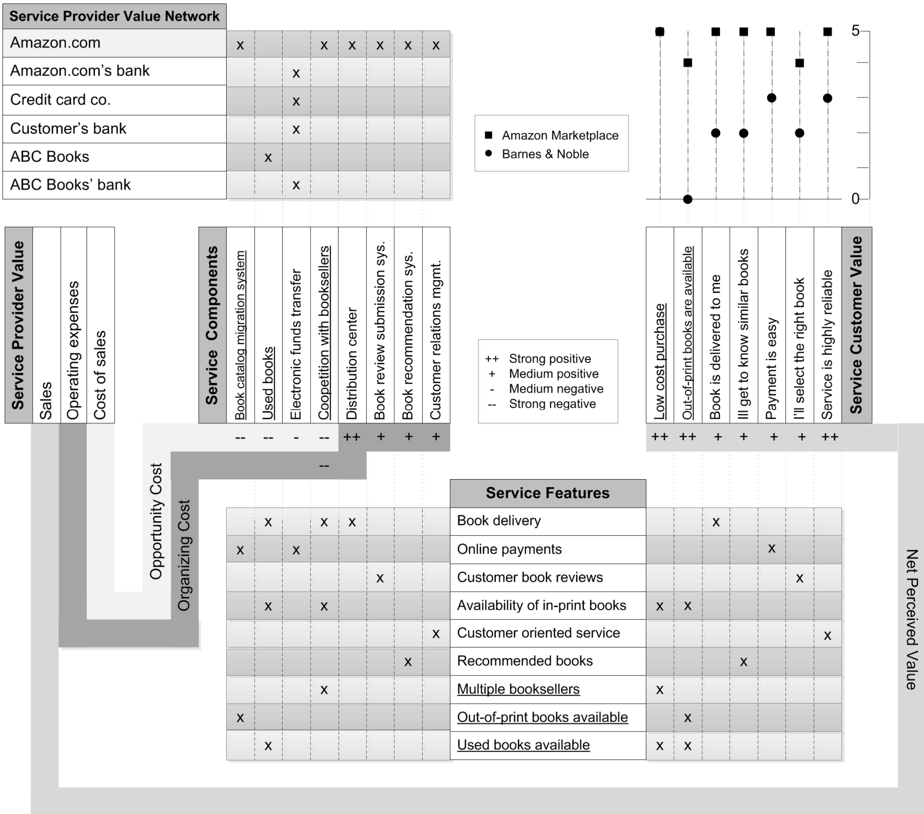

Fig. 4. The overall modeling framework, representing value creation and value capture in Amazon.com service system circa 2001. The changes to the model in Fig.3 have been underlined.

By launching the Marketplace services, Amazon.com put itself in a head-on price competition with the bookstores to win over customer orders. The CEO of the company, Jeff Bezos expresses his opinion about Amazon.com's coopetitive (simultaneous ly cooperative and competitive) strategy in Amazon Marketplace in the following way:

"….in 2000 we invited third parties to compete directly against us on our "prime retail real estate"—our product detail pages. Launching a single detail page for both Amazon retail and third-party items seemed risky. Well-meaning people internally and externally worried it would cannibalize Amazon's retail business, and—as is often the case with consumer-focused innovations—there was no way to prove in advance that it would work. However, our judgment was simple. If a third party could offer a better price or better availability on a particular item, then we wanted our customer to get easy access to that offer."[20].

Due to this competitionboth Amazon.com and the bookstores had to think out ways to decrease their organizing costs so that they can offer the book at the lowest price possible in order to win the customer order. As the book prices decreased, the net value perceived by the customer increased. In Figure 4, this is represented The strong negative relation between "Amazon.com's coopetition with booksellers" and Amazon.com's organizing cost and bookstores' opportunity costs.

Amazon Marketplace enables sellers to utilize the e-commerce services and tools to present their products alongside Amazon.com's on the same product detail page on Amazon.com's website pursuing what Bezos phrased as "single store strategy". To realize this single-store strategy, by adapting a coopetitive strategy, Amazon.com provided third-part sellers with automated tools to migrate their catalogs of millions of used and out-of-print books onto the new single product pages inside the Amazon books tab and thereby, reducing the bookstores' opportunity cost by decreasing their costs of doing business with Amazon.com. More importantly, the Marketplace created the opportunity for the bookstores to merchandise their products on the highly trafficked web pages that historically had sold only Amazon products. This, in effect, would mean higher volume of orders and thus lower opportunity costs for bookstores (see Figure 4).

The Marketplace led to the generation of significant business and thereby considerable increase in net sales and gross profit helping Amazon.com to offset operating expenses and sales costs and achieve profitability in 2003 for the first time after its establishment. The Marketplace was the major factor behind Amazon.com's profitability. Amazon reported that third-party transactions accounted for 20% of its North American units sold in the second quarter of 2002[25].

4 Related Work

e3Service [42] is a method for semi-automatically reasoning about matching service offerings with service adopter needs. In order to make this semi automatic reasoning possible, e3Service assumes that the service adopter and service supplier share the same ontology, that the service adopter specifies her needs in the same vocabulary as the service supplier specifies its offering. We precisely avoid making this simplifying assumption. This comes at the cost of enormously complicating automatic or event semi-automatic reasoning with the benefit of models that more accurately reflect reality. Also, e3Service defines the value of a service only from the point of view of the service adopter.

House of Quality [43]is an improvement method, in which the main modeling artifact is very similar to the modeling framework presented in this paper. The House of Quality was derived from Quality Function Deployment (QFD), a method that was developed by Japanese companies to improve manufacturing processes for greater service adopter satisfaction. House of Quality is, therefore, more geared toward manufacturing processes.

Strategy canvas [44, 45] is a diagnostic framework for strategy development. It allows an organization to visualize the competitive factors and the current state of play of those factors within a market place and to compare the organization's offering with those of the industry in general.

The Business Model Canvas [16]is a strategic management tool, which assists in the development of new and improvement of existing business models. The canvas includes the nine blocks of a business model: key partners; key activities; key resources; value propositions; customer relationships; channels, and customer segments. While Business Model Canvas discusses all the building blocks of a business model it does not provide a holistic view where the interplay and the linkages between the building blocks are modeled.

Value model in this paper is an extension to the SAR (Supplier Adopter Relationship) diagram in [46 – 48]. The SAR is a part of the Systemic Enterprise Architecture Methodology (SEAM) [49]. In [46], the authors present a value modeling technique based on Vickers' appreciative systems framework.

5 Conclusion and Future Work

In this paper we proposed a modeling framework to conceptualize and represent value creation and capture in service systems. Our framework is theoretically grounded in economic approach to value creation and capture. We illustrated the usability of our framework by modeling value creation and capture in Amazon.com service system circa 1997 and 2001. By applying our modeling framework we demonstrated how, in a matter of a few years, Amazon.com managed to move from the brink of bankruptcy to become a world-class e-tailer with the biggest online store.

Our future work will focus on validating the modeling framework by applying design and analyze value creation and capture in a service system.

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Commitment-Based Modeling of Service Systems

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Abstract. This contribution presents an ontological model of services that describes them as complex temporal entities, constituted by interrelations of states, actions and processes, occurring in a wider service system. Our aim is to establish rigorous ontological foundations for the various basic notions of service science, including service, service system, service process, service system life-cycle, and service value co-creation. A crucial role in our approach is played by the notion of commitment, which allows us to provide a definition of service as generic commitment to guarantee the execution of value co-creation actions.

Keywords: service science, service system, ontology.

1 Introduction

In an earlier paper [1], we presented some first ideas concerning the ontological analysis of the notion of service. As observed in [2], however, such work was mainly focusing on the IT literature, and omitted fundamental conceptual links to the theoretical foundations of service science, namely the Service Dominant Logic approach, originated by [3]. We present here the most recent evolution of such early work, which includes a discussion of the notions of service, service system and value co-creation, which are at the basis of the S-D logic.

In [1], our first ontological claim was that the classic distinction between goods and services can be explained by observing that services are entities occurring in time, while goods are entities lasting in time. In other words, services are (complex) *events* (in the most general sense of this word, which includes in particular static events), while goods are (complex) *objects*. As acknowledged by [4], this is in line with the S-D logic, which adopts the 'service as process' view. Indeed, in [5], the authors clarify that a service is "a *process* of applying resources for the benefit of another".

In our view, it is exactly the temporal nature of services which explains why they are radically incompatible with goods: objects and processes (or events, in the most general sense of this term) are just two disjoint ontological categories. Objects *participate* to events, but are disjoint from them [6]. In our paper, we also discuss how this ontological analysis explains Hill's distinction [7] between

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goods and services, based on the fact that services are transactable but not transferable; we understand however that such discussion has little relevance in the S-D logic, since it is still based on the G-D view.

Despite this agreement on the basic ontological category to which services belong, and our positive attitude to the radical shift of perspective proposed by the S-D logic, the notions of service and service system as defined by the recent S-D literature still present relevant ontological and terminological problems. Indeed, from the business point of view, we agree very much with the spirit of Alter's observations in [8], and we find his list of "common examples for services" (such as an Internet search engine, an ATM cash dispenser, an emergency service, or a garbage collection service) a very good rough test to verify what people mean when they use the word "service". Our ambition is to provide a formal definitional framework that, while grounded in rigorous ontological distinctions, yet reflects as much as possible the everyday business language, without imposing unnecessary radical changes in the way people talk (although possibly changing a bit the way they think). In the following, we shall first discuss some of the most crucial terms introduced in the S-D literature, and then we present our own model.

Tension between Microscopic and Mesoscopic Level. A first difficulty we have in understanding the S-D literature is related to the apparent tension between the microscopic and the mesoscopic level of analysis (both considering the time dimension and the number of resources involved). It seems clear that the notion of service is defined at the microscopic level, i.e. at the level of a single value co-creation interaction, while the notion of service system, although also valid in the atomic case, is defined as a dynamic, possibly complex configuration of resources, which has "a beginning, a history, and an end", and "has a unique identity" [9]. But what is the glue that keeps these resources together, guaranteeing the identity of a service system through time? In the everyday speaking, people would say that, throughout its life, a service system produces *the same service*. But it is exactly this generalized, mesoscopic notion of service – as denoting a business activity and not a specific economic interaction – which appears to be lacking in the S-D approach. Our own position, as specified below, is that the glue is a generic *commitment* to guarantee the execution of (value co-creation) actions of a certain kind, according to suitable conditions.

Service as Application of Competences. Independently of the considerations above, Vargo and Lusch's definition of service as "the application of specialized competences (knowledge and skills) through deeds, processes, and performances for the benefit of another entity", although making perfect sense, seems to be inadequate to capture some basic intuitions: according to the latin etymology of the term, enjoying a service presupposes having somebody (the *servus*) at your disposal, ready to do actions for your benefit; in this view, it is not so much the specific action which counts as a service, but rather the commitment to perform some kinds of actions. Consider for instance a telephone company, which provides – we say – *a* telephone service. Within a specific customer contract, we don't say it provides multiple services, but just *one* service, which is *active* even when no telephone calls occur. So in this case the service is not the application of a specific competence, but rather the commitment to perform some actions in a certain way (even independently from actually having the necessary competence).

Service as Value Co-Creation. A further, serious difficulty concerns what seems to be the most recent evolution of service definition adopted by the S-D logic community:

> Services are value co-creation phenomena that arise among interacting service system entities. [10]

We find this definition very confusing. In the marketing science literature, the notion of value co-creation seems to be mainly focusing on the *customer's* value [11], although the emergence of complex value constellations in modern service-based economy is also acknowledged, as shown for example in the IKEA case discussed in the seminal paper by Normann and Ramirez [12]:

> The work-sharing, co-productive arrangements the company offers to customers and suppliers alike force both to think about value in a new way – one in which customers are also suppliers (of time, labor, information, and transportation), suppliers are also customers (of IKEAs business and technical services), and IKEA itself is not so much a retailer as the central star in a constellation of services [. . .]. The result: IKEA has succeeded, arguably, in creating more value per person (customer, supplier, and employee) [. . .]

Now, what is value co-creation in this case? Does it focus on a single value experience (the customer's one), or does it also take into account the supplier's or employee's experience, including the whole value constellation? It seems that Vargo and Lusch have the latter view in mind, when they write:

> Although S-D logic is inherently customer-centric – that is, the beneficiary is considered the determiner of value – value co-creation does not focus solely on the beneficiary. This perspective would neglect to recognize the benefits the firm receives from an exchange. Value co-creation implies that value created through exchange is based on the mutually beneficial relationships among service systems and each system makes a decision for whether or not the result of the exchange is valuable, based on context and experience. [5]

This could also be the view Maglio, Kieliszewski and Spohrer have in mind, when they introduce service science as the study of value co-creation:

> The bank cannot exist without the funds customers store and the customer cannot have the convenience of access through various mechanisms (checking, automatic tellers, bank branches) without the capabilities the bank provides. Value is co-created by the interaction of the two. [13]

Clearly the question arising from the above statement is "who's value?" The bank's value of being able to invest the customers' funds seems to be clearly a result of the interaction process, as well as the customer's value of exploiting flexible payment means. So, it seems clear that a constellation of *values* (plural is crucial here) is (co-)created by the interactions described in the examples above. The point is how the notion of *service* is related to those of *value co-creation* and *interaction*.

Indeed, these interactions are *service exchange* interactions: at the origin of the S-D logic there is Bastiat's idea that people *exchange services for other services* [14], so "Service is at the basis of all exchange" [5] (notice it is service, not value that is exchanged, because value is subjective). Now, each of the two services exchanged implies some value co-creation, but also the overall service exchange results in value co-creation, and such global value co-creation is not a service in itself! If we *define* service just as value co-creation, we have no way to understand *what* is exchanged on each side, and so, for example, we cannot describe how a certain service can be negotiated. So, clearly, a service *implies* a value co-creation process, but it is too simplistic to collapse the two notions, saying that service *is* value co-creation. In other words, the notion of service is necessarily asymmetric, since it focuses on a value proposition on the provider's side and a value experience which is inherently customer-centric, while the notion of value co-creation as emerging from interaction processes is clearly symmetric (unless we eliminate the ambiguity saying "*customer's* value co-creation").

Service System Boundaries. Finally, a further concern is the notion of service system. The simple question is: is the customer part of the service system? If the customer is involved in value co-creation, the obvious answer should be yes! Otherwise, if a service system is just one party of the service interaction, how does a service system differ from a system? Yet, according to the leader proponents of service science [9], service systems are just, as observed by Alter [8], "complementary components of economic exchange". We find this view in contradiction with the very basic assumptions of the S-D logic for the reasons above, and we share Alter's concerns regarding its understandability and practicality. In our opinion, Alter's notion of work system is much more useful to clarify what a service system is. In particular, we find the idea of considering a single person as an atomic service system very strange and unintuitive. In our view, a single individual can be *part* of multiple service systems, depending on responsibility patterns (commitments) which may appear or disappear at different times. For example, the same person could be involved in different service systems (as a worker and as a volunteer).

2 A Commitment-Based Service Model

Starting from 2008, we have begun to explore the ontological assumptions behind the notion of service [1,15,16]. The initial motivation behind our approach was to develop an ontology of services suitable to be used in the e-government domain, where interoperability is particularly crucial, and multiple understandings of the word 'service' co-exist. By looking at the computer science literature, it was immediately evident that most of the available models adopt the *black box view* of services, describing them as transfer functions from an input to an output state, with a strong focus on the external service interface. Under this view, the internal details concerning *how* the service is performed are kept hidden, despite their relevance from the business point of view. Business applications need not only specify what the service does, but also how the service is performed and when the various processes involved in a service occur. Moreover, contracts and service level agreements need to refer to internal and contextual details (i.e., how the service interacts with its environment). In other terms, one needs to be able to look both *inside* and *outside* of the box, i.e., we need to adopt a *glass box view*, where the box is in this case, as Alter (cf. [17,18,19,20]) suggests, the whole service system.

However, adopting a glass box view to model a service system forces us to face some fundamental questions: what is there inside the box? What's the difference between a service system and a service? And what is a service, after all? Our main contribution is that a service — as opposed to a good — always develops in time, i.e, it has an essential temporal nature: ontologically speaking, services are complex *events*, while goods are *objects*.

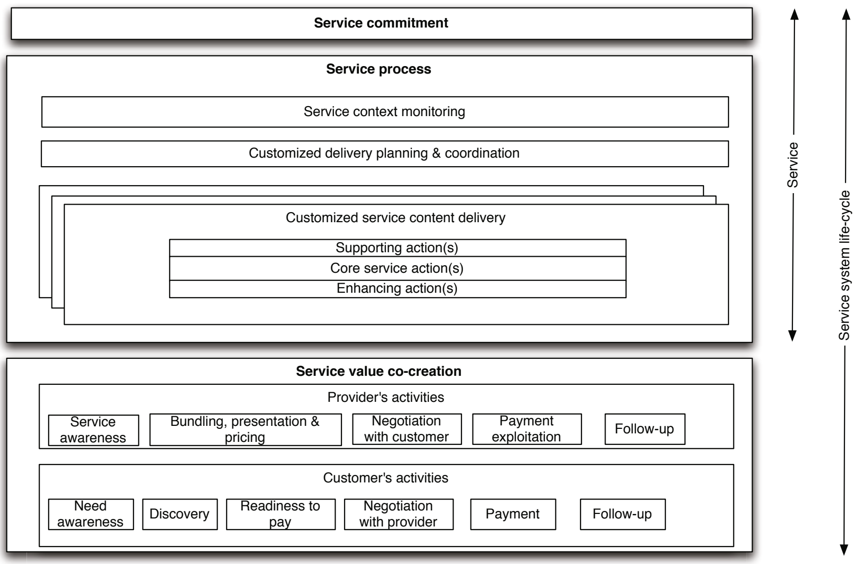

Fig. 1. Service and Service system life-cycle

The internal structure of a service, as well as its relationship with the broader service system, is depicted in Figure 1, which is a revised version of a similar figure presented in [1]. The picture clarifies Alter's idea of the service system life-cycle, presenting it as a complex temporal entity involving three main components, that are necessarily always present: the Service Commitment, the Service Process, and the Service Value Co-creation. In terms of the DOLCE [6] ontology of temporal entities, the Service Commitment is a *state*, holding as long as the provider is willing to offer the service; the other components are dynamic *processes*, involving a number of different activities. An ontological dependence relation holds between the service commitment and the service process, in the sense that the latter cannot exist without the former. The interplay between service commitment, service process and service as a whole is described by the following informal definitions, adapted from [1]:

A ***Service Commitment*** is an agent's explicit and enduring commitment to guarantee the execution of some type of *core actions*, on the occurrence of a certain triggering event, in the interest of another agent and upon prior agreement, according to a certain specification (*service description*) which constrains the way service actions will be performed. We see an agent's commitment as the state resulting from an act of engagement to assume an obligation for a specified period in the future. In such period, the agent is in the commitment state. In most cases, two kinds of service commitment need to be distinguished: a *generic* commitment towards potential customers, whose service description is intended to facilitate service discovery, and a *specific* commitment towards a particular customer, where the service description takes the form of a binding *contract*, resulting from a negotiation process.

There are important differences between generic and specific commitment. Generic commitment is a state resulting from an act that is in a sense unidirectional, as it does not imply an explicit agreement. As generic commitment is directed towards a generic, potential customer, it is not strictly speaking binding for the provider. Until there is at least one specific, actual customer, the provider cannot be directly sanctioned for not having respected his or her commitment. So not honoring a generic commitment can obviously result in a loss of credibility or reputation, but not in a direct sanction. The content of generic commitment is the service description, i.e. a description of the types of action that will constitute the service process, including constrains on such actions and possibly also on the type of customer whom the service is addressed to. For commercial services such description can be assimilated to the service offering.

Specific commitment, on the other hand, is the state in which both the provider and an actual customer are after a mutual agreement, most of the times consisting in the signature of a contract. The contract describes how the service will be implemented for the individual customer, so normally it specifies the service description in more detail. Two relevant differences with the generic commitment are given by the fact that the contract commits both parties, not only the provider, so it is the result of an agreement with a greater binding power, whose violation usually entails a sanction, that may be described in the contract itself.

Service Process is the actual implementation of a service commitment, consisting of a number of interdependent actions including those necessary to monitor the triggering events, the core actions mentioned in the commitment, and any further actions aimed at supporting or complementing the successful execution of such core actions. What actually happens in the service process is partly constrained by the *service description*, and, more importantly, by the contract, which defines and constrains the type of actions that must and/or can be executed in the service process.

Service is a complex temporal entity (a *complex event*)[1] consisting of a service commitment and the corresponding process.

Service System is defined as the mereological sum[2] of all the objects anyhow involved in a service (through a *participation* relationship). In other words, while a service is a complex *event*, a service system is a complex *object*, consisting of all the objects somehow participating to any of the sub-events, processes or states constituting the service: typically, a service system includes the provider, the customers, the resources used to produce the service, and so on[3].

Service System Life-Cycle is a temporal entity corresponding to the dynamics of a service system. So the difference between a service system and its life-cycle is like the one existing between a person and his/her life.

Service Value Co-Creation is a crucial part of the service system life-cycle. It is a complex process involving two symmetric value experiences: the customer's experience accounts for the service's benefits and the corresponding costs on the customer's side, while the provider's experience accounts of provider's benefits and the corresponding costs in implementing the service process. Such value experiences are also events, and, altogether, service value co-creation is also ontologically dependent on the commitment. Note that service value co-creation is not part of the service itself, since it involves activities occurring at the customer's side: it is rather part of the service system life-cycle.

In our opinion, it is necessary to distinguish service value co-creation from both service commitment and service process. It should not be considered as equivalent to service process, first because value is in part produced by the interaction between service and the surrounding environment, and also because the service execution is not by itself sufficient to determine its value.

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1 Generic temporal entities are called *perdurants* in DOLCE, and include *events, states,* and *processes.*

2 We refer here to the notion of mereological sum as defined by Achille Varzi in the entry "Mereology" of the *Stanford Encyclopedia of Philosophy*: "[...] whenever there are some things there exists a whole that consists exactly of those things – i.e., that there is always a *mereological sum* (or "fusion") of two or more parts." [21].

3 To stress that the notion of service system really includes the context it is embedded in, the expression *service ecosystem* might be appropriate.

The more the actual service execution complies with the service description and the specific contract signed, the more the value of a service increases. However, in some specific examples it is not even necessary to have the service executed to determine its value. Take for instance a car insurance service: the customer pays for having someone who guarantees to intervene in case of an accident and arguably he or she hopes that the core actions of the service process are never to be performed. Now let's consider a very familiar example in the services literature: car washing. Relating Figure 1 to such example, the service commitment starts when the car wash owner goes to the chamber of commerce to attend all the bureaucratic practices that are necessary to start the commercial activity. Among these practices, there will be some signed official declaration in which the main features of the service are described. In this description, the car wash owner commits to certain business intentions (to be integrated with the content of the ads he or she publicly posts).

The service process is composed of various events and sub-processes, including the events that trigger the service, e.g., a request by the customer who brings his or her car to the car wash. After the initiating event, we find the customized delivery planning and coordination; here we can imagine that the car wash offers a range of different possible service implementations, such as washing only the outside of the car, cleaning the inside, using particular products such as specific shampoos or waxes, etc. In the customized delivery planning phase, the customer and the car wash personnel agree to all these details.

With respect to the service delivery, the core action is washing the car; singling out supporting actions is a bit harder in the example, as there are many actions that are necessarily preparatory to the service but are not explicitly mentioned as constituting it. For instance, we could say that the activity of removing loose items from the car in order to be able to clean the inside could be considered a supporting action, as well as buying the cleaning products. Enhancing actions are actions meant to augment the value of the service. Here we could think of an additional service that is connected but not strictly included in the service, such as replacing air filters or, alternatively, we could think of a luxury service in which someone picks up the car at the customer's location, takes it to the car wash, washes it and then brings it back. The picking up and bringing back would be in this case enhancing actions.

Finally, all the activities connected to value experiences, including negative as well as positive experiences on both the customer's and the provider's side constitute the complex event of service value co-creation. In our example, negative value experiences on the customer's side include the payment as well as the time spent to drive to the car wash, wait for the car to be washed and drive back, while they include labor and materials used in washing the car on the provider's side. We should not forget that the whole service experience is deeply influenced by all the phases of the service system life-cycle, so for instance, the fact that the car wash was well advertised makes the customer's experience more enjoyable than if he or she had to wonder around the city for hours looking for a car wash.

A UML diagram of our model is shown in Figure 2. There are three main classes: *Service system, Service system life-cycle,* and *Service system description.* The elements of these classes have a different ontological nature (not shown in the figure): service systems and their parts are *objects*, service system life-cycles and their parts are *events* (generic temporal entities), service system descriptions and their parts are *informational objects.* We adopt specific relations to account for the way an object participates to an event, called "thematic relations" in linguistics [22,15]. Typical thematic relations are:

Agent	pointing to what plays an active role in the event
Theme/Patient	pointing to what undergoes the event; the patient changes its state, the theme does not
Recipient/Beneficiary	pointing to what receives the effects of the event
Instrument	pointing to what is used to perform the event

Starting from the center of Figure 2, we see that a service system life-cycle has two mandatory parts, the service itself and the service value co-creation process. In turn, a service has two essential parts: a commitment, and a process that realizes it. The commitment's theme is a *service description* that says what the service is supposed to do. In particular, such description constraints the *core actions* to be performed during the service process. The service description is part of a more general *service system description,* which accounts for the *constraints on service value co-creation* such as (among other things) the price policy and the legal constraints which limit or regulate the service's range of applicability. Participants to the service system life-cycle are all the parts of the service system, including the service system context (for instance the surrounding economic, legal, and social systems) and the various actors, such as the service provider, service customer, service producer, and service consumer[4].

The picture explicitly shows the thematic relations characterizing the structure of *service commitment.* The commitment's agent is the *service provider*, while the beneficiary is the *service customer.* In the car wash example, the service provider is the car wash owner, and the beneficiary is a generic (possible) customer, while the chamber of commerce is, in a sense, acting on behalf of these possible customers. The service description is possibly contained in a document that is stored at the chamber of commerce and includes an explanation of the service. What is written there is what the owner of the car wash is promising to deliver and is what can eventually be handled by the customers in case what was promised is not then realized. In very simple terms, if the description only says that the service merely consists in washing cars, the customer can protest just in case his or her car is dirty after the execution of the service; but if the description specifies, for instance, that only ecological products will be used and the customer finds out that other products are used, he or she can claim that the

[4] We implicitly assume that participation is distributive with respect to parthood, so if the service system participates to the service system lifecycle all its parts do the same.

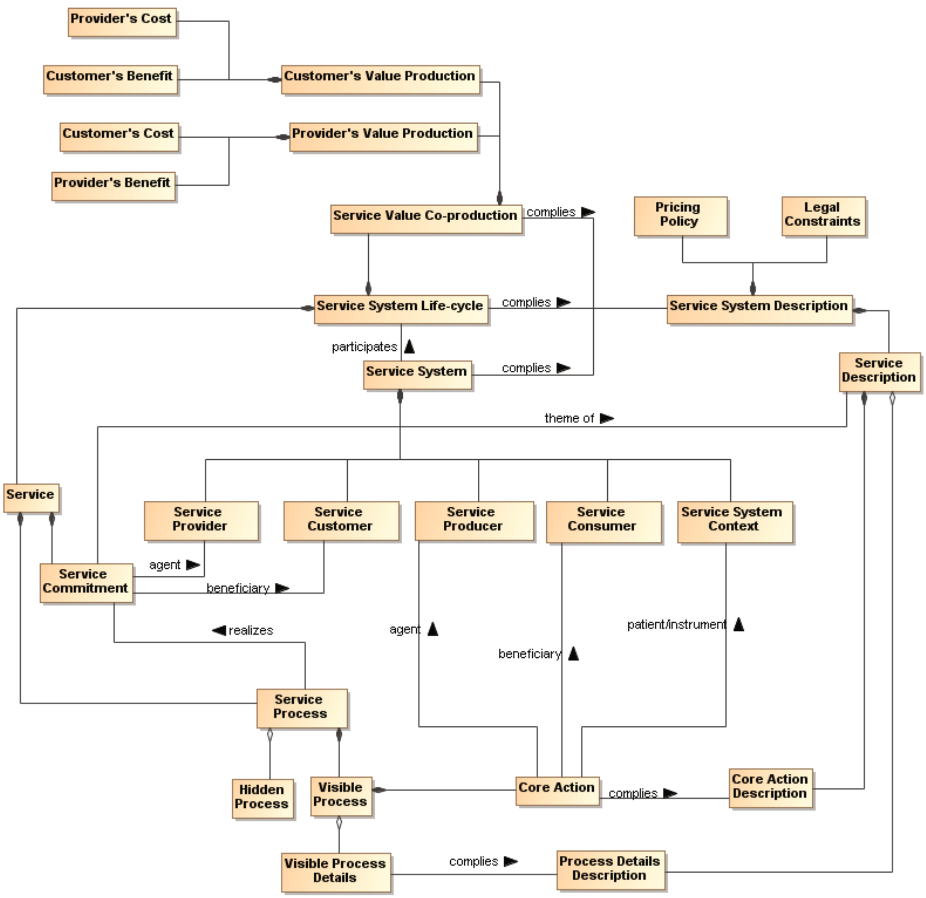

Fig. 2. The Commitment-based Service Model (revised version from [16])

commitment has not been honored. The service commitment has also a duration and location, which are the period and place where the owner guarantees that the service will be available. For the duration, usually it starts the first moment in which the car wash is open and lasts until the activity is ceased, i.e., the car wash will finally be closed. According to the modeling choices, one could decide to restrict the availability of the service to the opening hours of the car wash, but, as usual, this depends on what is written in the service description. In this example the commitment location is not particularly meaningful as it is identified with the car wash location, but there are more interesting examples, such as fire extinguishing, where the area in which the service is active must necessarily be specified beforehand.

The *service process* realizes the commitment, i.e., it is the execution of the actions described in the service description, according to the constraints there stated and is composed of two parts: the visible process (mandatory) and the hidden process (optional); these two can be roughly identified with the front end and the back end processes. The visible process has some mandatory core actions (those that in a sense define the service for what it is, i.e., the core action is what the service fundamentally does) and some optional visible process details[5]. These are usually enhancing or supporting actions, that may equally be visible or invisible. Also, the core action has to comply with the core action description, while the visible process details have to comply with the process details description. The core action description and process details description are both part of the service description (though only the former is necessary). The hidden process does not have a correspondent in the description because it contains all those actions that are performed but not constrained by the description, i.e., the provider is free to perform such actions as he or she wishes since they are not ruled by the commitment.

Note that the core action's agent and beneficiary are the *service producer* and *service consumer*, respectively, who may or may not coincide with the provider and the customer, depending on the kind of service. In the car washing example, the core action is the washing itself, whose agent is the worker who actually washes the car; this may or may not coincide with the owner; the consumer is the guy who goes to the car wash for having the car washed (also this may or may not be the owner of the car: in the former case he or she is also the customer, in the latter case he or she is not, think about someone who goes washing the car that a friend has lent him or her for a period who, though being the customer, is not the final beneficiary, i.e., the consumer).

The duration of the core action coincides with the time that is taken to actually wash the car and the location is again the car wash itself. The instruments here are the water system, the sponges, the brushes, shampoo, wax etc.

Finally, the upper part of Figure 2 describes the service value co-creation process, which is constituted of two symmetric value experiences, as described above. Consider again the car washing. While the physical action is performed, there is in parallel a cost event on the side of the provider, while there is a benefit event on the side of the customer, starting from the time the washing is completed, and lasting for a while. Symmetrically, there is a cost event (a sacrifice) on the side of the customer at the payment time, corresponding to a benefit on the side of the provider. Modeling sacrifices and benefits (negative and positive value experiences) as temporal entities having a non instantaneous duration allows us to account for different kinds of service, depending on how value is produced at different times. So we can say that, for instance, paying for having your car washed is a bad deal if the roads are muddy, so that you can enjoy your car clean only for a short time.

3 Service Life-Cycle and Service Value Co-creation

In this section we will specify the process of service value co-creation in more detail, clarifying how all the other components of the service system life-cycle

[5] Here "visible" and "hidden" refer to the customer's perspective.

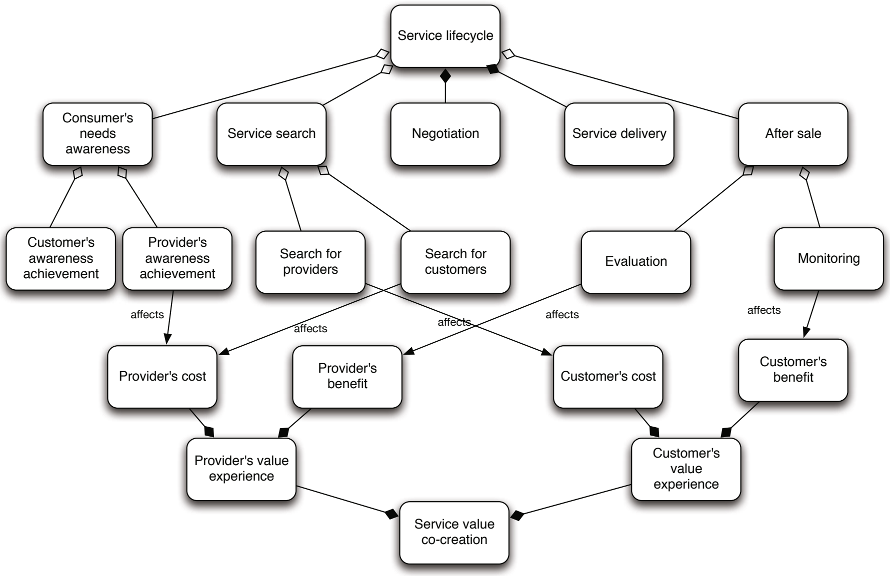

Fig. 3. Service Life-cycle and service value Co-creation

contribute to constitute value, even if intended as partly subjective (the value someone ascribes to a particular experience) and partly socially determined (influenced by trends and practices).

Figure 3 describes the *value co-creation process* composition, showing how the various phases of the service life-cycle contribute to determine costs and benefits, the main components of the value co-creation. The figure should also help in figuring out how value emerges from the interactions between providers and customers, and how these interactions characterize the whole chain of events that constitutes the service life-cycle.

Such life-cycle begins when the premises for instituting a service are created, namely when the awareness of the potential costumer's needs for such a service is achieved. And this can be achieved either by the customer (and this is what advertisement and marketing are for), or by the provider. In this latter case, achieving such awareness of the customer's needs can have a cost for the provider, as he or she may pay for some market studies enabling him or her to understand what the consumers need. It is interesting to notice that, in order for the service to be instituted, it is sufficient that one of the two agents acquires the awareness. Nonetheless, it is necessary that at least one of the two does.

The second phase is that of service search, that can be either search for providers (performed by the customer) or search for customers (performed by the provider). As for the previous phase, at least one of the two is necessary. The agent performing the search affords a cost.

After the search, a negotiation phase follows, in which both provider and customer are involved.

Then there is the service delivery phase, to be intended here as a customized delivery. This is what mainly determines the service value co-creation, i.e. the subjective value that will be ascribed to the service by provider and customer.

Finally, the after sale phase consists on one side of the evaluation of service on behalf of the customer, and on the other side of monitoring activities performed by the provider. The former affects the provider's benefit, as it allows, based on the customer's suggestions and complains, to make the service more valuable and, thus, more profitable; the latter contributes to the customer's benefit, because the provider goes on monitoring the service effects and performance even when it has already been paid for, and the customer may thus be helped with issues emerging afterwards.

Another point to be highlighted here is the relationship between the service value co-creation and the distinction we have introduced between visible and invisible parts of the service process: though it is reasonable to suppose that the commitment mainly relies on the visible process (the front-end), the value co-creation is heavily concerned also with the invisible process (the back-end).

If we go back to consider the service process, and in particular we look at the customized service delivery, there is an interesting similitude, as there we had core actions (that determine what the service is) and supporting and enhancing actions, that contribute to better characterize the service, determining how it is delivered. Similarly, in the service life-cycle some phases are mandatory and necessary to determine the value ascribed to a service, like negotiation and service delivery, while others are in a sense accessories, possibly contributing to determine such value, as consumer's needs awareness, service search and after sale.

As already explained, service value co-creation is part of the service system process, not of the service itself. The components of the service value co-creation, e.g. pricing, depend not only on elements which are intrinsic to the service, but also on things belonging to the service system context, such as laws that regulate the service or particular cultural and social traits that can make the result of a service more or less desirable. Moreover, we have to take into consideration the fact that intuitively we would like to be able to talk about the increase or decrease of the value of a service through time even in cases in which the producer executes actions of the same type. How would these variations in value be possible without considering the whole service system? What happens when the price of a certain service suddenly changes? Probably something in the (economic, social. . .) environment surrounding the service has changed.

It is interesting to notice how both costs and benefits can be expressed in terms of gain or loss of resources and labor. More precisely, costs translate in loss of resources and/or deployment of labor, while benefits translate in gain in resources and/or labor's saving.

In the car washing example, the service life-cycle starts with the consumer's needs awareness, in this case probably identifiable only with the provider's awareness achievement; we can imagine an entrepreneur who wants to start a commercial activity and makes a market survey and discovers that in a place where many cars circulate there are very few car wash services. This activity has a cost for the car wash owner. The other case, that of customer's awareness achievement is very difficult to tackle for commercial services, much easier for social services, where citizens (that can be considered as customers, as tax-payers) may require lacking services for themselves or for other citizens that are close to them.

For the service search phase we can see as providers search the activity that someone that is looking for a service to wash his or her car performs, for instance by looking at yellow pages or over the internet. On the other hand, we can think about advertisement, telemarketing etc. as activities performed by the car wash owner as customer's search. Clearly these latter activities have a cost for the car wash owner, but also the search over the internet and in the yellow pages have a cost for customer in terms of time spent in the search. Sparing some time because the service is well advertised augments the value attributed to the service.

Negotiation in this case can be visualized as the event in which the car wash owner and the customer sit at a table and discuss in order to reach an agreement on what should be paid and what should be delivered (and how).

The delivery phase is in this example when the car is washed and the way in which this action is performed and how much such action complies both with the original service description and with what specified during the customized delivery planning determine the service exploitation and thus how much cost in terms of labor and possibly resources for the car owner and how much benefit for the customer will result. At the same time this also determines the payment and thus the amount of resources (in the car wash case most of the times just in terms of money) that will be transferred from the customer to the car wash owner. As already pointed out, though such amount is mainly determined by the delivery phase, all other phases also contribute in such determination.

Finally, the after sale phase is probably not very common for a car wash service, maybe one could think as something like customer's satisfaction questionnaires as evaluation, something that can help the car wash owner to better understand the desires of his or her customers and eventually to ameliorate the service. More difficult is to think about a monitoring activity, given the short duration of the benefits of the service (even the cleanest car gets dirty after few minutes in the traffic!), but for other services, like car repair, we can think of successive controls of new pieces that have substituted old ones after a repair.

4 Concluding Remarks

Service science is just at its beginning, and a lot of work still needs to be done in order to properly understand service systems, which can be seen nowadays as complex socio-technical systems, where the interactions among humans, technical artifacts, organizations, and norms play a crucial role. We strongly believe that using the formal tools of ontological analysis – i.e., systematically asking yourself questions concerning identity, dependence, constitution, and similar basic notions – can help a lot to come up with well-founded, understandable, transparent models. In the current global crisis situation, achieving such kind of transparency is a key for participated governance and overall resiliency [23].

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Novel Service Discovery Techniques for Open Mobile Environments and Their Business Applications

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Abstract. In open mobile environments, mobile device may be connected to several network system offering heterogeneous sets of services using different names. The services can be anything and introduced by anybody, which results to have the possibility of having similar service with different names or different services having the same name. The current IEEE 802.21 Media Independent Handover Services facilitate handover across these heterogeneous networks. However, the standard just provides network continuity without ensuring service continuity during the handover. We propose extensions to the MIH, which enable the exchange of service information in addition to network information at handover. This service information constitutes the fundament for a novel service discovery capable of discovering equivalent services and enabling the handover between them. In this paper, the extended MIH handover procedure is explained thoroughly. The proposed service discovery system developed on Android is presented and a few use scenarios are given for illustration.

Keywords: service continuity, service handover, service discovery, service continuity business model, service discovery business application.

1 Introduction

In an age of convergence where media, information, service and network technologies are converging mobile phones are no longer terminals strictly tied to mobile telecommunication networks but have also the possibility to connect to data networks like Bluetooth, WLAN, WiMAX, etc. These data networks can be home, enterprise or public networks like airport, train station, shopping center, gas station, etc. The services offered on these networks, although originally different from the mobile networks, are now converging. Indeed, even telephony, a typical telecommunication service, is now offered on data networks using IP technologies. Although perceived as

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equivalent or comparable to the original telephony by the user, it is still technically considered as a different service and service continuity based on the combination of these two telephony services is consequently neglected.

The continuity of the telephony service between the telecommunication and data networks is quite desirable when the mobile phone is moving and the availability of networks and services is changing. To ensure smooth handover between heterogeneous networks, IEEE has specified the 802.21 Media Independent Handover (MIH) Services [1], which provide necessary information about the access networks such as availability, QoS resources, etc. Unfortunately, MIH is only aiming at preserving connections, which is insufficient to ensure service continuity for telephony realized by different technologies. The services are not considered as equivalent and there is no way to replace one service with an equivalent one. Typically, a mobile phone with an ongoing telephone conversation using IP telephony on a WLAN domain will lose this conversation when moving out of the WLAN domain and going into to the mobile network. To ensure service continuity, service information has to be provided to the mobile device in addition to the network information as proposed by the MIH.

In this paper, in order to ensure seamless service continuity across multiple heterogeneous networks the IEEE 802.21 MIH is proposed to be extended with service information and a sound service discovery capable of finding equivalent services in acceptable amount of time. The paper starts with a brief description of the IEEE 802.21 MIH. Next is the explanation of limitations of the MIH concerning service continuity. The main part of the paper explains the proposed extensions to the MIH handover procedure and to the Media Independent Information Service (MIIS). The mobile service discovery system developed on Android is presented and few use scenarios are given to illustrate the effectiveness of the proposed service discovery and matching procedure. Related works are then discussed and finally the paper is concluded with a summary of our research work and suggestions for further works.

2 Overview of IEEE 802.21 Media Independent Handover (MIH) Services

The IEEE standard 802.21 Media Independent Handover Services defines media access independent mechanisms that enable the optimization of handover between heterogeneous 802 systems and facilitate handover between 802 systems and cellular systems.

Fig. 1 shows an example of a network offering MIH services. A multi-access Mobile Node equipped with MIH functionality can connect to multiple Access network i.e. WiMAX, 2G/3G or wired Ethernet 802.3 via multiple Point of Access (PoA) and have access to MIH services at a Point of Service (PoS) provided by the Home MIH Information Server. This server includes an Information Database containing information about networks in the vicinity of the Mobile Network. When travelling the Mobile Node can communicate the visited MIH Information Server to acquire network information necessary for carrying out handover and preserving connectivity.

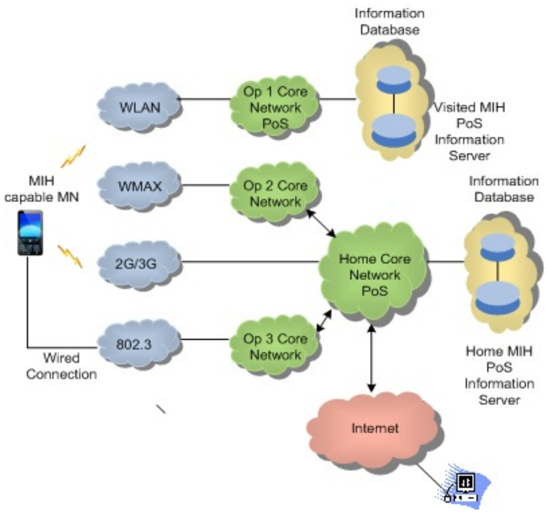

Fig. 1. Example of network model with MIH services

Fig. 2 shows the IEEE 802.21 MIH Function on layer 2 which provides three main services to layer 3 and upper as follows:

- **Media Independent Event Services (MIES)** which detects and notifies changes in link-layer properties.
- **Media Independent Command Service (MICS)** which provides a set of commands for the MIH users to control link properties.
- **Media Independent Information Service (MIIS)** which provides the information about different networks and their services thus enabling more effective handover decision to be made across heterogeneous networks.

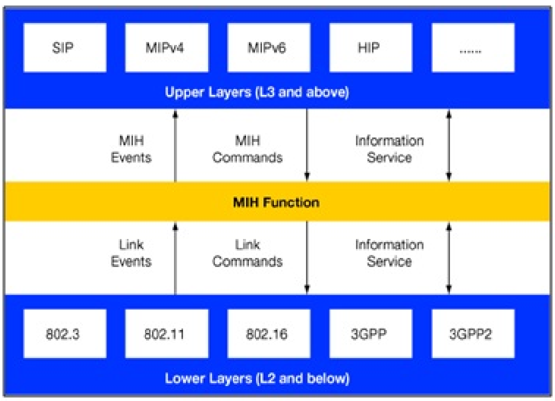

Fig. 2. The IEEE 802.21 MIH architecture

The MIH Function (MIHF) provides services to the layer 3 and upper through a single media independent interface (MIH SAP) and obtains services from the lower layers through a variety of media independent interfaces (media specific SAPs). Instead of having to keep powering up each of its individual radios and establishing network connections for retrieving heterogeneous network information, which causes battery drain, the Mobile Node can have access to the services of the MIHF via well-defined Point of Services (PoS).

3 Problem for Service Continuity and Service Availability

Preserving connectivity is a necessary but not sufficient condition to ensure service continuity. Indeed, it is sufficient only when the connection links are changed but it is insufficient when both the connections and the components realising the service are changing due to the mobility of the Mobile Node. To elucidate this let us consider two service usage cases as follows:

- **Asynchronous Services:** The user is quite used to a service offered by his home operator, called Taxi, which connects him directly to the appropriate taxi dispatch service depending on his location. For example, when being in Oslo the Oslo taxi dispatch service will be connected but the Trondheim dispatch will be used when he is in Trondheim. When being on the move, he runs onto area only covered by WLAN where an equivalent service called "drosje" is available. His favourite Taxi service will be unavailable because no Taxi service is found.
- **Synchronous Services:** The user is having a conversation using GSM telephony and arriving to an area where there is no GSM coverage but only WiMAX coverage. With the MIH support the mobile phone can smoothly switch to WiMAX. Unfortunately, the WiMAX network does not support GSM telephony but offers only an IP telephony service called WiPhone. The Mobile Node does not have any information about the WiPhone and is hence not able to use it. The user's conversation is consequently broken down.

From the two described cases, it is evident that in addition to network information it is necessary to have service information to ensure service continuity.

4 Proposed Extensions to the MIH Handover Procedure

In order to implement the extension necessary for the support of service continuity in the case of handover between two different but equivalent service let us consider the Mobile-initiated handover procedure and identify the steps where addition or modifications are to be done.

The Mobile-initiated Handover Procedure operates as follows:

- **Step 1:** Mobile Node is connected to the serving network via Current Point of Service (PoS) and it has access to MIH Information Server.
- **Step 2:** Mobile Node queries information about neighboring networks by sending the MIH_Get_Information request to Information Server. Information Server responds with MIH_Get_Information response. This information query may be attempted as soon as Mobile Node is first attached to the network.

- **Step 3:** Mobile Node triggers a mobile-initiated handover by sending MIH_MN_HO_Candidate_Query request to Serving PoS. This request queries information of potential candidate networks. It includes queries on QoS resources and/or IP address configuration method supported in the candidate networks.
- **Step 4:** Serving PoS queries the availability of resources at the candidate networks by sending MIH_N2N_HO_Query Resources request to one or multiple Candidate PoSs.
- **Step 5:** Candidate PoSs respond with MIH_N2N_HO_Query_Resources response and Serving PoS notifies the Mobile Node of the resulting resource availability at the candidate networks through MIH_MN_HO_Candidate _Query response.
- **Step 6:** Mobile Node decides the target of the handover and requests resource preparation by sending the MIH_MN_HO_Commit request to Serving PoS.
- **Step 7:** Serving PoS sends MIH_N2N_HO_Commit request to Target PoS to request resource preparation at the target network. Target PoS responds the result of the resource preparation by MIH_N2N_HO_Commit response.
- **Step 8:** When the resource is successfully prepared, Serving PoS sends MIH_MN_HO_Commit response to Mobile Node.
- **Step 9:** New layer 2 connection is established and a certain mobility management protocol procedures are carried out between Mobile Node and target network.
- **Step 10:** Mobile Node may send MIH_MN_HO_Complete request to Target PoS. Target PoS sends MIH_MN_HO_Complete request to previous Serving PoS to release resource which was allocated to Mobile Node. After identifying that resource is successfully released, Target PoS may send MIH_MN_HO_ Complete response to Mobile Node.

To support service continuity the following extensions are proposed:

Step 3: Extension is needed in step 3if the Mobile Node is looking for a particular set of services and the candidate networks must support them.

The primitive MIH_MN_HO_Candidate_Query request has to be modified to accommodate service information, which constitutes one of the criteria for identifying candidate networks. We propose to introduce an additional parameter called QueryServiceList as follows:

```
MIH_MN_HO_Candidate_Query.request (
                    DestinationIdentifier,
                    CurrentLinkIdentifier,
                    CandidateLinkList,
                    QueryResourceList,
                    IPConfigurationMethods,
                    DHCPServerAddress,
                    FAAddress,
                    AccessRouterAddress,
                    QueryServiceList,
                    )
```

The parameter QueryServiceList is the list of services that the Mobile Node is requesting. It has a type LIST(SERVICE) which contains 0 or more services. The data type SERVICE is defined as shown in Table 1.

Table 1. Definition of Data Type Service

Data type name	Derived from	Definition
SERVICE	SEQUENCE(SERVICE_NAME, SERVICE_TYPE, SERVICE_PARENT_TYPE, SERVICE_EQUIVALENCE_CLASS, SERVICE_KEWORDS, SERVICE_DESCRIPTION)	A type to represent a list of service in the access network.
SERVICE_NAME	OCTET_STRING	A type to represent a service name. A non-NULL terminated string whose length shall not exceed 253 octets.
SERVICE_TYPE	OCTET_STRING	A type to represent in which category the service belongs to. A non-NULL terminated string whose length shall not exceed 253 octets.
SERVICE_PARENT_TYPE	OCTET_STRING	A type to represent ParentType of a service. A non-NULL terminated string whose length shall not exceed 253 octets.
SERVICE_EQUIVALENCE_CLASS	OCTET_STRING	A type to represent equivalence services (any EquivalenceClass of the service defined by the Service Provider; it can also be service with the same ParentType). The value is a non-NULL terminated string whose length shall not exceed 253 octets.
SERVICE_KEYWORDS	OCTET_STRING	A type to represent keywords of a service. The value is a non-NULL terminated string whose length shall not exceed 253 octets.
SERVICE_DESCRIPTION	OCTET_STRING	A type to represent the description of a service. A non-NULL terminated string whose length shall not exceed 253 octets.

SERVICE_NAME identifies a service instance. A service instance has a unique SERVICE_NAME but a SERVICE_NAME may be given to several service instances. In a future mobile environment where anybody can be service provider and a service can be anything a SERVICE_NAME will not be standardized and the same name can be used by multiple service providers to denote multiple different services [2].

SERVICE_TYPE identifies the type of the service. As for SERVICE_NAME the SERVICE_TYPE can be ambiguous in a future mobile environment.

SERVICE_PARENT_TYPE identifies parent service type that the current service type is derived from. The SERVICE_PARENT_TYPE is necessary in the service matching when a partial match, i.e. only a subset of features is required [3].

SERVICE_EQUIVALENCE_CLASS identifies the equivalence class that the service type belongs to. This identifier is necessary to enable the usage of multiple languages to denote a service.

SERVICE_KEYWORDS contains attributes that helps narrow the scope of the service matching.

The SERVICE_DESCRIPTION contains information needed to use the service.

Step 4: It is necessary to modify the primitive MIH_N2N_HO_Query_Resources request to accommodate service information. We propose to introduce an additional parameter called ServiceRequirements as follows:

MIH_N2N_HO_Candidate_Query.request (
DestinationIdentifier,
QoSResourceRequirements,
IPConfigurationMethods,
DHCPServerAddress,
FAAddress,
AccessRouterAddress,
CandidateLinkList,
ServiceRequirements,
)

The parameter ServiceRequirements is the service requirements that the Mobile Node is requesting. It has a type LIST(SERVICE) which contains 0 or more services.

Step 5: In this step the list of candidate networks will be returned by Candidate PoS with the primitive MIH_N2N_HO_Query_Resources response and forwarded to the Mobile Node through the primitive MIH_MN_HO_Candidate_Query response. No modification is required for these two primitives but in order to compile the candidate list the Candidate PoSs will have to carry out a service discovery and matching in addition to the standard resource query.

Step 6: To select the target network for handover, the Mobile Node must choose the most appropriate available services and requests resource preparation by sending the MIH_MN_HO_Commit request to Serving PoS. In addition to resource preparation appropriate actions must be carried out on the network side to perform the service transfer to replace current service instance with new equivalent service instance.

The primitive MIH_MN_HO_Commit request must be extended with an additional parameter TargetServiceInfo as follows:

MIH_MN_HO_Commit.request (
DestinationIdentifier,
LinkType,
TargetNetworkInfo,
TargetServiceInfo,
)

The parameter TargetServiceInfo has LIST(SERVICE) as type and contains the names of services to be prepared for the handover.

Step 7: Serving PoS sends MIH_N2N_HO_Commit request to Target PoS to request resource preparation at the target network.

The primitive has to be extended with an additional parameter RequestedServiceSet of LIST(SERVICE) type which indicates the services that needs to be prepared for handover as follows:

MIH_N2N_HO_Commit.request (
DestinationIdentifier,
MNIdentifier,
TargetMNLinkIdentifier,
TargetPoA,
RequestedResourceSet,
RequestedServiceSet,
)

Target PoS responds the result of the resource preparation by MIH_N2N_HO_Commit response, which is extended with the parameter AssignedServiceSet of LIST(SERVICE) type as follows:

MIH_N2N_HO_Commit.response (
DestinationIdentifier,
Status,
MNIdentifier,
TargetLinkIdentifier,
AssignedResourceSet,
AssignedServiceSet,
)

Step 8: When the resource is successfully prepared, Serving PoS sends MIH_MN_HO_Commit response to Mobile Node. The primitive MIH_MN_HO_Commit.response is also extended with an additional parameter called TargetServiceInfo of LIST(SERVICE) type as follows:

MIH_MN_HO_Commit.response (
DestinationIdentifier,
Status,
LinkType,
TargetServiceInfo,
)

Step 9: New layer 2 connection is established and a certain mobility management protocol procedures are carried out between Mobile Node and target network. In addition to these standard procedures for the MIH, we propose to perform also service transfer procedures to ensure service continuity.

Step 10: Mobile Node may send MIH_MN_HO_Complete request to Target PoS. Target PoS sends MIH_N2N_HO_Complete request to previous Serving PoS to release resource which was allocated to Mobile Node. After identifying that resource is successfully relased, Target PoS may send MIH_MN_HO_Complete response to Mobile Node. In addition to the release of radio resources it may also be necessary to release service resources.

To enable service continuity the Media Independent Command Service (MICS) must accommodate the modified commands as described above.

5 Proposed Extension to the Media Independent Information Service (MIIS)

The Media Independent Information Service (MIIS) provides a framework and corresponding mechanisms by which an MIHF entity can discover and obtain network information existing within a geographical area to facilitate handovers. To ensure service continuity it is also necessary with extensions in the MIIS as proposed in [4].

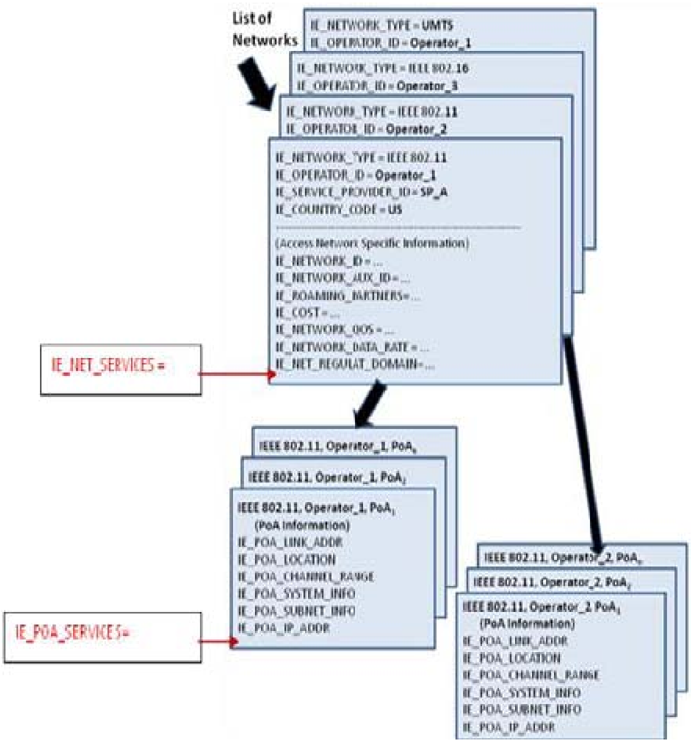

Fig. 3. Information elements with service information

More specifically, new Information Elements (IEs) containing service information must be added to the standard set as follows:

- IE_NET_SERVICES introduced in the Access Network Container which contains information about services supported by the access network. This element is used when the network is offering the same services at every PoAs. If the network does provide different services at different PoAs, this information element must be left empty. When encountering an empty IE_NET_SERVICES the service discovery will have to proceed to the respective PoA container to carry out the service matching.
- IE_POA_SERVICES introduced in the PoA Container which contains information on services supported at the PoA. For networks offering the same services at all the PoAs, this element must be empty since the information about the services is already specified at the network level.

Fig. 3 depicts the example on how the new service information is included in the Information Elements.

6 Implementation of Service Discovery

In this section the service discovery development environment is described. The user interface is explained and four use scenarios are given to illustrate the effectiveness of the proposed service discovery and matching procedure.

6.1 Mobile Service Discovery Testbed

The service discovery application is developed in the Java^{TM} [5] language using the Android Software Development Kit (SDK) which provides the tools and APIs necessary to begin developing applications on the Android platform. Android [6] is a software stack for mobile devices that includes an operating system, middleware and key applications. Android platform is chosen because it provides access to a wide range of useful libraries and tools that can be used to build rich applications.

Eclipse Helios [7] is used for the IDE and Android plugin for Eclipse is also needed for the system development. The developed application is flexible and capable of handling all the request variants from the Mobile Node. Android emulator is used for the testing purpose. The application can be installed and run in any types of mobile phones with Android 2.3 operating system and later.

6.2 System User Interface

Fig. 4 shows the icon of the service discovery in the Android emulator. Fig. 5 depicts the service discovery user interface offering three options to find service as follows:

1. by Service Name - the EquivalenceClass semantic will be used and all the similar services with different names and languages will be return.
2. by Service Type - all the subtype services under the same ParentType will be return.
3. by Keyword - even the non-exact match services will be return as long as it has something in common to describe about the service (for e.g. Snacks or Cocktail to define Food service).

Fig. 4. Service discovery icon on Android emulator

Fig. 5. Service discovery user interface

6.3 Use Scenarios

Use scenario 1 - Service discovery and matching based on the service name.

The Mobile Node may request for a specific service by specifying its service name. For example, if the Mobile Node requests for a Skype service, only the networks offering Skype service should be returned. It is worth noting that a network with a completely different service with the name of Skype can be returned because the service names are not standardized and unique. To avoid this situation the Mobile Node may have to specify the service type in addition to the service name to aid the service discovery. For example, when the Mobile Node requests a service with the service name Book and specify Online Business as service type as illustrated in Fig. 6, only the Book service with the service type Online Business is returned.

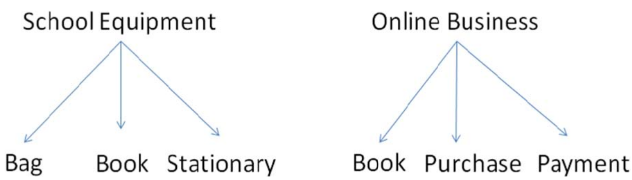

Fig. 6. Example of Book service denotes different type of services

If the Mobile Node specifies only the service type without the service name all the supported services with the same service type will be return. For example, if the Mobile Node requests for IP telephony service, Skype, VoIP and WiPhone, which has IP Telephony as same service type will be returned.

Use scenario 2 - Service discovery and matching based on ParentType.

The Mobile Node may also request a service by specifying the ParentType. All the services with the same ParentType will be returned. In this case only partial match is required. For example, if the Mobile Node specifies Telephony as ParentType all the child service types of Telephony e.g. Skype, GSM, VoIP and WiPhone will be returned as illustrated in Fig. 7.

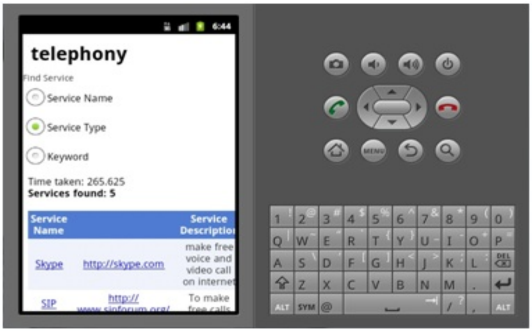

Fig. 7. Service discovery and matching based on ParentType

Fig. 8. Service discovery and matching based on EquivalenceClass

Use scenario 3 - Service discovery and matching based on EquivalenceClass.

The Mobile Node may request a service by specifying the EquivalenceClass. In this case all the services of equivalent service type will be returned. The returned services can have different names, types in different languages. For example, if the Mobile Node requests service by specifying Restoran as EquivalenceClass, Café, Bistro, Restaurant, etc. will be returned as illustrated in Fig. 8.

Use scenario 4 - Service discovery and matching based on Keywords.

The Mobile Node can request a service by specifying Keywords. This can be used especially when the user has only a vague idea about the service he wants to request. The service matching the Keywords will be returned. For example, if the Mobile Node wants to find a Food service, it may send Meal, Snacks or Dining as Keywords to request for the Food service as illustrated in Fig. 9.

Fig. 9. Service discovery and matching based on Keywords

The time taken in the output screen indicates the processing time (in seconds) to retrieve the search result.

7 Related Work

Semantic service discovery has been widely discussed and addressed by several research initiatives that have proposed enhanced discovery mechanisms. An Integrated Semantic Service Discovery proposed by Shanshan [8] enhances the discovery ability by making use of service ontology. It takes into account both the functional and non-functional properties to achieve accurate and satisfactory discovery results. Ontologies are defined in the Web Ontology Language, OWL [9]. Behavioral semantics are added to WSDL file by associating service functionality related elements with links to OWL-based service ontology. Non-functional properties are specified as QoS parameters and rule-based policies comprising business policies, QoS policies and context policies.

Efficient Routing Grounded on Taxonomy (ERGOT) [10] is a semantic-based system for service discovery in distributed infrastructures. It is a system that combines Distributed Hash Tables (DHTs) and Semantic Overlay Networks (SONs) to enable semantic-based service discovery in distributed infrastructures such as Grids and Clouds. ERGOT takes advantage of semantic annotations that enrich service specifications in two ways: (i) services are advertised in the DHT on the basis of their annotations, thus allowing establishing a SON among service providers; (ii) annotations enable semantic-based service matchmaking, using a novel similarity measure between service requests and descriptions.

UbiSearch [11] is a semantic service discovery network for large-scale ubiquitous computing environments. A semantic service discovery network in the semantic vector space is proposed where services that are semantically close to each other are mapped to nearby positions so that the similar services are registered in a cluster of resolvers. Using this mapping technique, the search space for a query is efficiently confined within a minimized cluster region while maintaining high accuracy in comparison to the centralized scheme. It supports scalable semantic queries with low communication overhead, balanced load distribution among resolvers for service registration and query processing and personalised semantic matching.

An Ontology-enhanced cloud service discovery system (CSDS) [12] aims to support the Cloud users in finding a Cloud service over the Internet. The CSDS interacts with Cloud ontology to determine the similarities between and among services. The Cloud Service Reasoning Agent (CSRA) determines the relations of Cloud services using three service reasoning methods which are similarity reasoning, equivalent reasoning and numerical reasoning.

In [13] a hierarchical and chord-based semantic service discovery system is proposed for the universal network (UniNServ). It uses OWL-S (Web Ontology Language for Services) to describe services and adopts Chord [14] as a distributed lookup protocol. Besides, UniNServ uses three types of ontologies to perform automatic semantic service discovery with QoS through exploiting the logical relationships within the services. They append QoS measurements to OWL-S and called it OWL-QoS.

MEMORY [15] is a matrix-based efficient semantic web service (SWS) discovery system which does ontological pre-reasoning and holds the reasoning results in matrix forms in service publishing phase, so that it can transfer the load of semantic reasoning from service query to service publication and perform fast matching during service discovery. A novel OWL-S (formerly DAML-S) based semantic service discovery system is proposed for dynamically discovering complex constraint-based services.

The main objective of the above mentioned semantic service discovery systems are to deliver and find the right service to the user in an acceptable time. Thus it has become an important factor for an efficient service discovery system but we propose a more comprehensive and novel service discovery system in open mobile environments which is capable of finding services having arbitrary names in any format given by any service provider.

8 Conclusion

In this paper, it is explained when and how the IEEE 802.21 MIH fails to support service continuity. To remedy the situation, it is proposed to exchange information about supported services in addition to the network QoS information. The paper also indicates the necessary extensions in the handover procedure and specifies the additional information elements containing service information. A novel service discovery has also been proposed as additional function for the MIH Information Servers. To verify the feasibility of the proposed extension, a simplified and simulated MIH containing only service information and service capability has been successfully implemented [16]. The MIH capability including service continuity support on the Mobile Node has also successfully developed on Android and illustrated by few use scenarios in this paper. For further work the proposed extension in the existing IEEE 802.21 MIH Services should be implemented and the service discovery should be installed in any MIH client so that testing and evaluation can be carried out in the real mobile environment.

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A Design Theory for e-Service Environments: The Interoperability Challenge

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Abstract. The delivery of e-services across organizational boundaries poses a number of issues in terms of design of inter-organizational systems that support service delivery effectively. In this context interoperability emerges as a mandatory requirement for the design of Information Technology (IT) platforms supporting collaborative e-service environments. In this paper we address this issue by presenting a design theory for IT platforms supporting e-services based on both a deep understanding of the interoperability concept and a design research approach. Through the analysis of a cooperation framework developed in the context of an EU funded project, we instantiate the theory by providing the concrete example of a solution addressing this design problem.

Keywords: design theory, interoperability, IT platform.

1 Introduction

The potential of value creation through the intensive cooperation of individual subjects and organizations has emerged as a new paradigm complementing the classical value chain model [1] since the beginning of the internet era. Normann and Ramirez introduced the concept of value constellation in 1993 [2] by underlining differences between the two paradigms. The concept of value chain suggests that value is added, step by step, in any phase of the flow that starts from suppliers and ends to customers. Value is added, in sequence, by any actor involved in the product or service output. With the advent of advanced networking capabilities, economic activities are reformulated according to innovative temporal sequences, reallocated geographically and shared differently among economic actors leading to new configurations of production processes.

This reveals the importance of the emergence of a new business paradigm: the reconfiguration of value-creating systems [3]. That is to say, businesses are not only considered as competent actors, producing or establishing relationships with customers but are also seen as value makers. Rather, they see customers, suppliers, competitors and partners as potential players for co-producing and co-designing. Thus businesses are able to reorganize not only organizational borders but also business borders as well as entire business sectors. Notwithstanding these concepts are well accepted today in the strategic management literature, private and public administrations are more and more facing the problem of implementing IT platforms that effectively support these new forms of dynamic interactions. This is especially true in the domain of e-services where actors exchange information that can be easily managed through the support of IT systems.

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However especially in the e-Government domain we have assisted to the failure of several interoperability projects whose causes have been often generically assigned to political – informal – friction among public agencies.

Many positive impacts are expected as practical consequences of an effective interoperability achievement. For instance Chen and Doumeingts [4] claim that steps being made towards multidisciplinary interoperability research will lead to a substantial reorganisation of the research activities and cooperation in Europe. However achieving interoperability among different actors and their Information Systems is a non-trivial issue especially when value constellations encompass national boundaries and are subject to continuous reconfigurations.

In our view a deeper understanding of the interoperability concept can be the first step towards the definition of a set of properties and processes through which interoperability can be achieved effectively within inter-organizational contexts. The objective of this paper is to deeply investigate this issue by providing both descriptive and prescriptive knowledge on this phenomenon.

With respect to Gregor's framework for classifying theories in Information Systems [5], we are addressing a research problem that ask for the development of a design theory for IT platforms supporting e-service environments. In fact, the majority of contributions available in the managerial literature on inter-organizational cooperation are aimed to analyze, explain, predict, or explaining and predicting the behavior of such socio-technical phenomenon. On the opposite, the technical literature on IT platforms supporting e-service collaboration has contributed with many technical solutions and new methods and techniques such as Service Oriented Architecture (SOA), Model Driven Architecture (MDA), Ontologies and Semantic Web, to name a few [6]. Despite these achievements are in line with the scope and objectives of service science, the effectiveness of available technologies, methods and techniques in addressing the field problem when applied to real contexts still demands a rigorous and careful evaluation. The assumption underpinning this claim is that service science belongs to the research stream of design science. This stream of research contributes to the knowledge base through theories for design and action that focus on "how to do something" and give explicit prescriptions on how to design and develop an artefact, whether it is a technological product or a managerial intervention [5]. Indeed services, together with their supporting IT platforms and managerial methods (i.e. Business Process Management) are human made artefacts whose effectiveness must be assessed and demonstrated.

In this paper we address the design problem of IT platforms supporting collaborative e-service environments. We base our design theory on a deep understanding of the interoperability concept and we instantiate the theory by presenting evidences collected in the context of a EU funded project aimed at fostering the cooperation among Chambers of Commerce and other public and private service providers, located in four EU countries, for the provision of innovative G2B services. The presentation of project results allows us to instantiate the generalized design theory and to emphasize both explanatory and prescriptive aspects related to this field problem which have implication at both theoretical and practical levels.

The paper is structured as follows. First we introduce the research method. Then we analyze the interoperability concept in order to build the foundations of our design theory. Subsequently we illustrate the remaining components of the theory by instantiating them with the help of the empirical case. Finally we summarize findings and we underline the implications for research and practice.

2 The Design Theory Framework

The problem of giving explicit prescriptions on how to design and develop an e-service environment belongs to what has been named as “IS design theory” by Walls et al. in their seminal work [7] inspired by Simon’s [8] and Dubin’s [9] contributions. In this article and in the following review and assessment in 2004 [10], Walls et al. distinguish two aspects of a design theory: the design product and the design process. The design product is composed by meta-requirements, meta-design (features), kernel theories and a set of testable design product hypothesis. Differently, the design process components are the design method, kernel theories and a set of testable design process hypothesis.

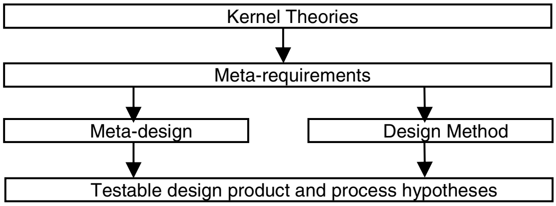

Fig. 1. Relationships among IS Design Theory components (Adapted from [10])

This model has been extended by Gregor and Jones [11] who have proposed a new “anatomical skeleton” for IS design theories, based on eight components which encompasses four issues identified in the Wall et al. conceptualization. For instance, the distinction between kernel theories for design processes and kernel theories for design products made by Walls et al. [10] has been criticized. For the purposes of the present work, we derive a model for formulating a design theory of e-service environments that lies on both the above mentioned frameworks. The model is based on five components whose relationships are depicted in figure 1. The rest of the paper is structured along the components of the above mentioned design theory which are illustrated in the following table.

Table 1. Components of the IS Design Theory (see [7][10])

Components	Description
Kernel Theory	The underlying knowledge or theory from the natural or social or design sciences that gives a basis and explanation for the design
Meta-requirements	The class of goals to which the theory applies
Meta-design	The abstract “blueprint” or architecture that describes an IS artifact, either product or method/intervention
Design methods	A description of processes for implementing the theory (either product or method) in specific contexts
Testable propositions	Truth statements about the design theory

3 Understanding Interoperability

The term "interoperability" has been used many times in the literature without a shared and common definition. Many authors simply avoid offering a definition, and among the papers that do attempt to give a meaning, there is a surprisingly varied selection to choose from [12][13][14][15]. In this section, we aim to develop a common understanding of this term in order to identify the key elements of a kernel theory for deriving the meta-requirements of our design theory.

For some authors (information) interoperability is the ability of processes and systems to effectively exchange and use information services [16], while others provide a richer definition seeing it as "the ability of different types of computers, networks, operating systems, and applications, to exchange information in a useful and meaningful manner" [17]. These two definitions reflect perhaps a relatively technical perspective. This is understandable considering the historical context in which, ever since computerised networks began to support and interrelate more than one single unit of independent function, interoperability has been an important concern for systems development [18]. In this perspective the need for interoperability arises from the undeniable, exponential increase in system complexities and components, and their related coding and data processing requirements. In contrast with this technical view, other authors argue that interoperability is "more than getting bits and bytes to flow properly" [19]. In their view, within an Information Technology (IT) environment, the fundamental goal of interoperability is to overcome the challenge of assimilating people and organisations and to encourage the sharing of information – it is "people talking and sharing information".

A broader perspective on interoperability is suggested by Backhouse and Halperin [20] who see interoperable systems as something that goes far beyond the technical interconnectedness of databases and systems. In their view interoperability emerges from the need to communicate data across different domains for a specific purpose. In fact, while transferring data may represent a technical challenge because of different protocols, standards, and so forth, the key challenge highlighted by these authors is with the purpose, use and changes consequent on transferring that data. Changes in data ownership and custodianship have an effect on power structures, roles and responsibilities and on risk. These issues go well beyond the technical dimension into the formal and social spheres and ask for a holistic conceptual understanding of this phenomenon.

3.1 Using the TFI Model to Understand Interoperability Requirements

As a kernel theory for our design research purposes we refer to the work of Stamper et al. [21] which has already been applied to the information systems field as a powerful conceptual tool [22]. This model allows to analyse the interoperability phenomenon with a holistic perspective by viewing an information system as constituted of the technical, formal and informal (TFI) parts which are in a state of continuous interaction. Using the words of Stamper et al. [21] is it possible to illustrate this interrelation of abstracted layers explaining that, "Informal norms are fundamental, because formal norms can only operate by virtue of the informal norms needed to interpret them, while technical norms can play no role…unless embedded within a system of formal norm.” In other words, the informal ways of managing information in organisations are critical and not always they can be replaced by rules or embedded in technical systems. With this view the informal elements (i.e. perception of risks, awareness, beliefs, culture, values, etc.), which are very context related, should drive the design and the selection of formal (policies, business processes, standards, procedures, etc.) and technical solutions (i.e. software and hardware platforms, network infrastructures, devices, etc.). In the context of information systems crossing the boundaries of a single organization (i.e. collaborative e-services), the relationship among these three levels is even more complex and requires to address additional issues such as the need to share a common understanding of basic concepts and their relationships in the domain of interest among involved members. Metaphorically, the TFI model can be viewed as a ‘Russian doll’ effect, were the informal is the outer shell containing the formal, which in turn contains the technical. Inside out, the technical cannot be removed from the toy without consideration for (unwrapping) the outer layers.

4 A Design Theory for IT Platforms Supporting e-Services: The LD-CAST Case

The LD-CAST (Local Development Cooperation Actions Enabled by Semantic Technology) project focuses on the cooperation and integration of public institutions, allowing SMEs to access a multitude of cross-border G2B services and applications for business development in the context of the enlarged Europe. The cooperation framework and the service platform developed in the context of LD-CAST address all the three levels of interoperability according to the European Interoperability Framework (Organisational, Semantic and Technical interoperability) [23].

The main objective of the cooperation framework is to allow the LD-CAST Local Agencies to provide cross-border services to enterprises adopting the “business episodes” model, an end user centric approach. Each business episode is associated with the relevant actions and interactions with and between the LD-CAST Service Providers (mainly Chambers of Commerce, Public Bodies, local/national development agencies). In the context of e-Europe, this translates into defining services available to enterprises and the subsequent inter-organizational business processes that have to be managed by the Service Providers. The LD-CAST approach to this problem is based on a methodology and a platform support process composition both at design time introducing a first level of flexibility in the business process modelling activity and at run time focusing on service discovery to guarantee the satisfaction of user needs trough the adoption of semantic technologies [24].

From an architectural point of view the project adopted a distributed SOA in which the delivery of business services (i.e. the outcome of inter-organizational processes) is performed through an Execution Platform, which is driven by a Modelling Platform and is supervised by an Administration Platform. The Modelling Platform embeds semantic modules, while the Administration Platform implements a federated authentication and authorization infrastructure. For sustaining the rapid evolution of e-service demand expected in the near future, this approach allows multiple points of extension, like: designing new processes for new business services, registering new web services, enriching the ontology, annotating processes and web services with ontology concepts, registering new local agencies and new service providers. In addition to the design, implementation and validation of the technological infrastructure supporting the cooperation among service providers, an exploitation strategy has also been defined. The LD-CAST business plan has been built upon the concept of the LD-CAST Global EU Agency, the point-of-sale of LD-CAST cross-border services, which correspond to an interoperable portal accessible (directly or indirectly through the Local Agencies) by the end users. The LD-CAST Global EU Agency is owned by a spinoff company (LD-CAST.org) that is entitled to carry out a number of activities both at a strategic and operational level. Among the operational level activities an important task performed by this central agency is the establishment of agreements with Local Agencies and Service Providers.

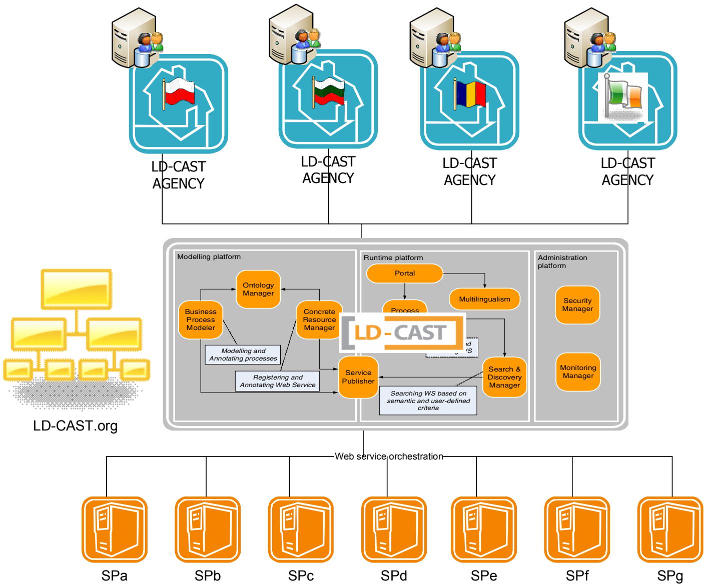

Fig. 2. The LD-CAST architecture

The Local Agency is the local distributor of the LD-CAST services to Local Agency's members (SMEs and entrepreneurs), while the Service Providers provide atomic business services orchestrated by the LD-CAST Global EU Agency to create new complex services. It is important to note that Chambers of Commerce can play both the Local Agency role and the Service Provider role.

The evidences collected during the project confirm the relevance of our design problem by showing that developing an integrated social dimension for e-Government applications (in practice) poses difficult challenges. In fact, the multilevel, hierarchical nature of local, national and international public administrations, government procedures for production and dissemination of information are in fact overcomplicated, rigid, fragmented and dispersed. Despite the interoperability requirement for the LD-CAST project was already addressed in the project proposal phase, the actual design of an effective cooperation framework has required additional efforts to derive the meta-requirements driving both the implementation of the technical system (meta-design) and the methodology for implementing it (design method).

In figure 3 the main elements of the proposed theory are captured through the dimensions of the above mentioned framework.

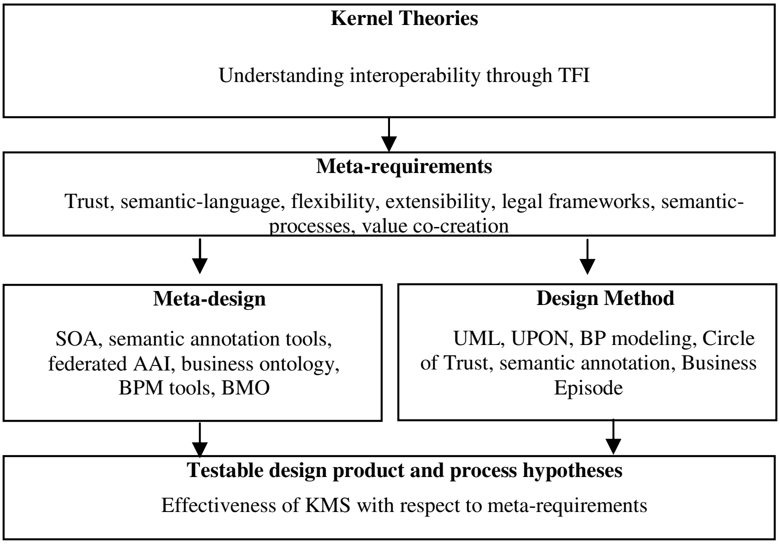

Fig. 3. A Design Theory for IT platforms supporting e-services

4.1 The Holistic Implementation of Interoperability

The IT platform adopted in the LD-CAST project for enabling delivering in a trustful manner a multitude of cross-border services is based on SOA [25]. SOA allows the system to be easily adapted to new requirements and to assimilate new business services and new service providers, while the e-service demand evolves. The architecture supports a wide distribution of the deployed software artifacts; the flexibility and extensibility increase with the use of the second generation web services - discovered at runtime, sometimes on the basis of semantic web - involving the necessity to define ontologies.

Furthermore, an additional implementation of service oriented architectures has been adopted in the Administration Platform in order to face security and identity management issues posed by such a distributed system. The possibility to implement a federated identity management system based on the Liberty Alliance framework has been investigated during the technology selection phase of the project following the user requirements specification. The applicability of this technological solution together with the underpinning organizational model (i.e. Circle of Trust, Identity Provider, Service Provider) has represented an interesting argument to discuss also at a research level especially in the eGovernment domain [26].

To overcome problems related to the non-homogeneity of national terminology and processes around Europe, LD-CAST adopted an approach based on modeling processes at a high level of abstraction and using an ontology specific to the business domain. The web services are searched and discovered based on semantic technologies, quality criteria and client preferences. The business domain ontology may be used for characterizing modeling elements, like processes, activities, or implementation elements, like web services. On one hand, the ontology helps the domain expert to use a familiar language when dealing with the information system and, eventually, to introduce new concepts interactively into the system. On the other hand, the concepts and their relationships may be used for defining criteria in order to perform various transformations and matches, as the discovery of web services at run time. Reference ontologies and their mapping on local ontologies has proven to be a viable solution for the interoperability of non-homogenous systems, with different European countries involved, and with stringent flexibility and extensibility requirements [26]. In order to build the LD-CAST Business Ontology the UPON (Unified Process for ONtology building) methodology has been adopted for capturing the knowledge of behind business processes in different national frameworks [28] . The description of the resulting ontology, which embeds more than 230 concepts divided in three levels, is out of the scope of this paper.

Interoperability issues at organizational level are mainly related to the differences among both legal frameworks involved and institutional and business goals of actors involved. The first issue required an in depth analysis of the legal frameworks (i.e. privacy regulations, etc.). Furthermore, the necessity to develop a business model to exploit the project results demanded for a debate among partners on aspects such as value configuration, technological infrastructure and market needs. Therefore a deeper analysis was needed in order to understand the multiple contexts involved and to find an agreement to define different strategies at a local level. These elements have an impact on the overall cooperation framework as they influence the choice of the most appropriate organizational configuration for the exploitation of project results. Also in this case research contributions have been published on the use of conceptual models (Business Model Ontology) and structured methods to develop a business model. Results of this analysis underline the communicative value of these tools when different stakeholders are involved in a collaborative business environment [29][30].

4.2 Towards an Explorative Design Theory for IT Platforms

A different perspective to analyze the findings of the LD-CAST project is based on the notion of explorative design theory [31]. In their recent paper Baskerville and Pries-Heje focus on the design product aspects of a design theory by proposing a distinction between design practice theories and explanatory design theories. According to them an explanatory design theory explains why a generalized set of requirements is satisfied by a generalized set of object components. The essence of an explanatory design theory can be captured by representing the general requirements, which can be both conditions or capabilities, the general components and the relationships between them. Therefore general requirements and general components are related through a circular link representing the functional (teleological) relationship among them.

This leads us to move the first steps toward the development of a twofold contribution. First, a descriptive theory for functionally explaining the characteristics of IT platforms supporting e-service environments emerges from the relationship between requirements and components related to technical and formal interoperability. Second, a prescriptive design practice theory summarizes the methods and constructs which are relevant for managing the informal aspects of interoperability.

Future developments in this direction can contribute to the body of literature on the design of complex socio-technical systems. In fact, the LD-CAST cooperative framework can be considered as an instantiation of the generalized concept of "platform" as has been defined by Hanseth and Lyytinen in their article on the design of information infrastructures [32]. According to these authors, "platform designs draw upon architectural principles that organize IT capabilities into frameworks allowing the software to address a family of generic functional specifications that meet the needs of multiple, heterogeneous and growing user communities". The possibility to extend the IT capabilities of platforms is provided by design in the original architecture. Hence their evolution is governed and constrained by the initial specifications. The LD-CAST case provides an interesting instantiation of these generalized assumptions on IT platform design. By generalizing the requirements, the architectural choices and methods involved in this case we setup the basis for the development of a design theory for IT platforms from which our narrow theory on IT platforms supporting e-services inherits some of the capabilities, constraints and components.

Table 2. TFI view on the design theory elements

Requirements	*Components*		*Methods*
	Technical interoperability	*Formal interoperability*	*Informal interoperability*
trust	Federated AAI	Circle of Trust	Risk analysis
semantic-language	Semantic tools	Business ontology	Semantic annotation
flexibility	SOA, Sem tools	Business ontology	UPON
extensibility	SOA, Sem tools	Business ontology	UPON
legal frameworks	BPM, Sem tools	Business ontology	BP modelling
semantic-processes	BPM, Sem tools	Business ontology	BP modelling
value co-creation	-	Business Model On.	Business Episode

5 Conclusions

The cooperation among service providers operating remotely in a dynamic environment poses a number of interoperability issues at informal, formal and technical level. We address this problem by developing design theory for IT platforms supporting e-service environments. Our contribution is based on a deep understanding of the interoperability concept and on the evidences collected in the context of a EU project aimed to develop a platform and a cooperation framework for providing cross-border G2B services. Since the credibility of the generalization of a theory depends, among other factors, on the credibility assigned to the evidence [31], the main limitation of this research stands on the fact that this type of EU funded R&D projects are aimed to develop a proof of concept of a given system. Therefore, validating the relationships between kernel theories, meta-requirements, meta-design, and design methods through a set of testable hypotheses was not possible after the pilot. Nevertheless, both the descriptive and prescriptive parts of this work provide a substantial contribution. In fact, the design practice theory projects the explanatory design theory into an instance while both provide interesting contributions to both practitioners facing the same field problem and to researchers investigating design problems which are either more general or more specific in nature.

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When Technology Supports Educational Services: Distance Education Use in Rural Italian Schools

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Abstract. This study focuses on the factors that affect the schools decision to offer educational services by an e-learning platform. We based on institutional framework to explain the choice of e-learning adoption by schools operating in rural contexts. These schools face greater difficulties to achieve education requirements and, thus, they are forced to ensure their services adopting an alternative educational model compared with traditional face-to-face learning. Based on the qualitative approach, we investigated the case of the "Digital school project" in Italy. The study highlighted that coercive and mimetic institutional isomorphism affect rural schools decision to use the distance education.

Keywords: Educational services, e-learning platform, institutional pressures.

1 Introduction

In recent years, service sector has grown to be the largest part of the economies of most industrialized nations. Many authors [e.g., 1, 2, 3, 4] have argued that the economies of many countries are shifting toward service sector highlighting as it has become the most active sector in the global economy. At present, more than 75% of the employment and gross domestic products (GDP) are already attributed to the service industry [3].

The growth of the service sector is the result of a number of interacting demand forces [5]. The increased of per capita income and new technologies investments driven by the progressive dematerialization of industrial processes and the increasing integration of products and services, lead to higher demand for individual and business services [6, 7, 8]. Moreover, the increasing marketisation of traditional production activities and the services outsourcing (business services, trade and transport activities) lead to same direction reinforcing the importance of service sector respect than manufacturing. Despite the growth of the service sector is changing the nature of the organizations and their relationships with suppliers and customers has became apparent that there is a lack of research and knowledge in service sector [9, 1, 10].

In 2006, Chesbrough and Spohrer [11] published a manifesto in service science named "call to action" for academia, industry, and government in order to create a shared agenda based on a common set of research problems and a systematic and interdisciplinary approach to investigate them. The manifesto has become an emerging discipline on

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study, design, and implementation of service systems commonly known as Service Science, Management, Engineering and Design (SSMED) research [1, 11, 12, 13, 14, 3]. The SSMED focuses service innovations and on how an organization could get them in order to realize more predictable outcomes [1]. In this perspective, service can be defined as the application of competence (knowledge, expertise, resources, and relationships) for the benefit of another entity [15].

An important research topic focused on the innovation technology in services underling the improvements in management and organization of business activities [e.g., 16, 17]. In particular, technological change and the diffusion of new technologies are key factors behind the growth of services in the last decades. Much of the literature on technology and innovation has focused on the manufacturing sector, but the intangible nature and the information-based characteristics of services give to the use of technology a central role in service firms. Consequently, the use of technologies has represented a major driving force in the service sectors [16, 17, 2].

In the 1980s appeared the first analyses about tertiary service sector innovation [18, 19, 17, 20]. In particular, new technologies increase services' efficiency and quality, as well as to form a technological platform upon which new services can be designed and traded [18, 19]. More specifically regarding the educational services, the changes that involve the world's educational system are not fast enough in order to follow the rapidly changing service sector [1]. This condition represents an important problem that has as a consequence the need for more innovation to improve the performance of service systems in general, towards a more service-oriented students [3]. In this perspective, the educational institutions develop and adopt sophisticated processes to manage their complex service relationships through information technology (i.e., remote self-teaching, self-paced learning, and online learning through role-playing games) [1]. Spohrer and colleagues [12:6] showed that the educational institutions, above the universities, are conceived more like "a complex adaptive system of people and technologies working together to create value (learning)". In the last ten years, the concept of teaching and learning has been transformed profoundly by new technology [17]. One of the main aims of the educational institutions is to create an effective and positive social dynamic between student, families, and teachers in order to make a service all together with higher value (value constellation). From this point of view, new technologies play a key role in supporting the learning and teaching processes, increasing the quality of the school service and improving the results of the teaching activity.

The rapid expansion and popularity of the Internet have favored computer-assisted teaching changing the teaching paradigm [21]. In this regard, numerous studies have focused on the impact of teaching and learning by technology on students, highlighting positive pedagogic findings [e.g., 22, 23, 24]. Distance education technology encourages learning opportunities for students and allows teachers to obtain new resource materials and experts across the country [25, 26]. Other studies, instead, have focused on the role of Information and Communication Technologies (ICTs) on organizational and economic school performance [27, 28, 29, 30]. E-learning is one of the most used technologies to support distance education [31]. It has been defined as the use of new multimedia technologies and the Internet to improve and facilitate the quality of learning by facilitating access to resources and by favoring the remote change and the collaboration [32]. The conventional education system often fails to guarantee these standards, and the pupils may not be receiving an efficient personalized education. On the contrary, e-learning allows a personalized learning process according to knowledge and needs, facilitating also the access to resources and services anytime and anywhere. For these reasons, the educators and school institutions are paying much attention and interest to e-learning tools, highlighting potential advantages and drawbacks of using it.

This paper investigates the factors that could affect the rural schools decision to offer educational services by an e-learning platform. Previous studies suggested that the choice to adopt an e-learning solution is affected by cost dilemma [27, 28, 29, 30]: schools use e-learning tools if its costs are lower than traditional education. However, some schools that operate in rural areas have adopted an e-learning platform to overcome rural disadvantages, taking as benchmark and imitating some foreign positive experiences. Based on institutional framework, we believe that the choice to adopt an e-learning solution by schools also might be driven by environmental features characterizing the context rather than the market conditions.

We conduct a descriptive and exploratory study using a qualitative approach. In particular, we analyze the case of the "Digital school project" in Italy. Based on the positive experiences of some Canadian, French, and Irish schools operating in rural environments, the "Digital school project" allowed to establish four virtual school networks: the schools operating in small islands are connected to schools operating in the mainland.

We begin by deepening e-learning literature to highlight how distance education solution could enable rural schools to face greater difficulties to achieve Italian education requirements. Then we apply new institutional framework to emphasize how institutional pressures affect rural schools to adopt a model of distance education by implementing an e-learning platform.

2 E-Learning and Distance Education

E-learning is an alternative method of learning based on the use of multimedia technologies and the Internet to deliver information and instruction to individuals [32].

Using this new educational method, students can interact with instructional materials in various formats (text, pictures, sound, video on demand, etc.) anytime and anywhere. Moreover, e-learning allows students to share instant messages and information and teachers to give video conferences, and it also allows interactions between teachers and classmates both individually and on a simultaneous basis [33, 25].

E-learning has received an extensive attention from practitioners and academics in different fields. In particular, according to Welsh and colleagues [29], organizations decide to adopt an e-learning solution because it provides consistent worldwide training, reduces delivery cycle time, increases learner convenience, reduces information overload, improves tracking, and reduces expenses. In this perspective, they mainly focused on the improvement of organizational and economical performance arising from e-learning adoption. The key role of economic factors to determine the choice to adopt an e-learning solution by organizations also has been shown by other scholars [27, 28, 29, 30]. Fielden [28] argued that online education is more expensive than traditional education. Bassi [27] also claimed that the cost of e-learning is highly dependent on the number of learners involved. Therefore, in increasing the number of learners, organizations can obtain economies of scale and make e-learning an attractive solution from a cost perspective. With respect to previous research, organizations should follow the market conditions adopting an e-learning solution if their number of learners is high. However, there are some specific contexts whose minimum essential requirements to the community must be ensured by the organization without considering the cost prospective. For example, public institution could establish the adoption of an e-leaning platform to allow the connection between teachers and students of geographically dispersed schools that operate in a rural environment. Thus, we believe that the choice to adopt an e-learning solution by schools might be driven by institutional pressures rather than solely by market conditions.

3 New Institutional Framework and Educational Context

Since Meyer and Rowan's [34] article, many scholars have focused on institutional theory especially to explain a wide range of phenomena [35, 36, 37, 38, 39]. Basing on Meyer and Rowan [34], DiMaggio and Powell [36] argued that organizations exist in fields of other organizations that influence their behavior. Meyer and Rowan [34], but more explicitly DiMaggio and Powell [36], marked a break point between "old" and "new" institutionalism, contrasting the adaptation perspective and viewing the organizational change as highly constrained.

Organizational behaviors are regularized and arise from a set of ideas, values, and beliefs that originate in the institutional context [34, 40]. According to Meyer and Rowan [34], formal organizational structures arise in highly institutionalized contexts, incorporating the practices and procedures and increasing their legitimacy and survival prospective. To survive, organizations must accommodate institutional expectations, and thus, their organizational behaviors are responses not solely to market pressures but also to institutional pressures [36, 37]. In this perspective, institutional pressures lead organizations to adopt the same organizational form, generating a phenomenon known as isomorphism. Meyer and Rowan [34:346] pointed out that "organizations are structured by phenomena in their environments and tend to become isomorphic with them."

Organizational isomorphism is the resemblance of a focal organization to other organizations in its environment [36]. Meyer [41] and Fennell [42] have identified two types of isomorphism: competitive and institutional. Competitive isomorphism is a rationality system that emphasizes the market competition and the change and fitness measures, operating above all free and open competition fields [43]. On the contrary, organizations could compete for political power and institutional legitimacy, rather than for resources and customers [44]. This prospective is named institutional isomorphism. Powell and DiMaggio [37] identified three mechanisms of institutional isomorphism: coercive, mimetic, and normative. Coercive isomorphism "results from formal and informal pressures exerted on organizations by other organizations upon which they are dependent and by cultural expectations in the society within which organization function" [39:151). This perspective focuses on how the common legal environment affects organizations at different levels as well as its structures. Not all institutional isomorphism derives from the coercive authority, but the uncertainly represents also a force that encourages imitation [36]. Therefore, mimetic isomorphism appropriately results in contexts characterized by high levels of uncertainty, in which organizations imitate the established models by reducing both the risks and research costs to find an alternative solution. In fact, most homogeneity in organizational structures stems from the tendency to model the organization to be perceived legitimate or successful. Finally, normative isomorphism emanates from increasing professionalization in modern societies. Professionalization represents a key source of isomorphism for two reasons. First, university specialists provide the formal education. Second, professionals increasingly manage organizations. In this regard, universities, companies, and associations are another vehicle for the definition and promulgation and diffusion of norms and models of organizing to numerous organizations.

Research on institutional theory has mainly focused both on the causes of isomorphism [e.g., 36, 35] and on its consequences [e.g., 34, 45]. In this study, we focus on the causes that lead the institutional isomorphism in the educational context. Previous research has already investigated how isomorphism determines organizational structures and behaviors in the educational field [e.g., 46, 47, 48]. However, these studies mainly focused on how universities and schools are or should be organized and on the functions that these institutions provide [38]. In fact, these organizational forms are not prefabricated and available in the institutional environment, but they depend on external cultural models [48]. Universities, schools, and professional associations are important institutions for the development of common patterns as well as the communication and diffusion of norms and models to the organizations. Literature also highlighted the strong connection between the educational attainment processes and the institutional arrangements of national educational systems [49, 50], exploring how institutional pressures could affect school systems to improve the learning process and achieve the specific goals of these educational institutions. Thus, previous studies have mainly focused on normative isomorphism prospective.

Some schools are trying to overcome specific context difficulties and to meet the regulatory requirements through the use of appropriate and innovative solutions in Italian educational system. Basing on foreign similar experiences, rural schools have decided to adopt a model of distance education by implementing an e-learning platform. In this case, we believe that mimetic and coercive institutional isomorphism, rather than normative isomorphism, could further explain their organizational behavior.

4 Methodology

4.1 Simple and Data Collection

We conducted a descriptive and exploratory study using a qualitative approach. In particular, we analyzed the case of "Digital school project" in Italy provided by "*Agenzia Nazionale per lo Sviluppo dell'Autonomia Scolastica*" (ANSAS), focusing on four different virtual school networks, such as *Marettimo-Firenze, Capaci-Niky, Lampedusa-Linosa-Palermo, and Salina-Alicudi-Filicudi.*

Rural schools were chosen to meet some crucial parameters: a) schools b) in rural setting c) that decided to adopt an e-learning platform to overcome rural issues d) based on previous positive experiences.

Data were collected from archives and Web site of Italian Minister of Education (MIUR) and rural schools and two semi-structured interviews with ANSAS project managers. In particular, the interviews allow us to investigate the results and future directions of ANSAS project, whereas the analysis of documents was crucial to investigate the aims and different steps of the ANSAS project itself.

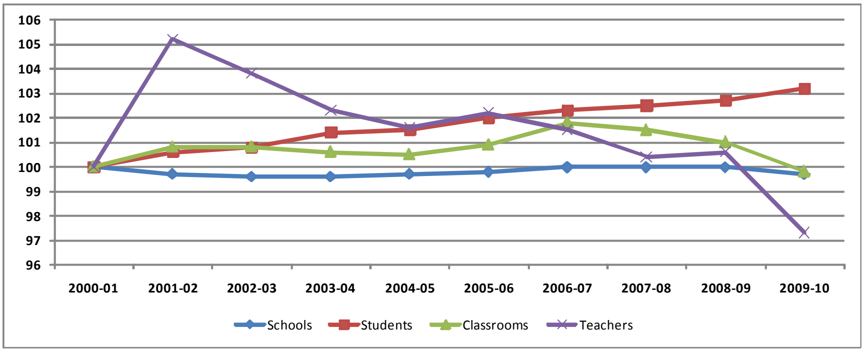
4.2 Italian Educational System

Italian educational system is living a particular and complex situation characterized by a complete re-organization of primary and secondary schools. In particular, the Italian educational system is experiencing both economic and organizational cuts brought about by the rationalization of a need for public investments. The two school reforms have caused important changes starting by the rationalization process that has profoundly affected the organizational sizes.

In the late 1990s, the first school reform has given schools the legal status and greater autonomy, leading to a reorganization of the education sector and school consolidation. The consolidation concerns the combining of schools or districts to create administrative efficiencies and improve academic and social experiences for students. In this regard, many administrative office, sites, and undersized schools were aggregated into comprehensive schools characterized based on administrative and organizational responsibilities against schools administered. Moreover, the comprehensive schools also exert management and coordination activities to related schools.

The second school reform led to a greater rationalization of economic resources obtained by a new reorganization of the education system. The reform allowed regions to plan the educational offer and to define the educational services that will be provided to citizens for an effective and efficient improvement. Thus, Italian regions should decide on the territorial allotment of comprehensive schools and the educational plans of meeting both the citizens and the local enterprise needs. On the other hand, the second school reform reduces the number of secondary schools' lesson plans and the hours of instruction. Moreover, the secondary schools could create ad hoc school facilities to improve the teaching quality by linking the needs of schools, people, and environment. These schools could develop innovative learning methodologies based on the use of new technology (e-learning) and laboratories (learning centers) by tightening the links between the different actors of education system and improving their relationships quality. Thus, the second reform leads to cultural and moral change through a new, personal, and friendly educational approach and new methods of learning that are more concrete and oriented to the environment and people.

Despite the increase in the number of students over time, Ministry of Education's data have shown a reduction of schools, classrooms, administrative personnel, and teachers [51]. Figure 1 shows the percentage changes of schools, students, classrooms, and students for the period 2000-2010.



Source: MIUR, 2010.

Fig. 1. Statistical of Italian educational system from 2000 to 2010

Therefore, MIUR [51] data show that the school reforms have led to the rationalization of economic resources and to the re-organization of school structures without paying particular attention to some disadvantageous situations, such as rural schools that operate in rural areas characterized by specific difficulties and needs.

Rural schools face unique challenges associated with geographical isolation, social and cultural integrations, limited resources, and numerous communication difficulties among various school sites. The rural schools also suffer a specific condition associated with a teacher shortage, an insufficient number of students, and a lack of specialized or advanced courses [26]. However, the Italian legal system stipulates that schools must meet the regulatory requirements that include the obligation to ensure the minimum essential requirements of the community. Schools that operate in rural areas characterized by huge disparity, compared with urban and suburban schools, should still provide educational service for a few students. The rural schools are located on island regions that already support the higher costs compared with economic resources allocated by the central state for education and are thus more oriented to cut the school services deemed nonessential. With these assumptions as basis, we asked how rural schools ensure the adequacy and effectiveness of education.

4.3 The “Digital School Project”

ANSAS is a public institution established by the Italian Ministry of Education that developed an e-learning platform based on a blended learning method. ANSAS developed a project, named “Digital school project”[1], to connect schools operating in small islands to schools operating in mainland. In particular, the “Digital school project” favors the training and learning process by the adoption of new educational technologies that allowed the connection between teachers and students of some geographically dispersed member schools.

[1] http://www.scuola-digitale.it/isoleinrete

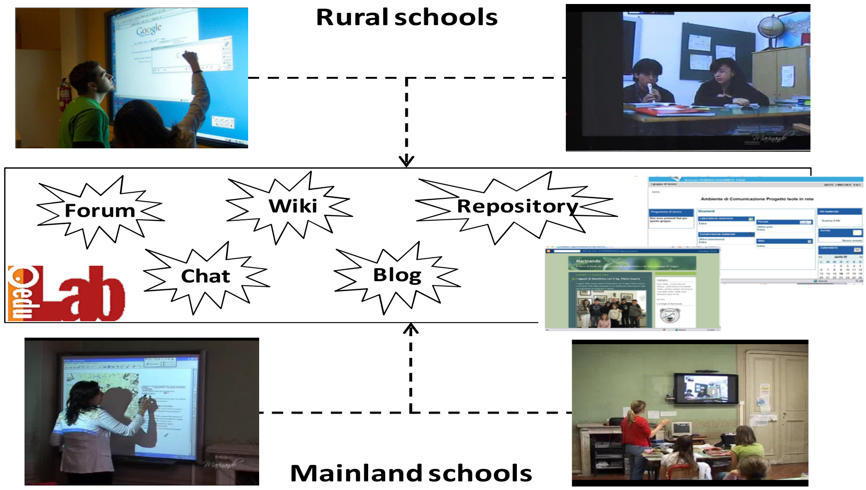
Initially, the technology used from rural and mainland schools was the videoconferencing tool via Internet (Internet videoconferencing) that allows video and audio transmissions simultaneously. To allow the connection between the different sites, each school had set up a classroom with appropriate technologies for the videoconferencing, such as TV, videocamera/Web cam, telephone line, Personal Computer, projector, loudspeakers, and Internet. In particular, videoconferencing tool allows students of rural schools to learn by following the lessons of teachers of the mainland schools. Figure 2 shows some pictures of lessons made through videoconferencing, showing the classrooms of the different schools that are connected.

Source: the “Digital school project”.

Fig. 2. Rural and mainland schools connected by videoconferencing system

Subsequently, to improve the connection and interaction between the rural and mainland schools joined to “Digital school project”, these geographically dispersed schools have implemented another technology for learning: the Interactive Whiteboard (IWB). It is a large interactive display that fully exploits the potential of technology in educational processes by improving the quality of teaching and engaging students through vivid images, video, and audio. IWB can be viewed and used by more than one person in more than one computer, allowing users to reduce the temporal and space distance and, thus, resulting in the improvement of learning in distance education.

In the last two years, the “Digital school project” has developed a collaborative learning environment, named “LabEdu,” to improve the learning process given to students and provide new tools to teachers to interact and communicate in both synchronous and asynchronous modes. In particular, collaborative learning environment allows the interaction and communication both between students and teachers during the lessons using videoconferencing tools and IWB, and between students of different schools during the time outside the school using some collaborative tools, such as forum, chat, wiki, and blog. Thus, LabEdu represents an important instrument to reduce the disadvantage caused by isolation of rural schools’ students favoring the learning and socialization processes.



Source: the "Digital school project".

Fig. 3. The collaborative learning environment of the "Digital school project"

Therefore, the "Digital school project" s aim is to facilitate the cooperation among schools and offer a range of educational contents and teaching services by responding to regulatory requirements and ensuring school services in rural contexts. The "Digital school project" is based on positive experience of some Canadian, French, and Irish schools operating in rural regions. These schools have adopted collaborative tools and implemented e-learning solutions in response to some critical aspects that characterized their environments. In particular, ANSAS project is based on three previous successful experiences: "L'École éloignée en réseau" (ÉÉR), "North-Eastern Education and Library Board" (NEELB), and "WEB Project". ÉÉR project was born to resolve the problem of equal opportunities by giving the people of Quebec living in rural villages the access to primary and secondary schools. The Ministry of Education, Recreation and Sports established a network of schools using online collaborative technologies to allow village schools to interact with other schools. NEELB and Ulster's Magee College developed a project to connect Northern Ireland secondary schools and French secondary schools by a videoconferencing system. The main aim was to allow school teachers to discuss environmental issues, removing the spatial and temporal distances among them. The WEB Project is one of the 19 projects developed by the U.S. Department of Education to establish processes to improve the learning process of students of Vermont elementary schools through the use of multimedia and telecommunications. In connecting technology and learning, students can have an access to collaborative environments that rely on group discussions, rather than one-on-one mentoring, to explore questions and build knowledge about economic development, heritage, and the artistic celebration of rural living.

4.4 Italian Virtual School Networks

ANSAS considers that Canadian, French, and Irish schools operating in rural environments represent a model to imitate and the solution to organizational problems of Italian schools that operate in rural areas, such as small islands. These community schools face a set of problems similar to those of North American schools: low student enrollment, declining population, not enough teachers, limited resources, and limited course and program offerings for the students. Thus, some rural Italian schools located in islands have joined the "Digital school project" constituting other urban or suburban schools with four different virtual school networks[2]: *Marettimo-Firenze, Capaci-Niky, Lampedusa-Linosa-Palermo,* and *Salina-Alicudi-Filicudi*.

Born in 2005, *Marettimo-Firenze* is the first project of virtual school networks achieved to connect a middle school class in Marettimo Island with two classes of some schools in Florence. The aim was to meet some typical needs from the context in which the school operates, such as the absence of interactions with other contexts and the subsequent cultural closure of pupils. After two years, the project represented an opportunity to increase the rich and the varied educational path, to promote the use of multimedia and communication technology, and to favor the interaction and the cultural integration among students. This project has allowed to obtain three middle school classes in Marettimo Island.

Capaci-Niky is another model of virtual school designed and implemented by the "Biagio Siciliano" school of Capaci. The project was designed to allow Nicky, a primary school student suffering from health problems who cannot live on the mainland, to continue his study by connecting to Biagio Siciliano class using a videoconferencing tool and ICTs for 30 hours a week. The aim of this project was to promote a real integration between Nicky and other pupils of "Biagio Siciliano" class and to develop their interpersonal relationships, knowledge, and skills.

Lampedusa-Linosa-Palermo is a project developed for resolving some important problems, such as meeting the requirement of students who live in very small villages of Sicily islands (Lampedusa and Linosa) characterized by strong isolation and high cultural barriers. These very precariousness contexts do not allow schools to provide the minimum classes' number ensuring educational continuity. This situation brings two major problems: students leave islands to study at mainland schools that allow them to have a more stable and better training plan, and the islands became depopulated, and the schools are thus characterized by high dropout rates. To overcome these problems, an internal network to connect the two classes of "Tommasi" high school of Lampedusa Island with one class of Linosa school was designed and implemented. In turn, these schools were connected with a class of "A. Volta" high school of Palermo by synchronous and asynchronous tools, interactive whiteboard, and videoconferencing systems. In this regard, teachers can give lessons at a distance by e-learning, whereas students can improve their knowledge and skills as if their lessons were conducted by face-to-face mode. Moreover, students can socialize and exchange information and educational materials with students located in other islands.

Salina-Alicudi-Filicudi is the last ANSAS project, which provides the building of a virtual school network to connect the various sites of "IC Isole Salina" school. The school is composed of 13 sites located in 5 islands of Aeolian archipelago (*Salina, Alicudi, Filicudi, Stromboli, and Panarea*), in which 332 students are attending. Salina, the largest island of the archipelago, has two middle schools (Malfa and Santa

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[2] `http://www.scuoladigitale.it/isoleinrete/`

Marina), whereas the other islands have courses in some sites named CPE (learning centers) characterized by students of different ages for each class (multi-class). The CPE students suffer from the isolation and the lack of single classes. Last year, the project provided the building of a virtual school network to connect Alicudi and Filicudi CPEs to “Malfa” school (Salina); it also provides another virtual school network to connect Panarea and Stromboli CPEs to “Santa Marina” school (Salina) for the next year. This project allowed and will allow CPE students to connect and interact with the other students using IWB and videoconferencing systems, overcoming the isolation issues and the close culture.

5 Conclusions

The case of the “Digital school project” provided by ANSAS explains how some Italian schools located in islands have tried to ensure educational services overcoming their contextual problems and meeting the Italian regulatory requirements. Schools must meet the regulatory requirements that include the obligation to ensure the basic services to the community. However, schools often struggle to meet the people’s needs using traditional learning models in some rural areas, such as the islands, characterized by specific difficulties. In these cases, school decision makers would find a solution to ensure the educational services enabling both to meet educational needs and to resolve specific contextual problems. The geographical isolation, communication difficulties, low pupil-teacher ratios, cultural closure, and high distance from headquarters and among sites represent some common contextual problems of rural Italian schools that have joined the “Digital school project”. With the previous positive experiences of Canadian, French, and Irish schools operating in rural environments, Italian schools have adopted a model of online education carried by e-learning platforms.

Previous research has used new institutional theory to explain how isomorphism determines organizational structures and behaviors in the educational field, mainly focusing on normative isomorphism prospective [46, 47, 48]. However, we believe that school organizational behaviors might be explained by coercive and mimetic institutional isomorphism.

With respect to coercive pressures, the study has shown that Italian regulatory requirements exert formal and informal pressures on schools pushing them to adopt ad-hoc solutions to meet people’s needs. The formal pressures are represented by school reforms and by the laws that established the obligation to ensure the minimum essential requirements to the community, whereas the informal pressures is represented by ANSAS project that leads schools to adopt an e-learning platform to overcome the rural context issues and to meet regulatory requirements. The school reforms have initiated an ongoing change process that is still affecting the educational system at different levels, such as organizational structures and working practices. In particular, school reforms have started a streamlining and modernization processes that aim to improve the organization structures, to increase the educational plans, and to improve the service provided. However, the re-organization of educational system has been driven by economic logic as the rationalization of economic resources that often make indiscriminate cuts without considering the peculiar conditions of disadvantaged areas. Despite these changes, urban and suburban schools were able to ensure the minimum essential requirements to the community, whereas rural schools have suffered more from these changes because of the particular conditions and environment in which they operate. For these reasons, ANSAS has developed an e-learning platform and started a project named the "Digital school project" to connect some rural schools with urban and suburban schools, allowing students of rural areas to continue to follow the lessons without necessarily having to reach the mainland. Thus, the ANSAS' "Digital school project" represents an obligatory solution to achieve the aims of the Italian Ministry of Education and to ensure that the minimum essential requirements of the community are met, allowing these schools to operate and survive in rural contexts.

With respect to mimetic pressures, the study has shown that some Italian schools are changing over time to become more like other schools in its environment. Some scholars [52, 53] have suggested that organizational decision makers could succumb to mimetic pressures to economize on research and experimentation costs and to avoid first-movers risks. With these assumptions as basis, Teo and colleagues [54] argued that mimetic pressures could have an influence on organization decisions by confirming its applicability to technology adoption that allow them to overcome uncertainty. The "Digital school project" tends to emulate other models perceived to be legitimate or successful to reduce both the risks and research costs to find a solution. In particular, the "Digital school project" is based on the positive experience of projects (ÉÉR, NEELB, and WEB Project) previously undertaken by some Canadian, French, and Irish schools operating in rural environments. These rural schools have adopted collaborative tools and implemented e-learning solutions to overcome the critical aspects that characterized their environments, such as low student enrollment; declining population; and limited teachers, course, and program offerings for the students. Despite being localized in different contexts, Italian rural schools are characterized from the same set of problems, and thus, ANSAS tried to replicate a project as faithful as possible to those previous experiences. In the past few years from having the ANSAS project, the results are becoming more positive. In fact, other Italian schools operating in rural environments are joining the "Digital school project" to overcome their contextual limitations. In this regard, the "Digital schools project" encouraged the homogenization of school structures and policies that operate in the rural environment, offering a viable alternative to traditional teaching model. We believe that this process of homogenization was involved, and it involves some Italian schools representing an example of mimetic institutional isomorphism.

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DEMO-Based Service Level Agreements

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Abstract. The services industry is currently the fastest growing part of economic activity in the world and some companies are changing their business models from product manufactures to service providers. However, the services quality is still affected by gaps identified two decades ago. One example of these gaps is when the service provider has a perception of what the customer expects that diverges from the real expected service. To solve this problem, we are working on a service quality approach based on the Enterprise Ontology theory. According to this theory, the operation of organizations is all about communication between social actors and their production. Based on it, a Service Level Agreement definition is given and a service quality specification solution is derived. We applied the solution in the Information Technology Division of a private bank and the solution showed to be mature enough to model the bank reality regarding service quality levels.

Keywords: Services Quality, Service Level Agreement, Enterprise Ontology, DEMO.

1 Introduction

While acknowledging the importance of manufacturing, today we live in a "post manufacturing" world. We enjoy the unsurpassed material comfort, because of a vast array of services that comprise nearly 80% of our economic activity [1] [2]. Nowadays services mean jobs and growth, but the companies who have been leading the charge lack a strong conceptual foundation [3]. This lack contributes to the gaps [4] that reduce the services quality for, without a solution to specify it, it is difficult for the service providers and their customers to align their expectations about the services quality. The problem is that the majority of the current solutions used to specify the services quality lack a strong conceptual foundation or/and suffer from *web tunnel vision* [5], i.e. they are focused on technology and they tend to ignore conventional services.

Our research seeks to define an approach based on Enterprise Ontology [6] to deal with the communication gaps that diminish the services quality [4]. In this paper, we focus on gap number 1, the difference between the customer expectations and the perceptions of the service provider regarding those expectations. In order to tackle this problem we propose to model the customers' expectations using DEMO-based SLAs. DEMO (Design & Engineering Methodology for Organizations) is a

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methodology for modeling, (re)designing and (re)engineering organizations and networks of organizations. The theory that underlies this methodology is called Enterprise Ontology (EO) and it was chosen as the basis for our solution because EO is the only theory that produces conceptual models that are coherent, comprehensive, consistent, concise and essential [6]. For this reason, we believe that EO is a perfect candidate to fulfill the mentioned lack for a strong conceptual foundation. Besides that, Enterprise Ontology relies on fifteen years of practical experience using the DEMO methodology [6].

Furthermore, DEMO models are completely implementation independent. The actor roles defined in these models can be executed by human or IT systems, so they do not distinguish from business or web services. Therefore, it appears to be a solid foundation to build a solution that is generic and suitable for any type of services.

At first glance EO and the service concept may not look related, however a recent research [7] defined the service concept using EO terms. This work gave us the connection point needed to use the EO theory as the basis for our proposals. Recently this methodology helped us to conclude that if the service catalogue is produced only by the service provider and without the customer point of view, then the service list will represent what the provider thinks he provides and not what he actually offers [8] [9].

The main contributions of this paper are the mapping between the gaps model and the EO basic transaction pattern (Figure 3), the SLA definition with EO terms, the SLA attributes proposal and relation to Enterprise Ontology (Figure 5) and finally the case study that shows the applicability of the proposal.

Our study was conducted using the Design Science Research Methodology [10] (DSRM) that aims at creating and evaluating IT artifacts intended to solve identified organizational problems. These artifacts include constructs (vocabulary and symbols), models (abstractions and representations), methods (algorithms and practices) and instantiations (implemented and prototype systems). This research method includes the following phases [11]: problem identification, objectives definition, design and development, demonstration, evaluation and communication.

This paper is structure as follows. We will start by describing the research question addressed in this paper in Section 2. Next, we provide a brief overview of the literature on the research question area (Section 3). In Section 4, we introduce the theoretical background of this research, the Enterprise Ontology theory. Afterwards, we present our proposal, namely the SLA definition using EO terms and our DEMO-based proposal to specify the services quality (Section 5). In Section 6, we describe the case study at a private bank. In Section 7, we discuss the results of the case study and specify the lessons learned. Finally, we present our conclusions (Section 8).

2 Research Question

Service quality poses a number of challenges and research topics. We decided to focus on the gaps [4] that influence the services quality for they represent the factors that diminish the services quality. Service marketers often use these gaps to illustrate how differences between perceived service delivery and expected service can come about (Figure 1). The net difference between the perceived quality of the services and the expected quality (gap 5) is caused by four other gaps [12]:

- **Gap 1** – The expected service as perceived by the service provider differs from what is expected by the customer. The service provider has a perception of what the customer expects that diverges from the real expected service due to inadequate market research, lack of communication between contact employees and management, and insufficient relationship focus;
- **Gap 2** – The service specification as used by the service provider differs from the expected service as perceived by the service provider. The service designs and standards will not match the service requirements as perceived by the provider by a lack of customer-driven standards, absence of process management, lack of a formal process for setting service quality goals, poor service design and inadequate service leadership;
- **Gap 3** – The actual service delivery differs from the specified services. Service delivery does not follow the service designs and standards because of deficiencies in human resource policies, failures to match demand and supply, and customers not fulfilling their role;
- **Gap 4** – Communication about the service does not match the actual service delivery because of ineffective management of customer expectations, overpromising, and inadequate horizontal communications (i.e. insufficient communication between sales and operations, advertising and operations and differences in policies and procedures across the organization);
- **Gap 5** – The actual service performance differs from the customers' expectations. Judgments of high and low service quality depend on how consumers perceive the actual service performance in the context of what they expected. This gap is caused by the four preceding gaps. Hence, service quality can be increased by closing the first four gaps and, as a result, align the perceived service with the expected one.

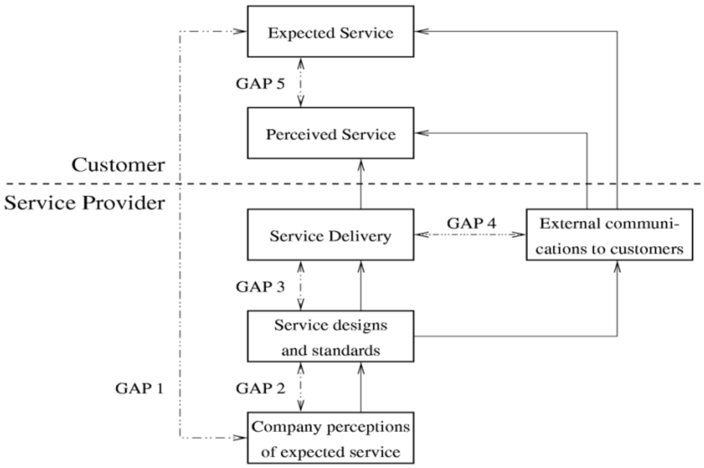

Fig. 1. The Gaps model of service quality [4]

As mentioned before, the context of this paper is limited to gap 1. We are trying to understand if we can model the customers' expectations using DEMO-based SLAs. Therefore, the research question that this paper seeks to answer is:

Can DEMO be used to specify SLAs in order to model customers' expectations?

This gap model has been chosen because we consider it describes the five major gaps that influence the services quality. This paper does not aim to propose changes to this gap model, instead we propose a solution to mitigate the gaps that are perfectly described in it.

This section corresponds to the problem identification and motivation phase of DSRM. It also corresponds to the objectives definition phase.

3 Related Work

This section describes the current solutions for specifying services quality and explains why these solutions do not solve the gaps problem.

We analyzed several solutions to specify the services quality: Service Level Management best practices, web services based solutions and the Generic Service Specification Framework (GSSF). In spite of the different backgrounds, all contributed to the service quality specification. The first solution is proposed by many best practices frameworks, such as ITIL [13] or CMMI [14], the second represents the solutions focused in web services and the third is an Enterprise Ontology-based approach (even though the main goal of the GSSF was to specify the services and not the service quality itself, this framework also contributed in the problem area).

Service Level Management is one of the key processes by which organizations manage their services, because it acts as the interface between the customer and the provider. At the most basic level, Service Level Management is involved in the following activities: define, agree, record and manage levels of service. There are a number of key elements required to ensure that services are fit for purpose and use, and remain so throughout their lifetime: service level requirements, targets and agreements [13].

Basically, to understand the Service Level Requirements (SLR) means that the customers' needs and wants are understood, i.e. an SLR is a customer requirement for an aspect of a service. SLRs are based on business objectives and are used to negotiate Service Level Targets (SLT) which are commitments documented in Service Level Agreements (SLAs). SLTs are based on SLRs and are needed to ensure that the service is fit for purpose. SLTs should be SMART: specific, measurable, attainable, realistic and timely. Finally, SLA is an agreement between a provider and a customer that describes the service; it documents the SLTs and specifies the responsibilities of the provider and customer. Over the years it has also been the chosen concept to specify services quality [13].

Regarding Service Level Management solutions, current approaches have two main flaws. First, they lack a strong conceptual foundation because they were derived from best practices of several years of implementations - not from a well-founded theory. Consequently, the inexistence of a theory may cause incoherencies among those solutions (second flaw). Service Level Management solutions are process-driven and not service-driven. These solutions are designed to work individually as processes and the interactions between these processes (such as Request Fulfillment, Service Level Management and Incident Management) are usually unclear. For instance, the connection between an incident and an SLA is not clearly explained in ITIL nor in CMMI.

These solutions are focused on the activities that must be executed to support the function of an organization, instead of being designed to be customer-driven and centered on the interaction with the customer. This is clearly a drawback for this solution because, as previously mentioned, whatever the answer to closing the gaps is, it should always be customer-driven.

There are some solutions to specify the services quality that had origin in the web services community. In [15] the authors show how to use Web Service Description Language (WSDL) and Web Service Flow Language (WSFL) to specify SLAs. However this work suffers from the web vision tunnel as it is focused in the web services and does not try to specify business services. For instance, the specifications do not include penalties or prices. The researches in [16], [17] and [18] have the same bottleneck. Despite this trend in the web service community, there are some recent researches that try to overcome the mention web service tunnel vision. In [19] a novel framework for specifying and monitoring SLAs for Web Services is introduced, the Web Service Level Agreement (WSLA) framework. This framework is applicable to any inter-domain management scenario such as business process and service management or the management of networks, systems and applications in general. In [20] and [21] business criteria is also included in SLAs. These three solutions represent a new movement in the web service community, however none is based in a strong conceptual foundation.

Another contribution to the gaps problem is the Generic Service Specification Framework [22], which is based on the following generic service definition [23]: *a service is a universal pattern of coordination and production acts, performed by the executor of a transaction for the benefit of its initiator, in the order stated in the standard pattern of a transaction*. This framework defines four main areas of concern for each service: the service executor, the service production, the service coordination and the service contract option. The first one defines who the provider of the service is. The second focuses on the production act to be performed by the executor. The third gives the consumer all the information required for conducting a successful communication with the provider. And finally, the service contract option specifies one or several contract options from which service consumers can choose. Even though the quality aspects are very basic, the Generic Service Specification Framework represents a large contribution to the service specification research area. However, the level of service quality specification is not always sufficient, because sometimes customers and providers have different expectations due to a lack of specification [22].

4 Theoretical Background

This section briefly describes the Enterprise Ontology theory (the theory that supports our proposal) and demonstrates that, by itself, this theory is not able to solve the problem.

Enterprise Ontology [6] is based on four axioms – operation, transaction, composition and distinction – and the organization theorem. The operation axiom states that the operation of an enterprise is constituted by the activities of actor roles that are elementary chunks of authority and responsibility, fulfilled by subjects. In doing so, these subjects perform two kinds of acts: **production acts** and **coordination acts**. These acts have definite results: production facts and coordination facts, respectively. By performing **production acts** (P-acts) the subjects contribute to bringing about the goods and/or services that are delivered to the environment of the enterprise. By performing **coordination acts** (C-acts) subjects enter into, and comply with, commitments towards each other regarding the performance of production acts.

The transaction axiom states that coordination acts are performed as steps in universal patterns (Figure 3). These patterns, also called **transactions**, always involve two actor roles (initiator and executer) and are aimed at achieving a particular result. A transaction develops in three phases: the order phase (O-phase), the execution phase (E-phase), and the result phase (R-phase). In the O-phase the two actors agree on the expected result of the transaction; in the E-phase the executer executes the production act needed to create the expected result; and in the R-phase the two actors discuss if the transaction result is equal to the expected result.

The composition axiom establishes the relationships between transactions. This axiom states that every transaction is either a) enclosed in another transaction, b) is a customer transaction of another transaction, or c) is a self-activation transaction. The latter case refers to transactions that give rise to further transactions of the same type.

The distinction axiom states that there are three distinct human abilities playing a role in the operation of actors, called **performa**, **informa**, and **forma**. An ontological act (performa) is an act in which new original things are brought about. Deciding and judging are typical ontological production acts. Regarding the coordination between people, typical ontological acts are requesting and promising. An infological production act is an act in which one is not concerned about the form but, instead, about the content of the information. Typical infological acts are inquiring, calculating, and reasoning. Regarding the coordination between people, formulating thoughts (in written or spoken sentences) and interpreting perceived (through listening or reading) sentences are typical infological coordination acts. Acts like copying, storing, and transmitting data are typical datalogical acts, while speaking, listening, writing, and reading are typical datalogical coordination acts.

Although we recognize the qualities of the models derived from this theory, these models by themselves may not close the services quality gaps. This happens because the gaps existence depends on how the ontological models are implemented. For instance, the occurrence of these gaps can be potentiated by a concept that almost all organizations use, the delegation. In EO, by delegation is understood the allowance by the authorized subject to another subject to perform one or more steps in one or more transactions of the corresponding transaction kind. If the expectations and perceptions of two actors can create the mentioned gaps, then we can imagine that the expectations and perceptions of three, four or more actors can be even more difficult to align.

To understand what each gap represents in EO, one has to keep in mind that a coordination act consists of two concurrent acts: the intention act and the proposition act.

In the intention act, the performer proclaims its 'social attitude' in respect to the proposition while in the proposition act, the performer states the fact and the associated time of the intention (Figure 2).

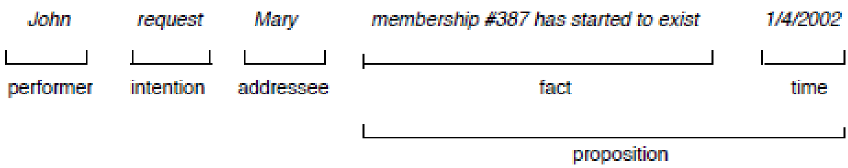

Fig. 2. Standard notation of a coordination act

However, without a clear specification of the proposition the two actors may have different understandings of it. In this example, the time in which John needs the membership in not mentioned and it is assumed to be as soon as possible. Nevertheless, as it is not specified, the initiator (John) may assume that the membership will be given as soon as possible, while the executer (Mary) may think that the request is not urgent. This would represent a clear gap between John's expectations and Mary's perceptions of those expectations that corresponds to Gap 1. Therefore, in DEMO models, the gaps problem is caused by the possible misalignment among notions (one from the initiator/customer and another from the executer/provider) of the agreed proposition.

Figure 3 shows how the five gaps are created in the Basic Transaction Pattern. Gap 1 represents the misalignment between the customer's expectations and the provider's perception of those expectations, i.e. the difference between the proposition in the c-fact request and the proposition in the c-fact promise. This gap occurs when the customer's expectations are not specified into clear service agreements.

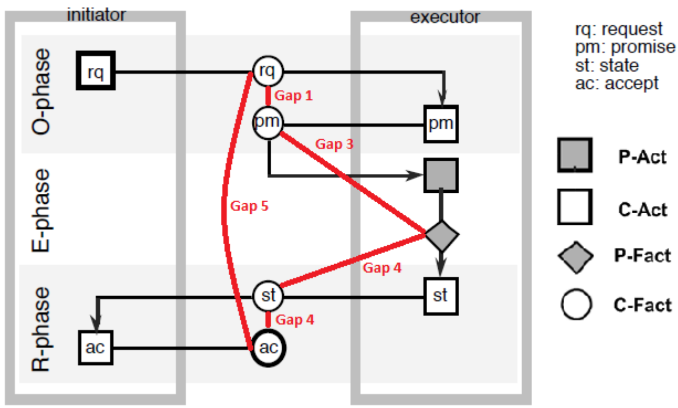

Fig. 3. Basic Transaction Pattern and the gaps model

Gap 2 represents the misalignment between the provider's perception of customer's expectations and what is designed, so it is created at design time and, therefore, has no representation in Figure 3. However, this gap may be visible in the O-phase, more precisely in the difference between the proposition in the c-fact request and the proposition in the c-fact promise.

Gap 3 is the difference between what is designed and what is offered, i.e. the difference from what is promised (c-fact promise) and what is executed (p-fact). Consequently, this gap is influenced by the E-phase. As only the provider knows about the p-fact existence, the initiator only becomes aware of this gap when the c-fact state occurs.

Gap 4 occurs when the communication about the service does not match the actual service delivery, so this gap represents the misalignment between the propositions of the coordination facts involved in the R-phase. This gap may also result from the misalignment between the p-fact and the c-fact state.

Gap 5 is the difference between what customers request and what they really get, i.e. this gap is the difference between the proposition of the c-fact request and the c-fact accept. Therefore, Gap 5 is influenced by all the transaction phases and by the other four gaps. Indeed, Figure 3 shows this influence more clearly than Figure 1.

EO has already a mechanism to deal with these gaps. In the R-phase, if the customer is not satisfied with the transaction result, he has the possibility to reject it. However, in these situations, both actors lose. The customer does not get the expected result and the service provider will probably lose this customer (not to mention the time and resources both used in the transaction). We propose to diminish the misalignments at their root instead of treating them after the creation. For this reason, the quality of the service exchange must be specified at the O-phase, stored and available to any actor that interviews in the service.

5 Proposal

This section corresponds to the design and development step of DSRM.

In order to show what an SLA looks like using the EO, let us start with a simple example of a transaction conducted during a face-to-face communication between two subjects. The example describes a customer (C) buying a bouquet of flowers from a florist (F):

(1) F: Hello! How can I help you, Mister Bean?
(2) C: I want to buy a bouquet of flowers.
(3) F: Do you want something specific?
(4) C: Yes, I want roses.
(5) F: How many?
(6) C: 15 please.
(7) F: When do you need the bouquet?
(8) C: In the next 5 minutes.
(9) F: Ok, that will cost you 30€.
(10) C: No problem, but I only have 5 minutes.
(11) F: Ok, one moment, please.

(12) < F makes the bouquet and puts it in front of C >
(13) F: Here you are, Mister Bean.
(14) C: Thanks.

The analysis of this example in terms of the three kinds of communicative acts yields the following result:

(1) Expressivum; will be disregarded.
(2) Performative act; intention: request; proposition: <unknown>.
(3) Informative act, serving to clarify the proposition.
(4) Informative act, serving to clarify the proposition.
(5) Informative act, serving to clarify the proposition.
(6) Informative act, serving to clarify the proposition.
(7) Informative act, serving to clarify the proposition.
(8) Informative act, serving to clarify the proposition.
(9) Informative act, serving to clarify the proposition.
(10) Informative act, serving to clarify the proposition.

Both the intention and the proposition of the performative act in line 2 are fully known at this point, so the request is considered to be performed successfully. Hereafter, we denote the proposition '*Deliver a bouquet of 15 roses in 5 minutes at 30€, otherwise the customer won't wait*' by P.

(11) Performative act; intention: promise; proposition: P.
(12) Material act related to the production act
(13) Performative act; intention: statement; proposition: P.
(14) Performative act; intention: acceptance; proposition: P.

According to this example we can argue that **a service level agreement is the proposition that two actors (initiator and executor) build together in the O-phase of any ontological transaction. This proposition is clarified by informative acts.**

A first analysis of the agreed proposition shows that an SLA may have at least four elements, as illustrated in Figure 4.

Fig. 4. Service level agreement elements (first analysis)

The first element that must be defined in a SLA is the service. This is a mandatory element of any SLA, because there is no SLA without a service. In this example, the service is to deliver a bouquet of 15 roses.

The second element is the target which defines a clear goal to be achieved when the service is delivered. As stated before, the target should be SMART: specific, measurable, attainable, realistic and timely. In this example, the target is to deliver the bouquet in 5 minutes, i.e. the florist state act should be done up to 5 minutes after the promise act; otherwise the agreed penalty applies.

The third element is the price that in fact represents the price of choosing that specific SLA. In this case the price is 30€. The price should always be quantitative (ex. 30) and the currency should be explicit (ex. € or $), so there is no room for misunderstandings about this element. In the example, the total price of the service is equal to the price of the SLA, but they are conceptually different. Although the SLA price influences the service price, they are not the same. The SLA price is just a component of the total price of the service, however the relations with other components that may also affect the services price will be dealt with in future work.

The last element is the penalty that describes what happens if the target is not achieved. In this example, the penalty is that the customer will leave without completing the transaction, i.e. the customer will cancel his request.

In this SLA case, the role accountable for fulfilling the target is the provider's, but we can easily think of an example in which the customer is the one accountable for the target fulfillment. For example the situations in which the customers must pay for the service in a specific period, otherwise they stop having access to the service value. So, an SLA must have a fifth element, the one accountable for achieving the SLA target.

Therefore, each SLA is composed by five elements: entity responsible for achieving the SLA, service, target, price and penalty. Figure 5 illustrates the relations between these SLA elements and the DEMO models and diagrams.

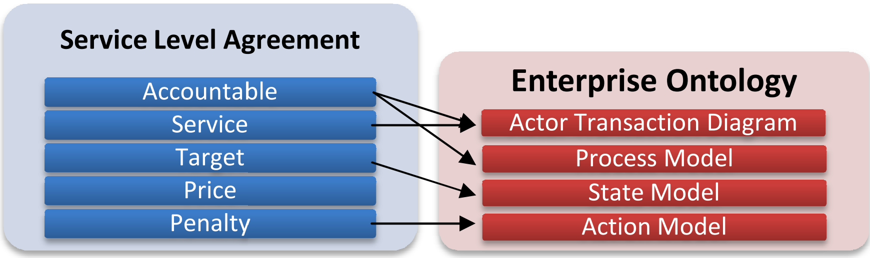

Fig. 5. Service level agreement proposal and relation to Enterprise Ontology

The first element, the one accountable for the SLA, can be gained from two types of diagrams provided by the Enterprise Ontology: the Actor Transaction Diagram and the Process Model. The service can be specified by using the Actor Transaction Diagram. The target, though, may be partially obtained from the State Model, because this model specifies the state space of the P-world: the object classes and fact types, the result types, and the ontological coexistence rules. The price has no direct representation in the DEMO models and diagrams, as it is implementation dependent. Information about the penalties is gained from the Action Model of the EO because this model defines the operational business rules of an enterprise.

In this case, the service is provided with only one SLA attached. However, a real-world example would be a lot more complex. So, we propose that a service may have several SLAs attached to it. This way the services quality may be specified through an infinite combination of targets, prices and penalties. The relation between these SLAs is a work in progress.

In this example, the SLA is defined at runtime, i.e. the provider and the customer decide the service quality when the service is being delivered. However, the service quality may also be defined at design time, i.e. the provider and the customer define several levels of services quality from which the customer can choose when requesting the service.

The proposal to specify the services quality is composed by the following steps:

1. Model the service provider in DEMO;
2. Specify SLAs for each identified transaction/service.

The first step is to model the service provider in DEMO, using for that purpose the methodology proposed in [6], or assume given DEMO models. For each identified transaction/service, one should specify the list of associated SLAs using our SLA definition (second step). Thus, this proposal intends to reduce the gap 1 by formally specifying the SLAs, using as foundation the EO theory.

6 Case Study

This section describes the demonstration phase of DSRM. We evaluated the proposal in one case study in order to validate its applicability. This case study was done in the Information Technology Division (ITD) of a private bank. ITD is constituted by 482 employees and provides services to about 10500 users.

The starting point to model the service provider in DEMO is called Enterprise Description and is characterized by producing a text which summarizes the actions performed by the service provider. In order to produce this text we interviewed six persons from ITD. During the interviews participants were asked to describe the activities performed by ITD. The interviews were recorded and transcribed as well as checked and discussed by two interviewers each ensuring unbiased findings and avoiding misinterpretation as specified in [24].

Having the Enterprise Description, the next step is to do the Perfoma-Informa-Forma Analysis and the Coordination-Actors-Production Analysis, both perfectly described in the EO book [6]. After these analyses, it is time to define the existent transactions in this text, by clustering the identified C-acts/facts and P-acts/facts, in what is denominated by Transaction Pattern Synthesis. The Transaction axiom can be helpful in this step, because it guarantees that each P-act/fact or C-act/fact previously found corresponds to a complete transaction. Then, for each identified transaction type, the result type (i.e., the P-fact created) should be correctly and precisely formulated, which can be achieved by identifying an entity uniquely, using variables. This result is represented in Table 1, called Transaction Result Table.

Table 1. Transaction Result Table

Transaction types / Services	**Result types**
T01 internal policies production	R01 internal policies P have been produced
T02 employee training	R02 employee E has been trained for internal policies P
T03 improvement implementation	R03 improvement I has been implemented
T04 feature development	R04 feature F has been developed
T05 implementation plan change	R05 implementation plan IP has been changed
T06 production environment change	R06 production environment PE has been changed
T07 audit	R07 audit A has been done
T08 implementation plan production	R08 implementation plan IP has been produced
T09 equipment access	R09 equipment access EA has been provided
T10 voice & data communication installation	R10 communication network N has been installed
T11 security access	R11 secure access SA has been granted
T12 file storage	R12 file storage FS has been provided
T13 specialized software access	R13 specialized software access SSA has been provided
T14 failure support	R14 failure FA has been solved
T15 general employee satisfaction evaluation	R15 satisfaction of employee E and semester S relating ITD function has been evaluated
T16 employee satisfaction evaluation	R16 employee satisfaction evaluation of failure FA has been done
T17 mandatory feature certification	R17 feature F has been certified as mandatory
T18 risk feature judgment	R18 feature F has been judged as risky
T19 business case benefits decision	R19 decision about the benefits of the business case B has been taken

After identifying the Transactions and the Actor roles involved, it is possible to develop the Actor Transaction Diagram (ATD) presented on Figure 6.

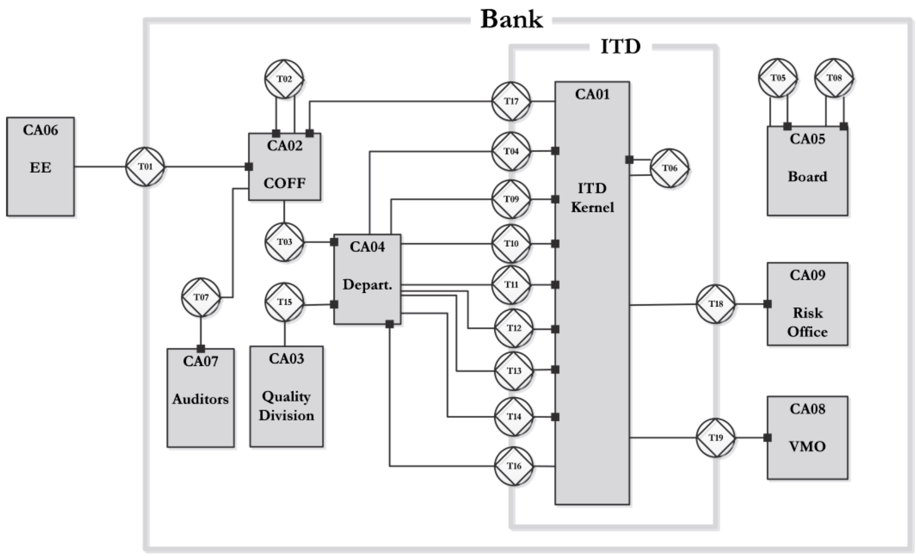

Fig. 6. Global ATD of the bank

As we mentioned before, each identified service can have several SLAs associated. We focused in the SLAs associated with the service 'failure support' (transaction T14) and we identified five SLAs for this service. The first one is related with the time to answer the phone calls. ITD employees accountable for failure support service have indications to answer the phone calls in one minute. This SLA attributes are described in Table 2.

Table 2. SLA attributes for the service 'failure support'

Service	Failure support (T14)
Target	Answer the phone in 60 seconds (the first coordination act must occur in a 60 seconds period after the request)
Accountable	Help Desk employee
Price	0 €
Penalty	Not defined

The following four SLAs are related with the time to solve the failures. Each SLA represents a different priority. Table 3 describes the SLA attributes for the service 'failure support' with critical priority.

Table 3. SLA attributes for the service 'failure support' with critical priority

Service	Failure support (T14)
Target	Solve failure with critical priority in 6 hours (the state act must occur in a 6 hours period after the promise)
Accountable	Help Desk employee
Price	0 €
Penalty	Not defined

The failure support service had also a SLA with high priority (the state act must occur in a 12 hours period after the promise), a SLA with medium priority (the state act must occur in a 60 hours period after the promise) and SLA with low priority (the state act must occur in a 120 hours period after the promise). From these last four SLAs the users of ITD could choose one on requesting time.

7 Evaluation

This section explains how we proceeded in the evaluation phase of DSRM.

The main objective of this research was to verify the maturity of the proposal, namely to validate if the SLA attributes were detailed enough to model the reality. We conclude that the proposal was mature enough to model the reality of the bank, because the current attributes were sufficient to specify the service levels. Indeed, the proposal has two attributes that were not used in this case, the price (always 0€) and the penalty. Although this fact, these two attributes are important in our proposal. The price is always 0 in these cases, because the services exchange is between departments of the same organization and there is no chargeback.

The penalty is also important in the definition of the SLAs, because not having penalties may diminish the efficiency of the service exchange. Besides that, penalties should be progressive. Imagine that in the studied bank an employee call the ITD reporting a failure, a minute passes and the call is not answered (the SLA target is not fulfilled). Then, for the service provider, it is the same if the call is answered passed two minutes or 10 minutes, however for the client it is completely different. Thus, the penalty should be a punishment aggravated according to time, for instance: for each minute M that passes and the call is not answered, then the service provider loses M credits.

Therefore, this case study **indicates** that the answer to this paper research question is yes, **DEMO can be used to specify SLAs in order to model customers' expectations**. As the EO theory describes the interaction between the customer and the provider in a very formal way and since the Service Level Management acts as the interface between customer and provider, the EO provides a solid basis for formalizing the notion of SLA. Nevertheless, the compatibility of a single case study with the SLA attributes does not indicate that the proposal is fully complete. It only indicates that it is compatible with the reality of the given case. However, the incremental results that are being obtained by each case study, gives a qualitative sense of confidence towards the completeness of the solution.

8 Conclusion

In this paper we tackled the old problem of the gaps that influence the services quality. There are several solutions that contributed to closing the gaps, but none solved the problem completely. Some lacked detail in specifying the services quality (like the Generic Service Specification Framework), others were not based on a strong conceptual foundation (such as ITIL, CMMI or WSLA) and majority of the web services based solutions suffer from the web service tunnel vision.

We are working in a solution to the gaps problem based on a methodology with a strong theoretical background. This fact allows for future solutions that, based on the same theory, could be integrated with the current proposal with no coherence problems. For instance, in the future one can propose a solution to describe an incident with EO concepts and integrate that proposal with our own.

Another contribution made by the paper is how to apply EO for specifying SLAs, thus using the existing knowledge in an innovative way (one of the design-science research objectives). We explain our proposal relevant notions on the basis of real-company example, which increase the practical relevance of our study and obtain an in-depth insight into how our proposal can assist in the service quality specification.

The last step of DSRM, communication, is being achieved through scientific publications aimed at the practitioners and researchers within the service science area.

As future work, we intend to apply the proposal in an organization with a service exchange more complex, namely one with penalties defined. We also intend to design a new diagram to integrate the SLAs in the DEMO models. For instance, we could develop a symbol to represent the SLAs and use it in the Actor Transaction Diagram, this way we could easily check out which services had SLAs.

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Service System Design and Engineering – A Value-Oriented Approach Based on DEMO

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Abstract. Modeling organizations as complex systems in permanent evolution as a response to change dynamics is an increasing challenge nowadays. Innovative approaches that assist in coping with it are called for, which include improving service system design and engineering activities. In this paper, we present a set of concepts that bridge Enterprise Engineering, Value Modeling and Service Science. Following an engineering approach we discuss how to develop a service system, starting by its construction model as a necessary step towards its implementation. Our contribution begins by identifying a relevant problem space regarding current approaches, both in academia and industry, particularly the lack of a sound structure to model a service system's *purpose*. We materialize our proposal of rationalizing service system design and engineering in a set of principles and a four-layer framework, which integrates the core concepts and their relative positioning.

Keywords: System Design and Engineering, Purpose, Market, Value Chains, Service Oriented Architectures, Service-Dominant Logic.

1 Introduction and Motivation

It is an increasing challenge to model organizations as complex systems in permanent evolution due to change dynamics. Particularly, there is a lack of an integrated perspective that is generally and recursively applicable to organization chains, organizations and sub-organizations of several types and sizes. Regardless of their composition and objectives (private or public, political, business, education, healthcare, non-profit, etc.) every organization brings about some form of value, directly or indirectly, so this is a unifying concept.

Modeling value statically is hard because of its subjective nature, let alone the dynamic aspects. These call for innovative approaches that assist in coping with these challenges. In this paper, we present a set of concepts that bridge Enterprise Engineering, Value Modeling and Service Science.

The main premise of Organizational Engineering is that organizations are systems and, therefore, can be object of engineering activities. ICT-based organizations are

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especially promising candidates for this kind of approach since their processes are mostly immaterial, ranging from a few activities to the whole chain and even the final product or service. Events are generated and handled in ways that facilitate their capturing in comparison to other systems without explicit state representation. But regardless of the main type of agents that support the organization activities, the focus should turn from doing things right to doing the right things, as it is inglorious to have outstanding performance at something that should not be done at all. This is especially critical in ICT-based organizations, where the high level of automation allows for transactions to be executed massively. This fact amplifies any flaws in the creation process of such systems, which end up embodying requirements that are implemented without being formalized aligned into an overall model. Even if the initial implementation serves the purposes it was created for, the evaluation of impacts, conception and implementation of subsequent changes is difficult to perform in a rational manner due to modeling shortcomings.

Service orientation generated a lot of hype in both the industry and academia in the beginning of the century. However, more than a decade later, there is still no consensus on how to rigorously scope a service or define its content in a way that is repeatable and that can be formally modeled. Both Service Science and Service-Dominant Logic [2] have been around for some years now. They rose from the need of a fresh approach to how business is performed. The change in the way of thinking and the set of foundational principles introduced were crucial in bringing together several chains of thought in this area. As a relatively new area combining inputs from many disciplines, there is still work to do both in theory and in the way of working.

Our contribution is mainly regarding service system design and engineering activities. In this paper, the main focus will be in matching the system design and engineering vision from Enterprise Engineering research. The challenge of how to represent purpose and integrate it in the current conceptual set is answered on the shoulders of structural recursivity of the service system - a great level of theoretical support exists in the SD-Logic Foundation Principles [2]. Our ideas regarding rationale modeling in the context of a system change process, directly connected with a proposal for conceptually supporting innovation will also be presented.

By matching SD-Logic's native concepts with DEMO as alternative conceptualization and positioning them in an integrated layered framework, richer models can be used in guiding service system development. Following an engineering approach we discuss how to develop a given service system, starting by its construction model as a necessary step towards its implementation.

This paper reflects ongoing research and is structured as follows: Section 2 presents problem analysis with a motivation example from a Library DEMO model, which is the base for identifying current challenges. These are grouped in four problem areas, with a brief and localized related work review. In Section 3, we present a set of principles currently applied in a real-world setting to tackle the identified issues, along with an overview of the proposed conceptual Framework. The paper closes with conclusions and contribution summary in Section 4.

2 Problem Analysis

2.1 Base Theory: Systemics, SD-Logic, DEMO and the GSDP

This paper addresses system development from a problem-solving perspective driven by value. The formal system definition we will use, from Enterprise Ontology [3], defines the following properties for a system: composition – a set of elements of some category; environment – a set of elements of the same category, disjoint from the composition; production – things produced by elements in the composition and delivered to the environment; and structure – a set of influence bonds among the elements in the composition, and between them and the elements in the environment.

In [4], the concept of *service system* is introduced, central to both service science (SS) and service-dominant (SD) logic. It is defined as "a configuration of people, technologies, organization and shared information, able to create value to providers, users and other interested entities, through service". In SD-Logic, resources are differentiated between 1) *operant* resources, which create benefit by acting upon other resources, such as competences and capabilities; and 2) *operand* resources, which must be acted on to provide a benefit, such as natural resources and goods. Service as a process involves using an actor's resources for the benefit of serving another actor.

Regarding the structural mapping between the service system definition and the formal system definition presented earlier, it is noteworthy that only *operant* resources are part of the composition of a social system. Additionally, value creation is done through the *production* of a system towards its *environment*, through *services*. Social systems are, therefore, of paramount importance in SD-Logic.

Design and Engineering Methodology for Organizations (DEMO) [3] is a cross-disciplinary theory for describing the structure and action of organizations, which are modeled as discrete dynamic systems consisting of social actors. These actors enter to and are responsible for coordinated commitments with each other. Enterprise ontology is a model of an organization in which these commitments serve as models for business transactions. DEMO was chosen because it models the essence of transactions between actors and abstracts away implementation issues.

In DEMO, an *organization* is defined as a social system, made up of *subjects*, who perform two kinds of *acts*: *production* (P-acts) and *coordination* (C-acts). P-acts give reason to the belonging of an individual to a given organization. C-acts are the way subjects enter into commitments with each other in relation to the performance of P-acts. An *actor* is a subject fulfilling an *actor role*. Actor roles abstract a particular subject performing an act, thus representing the *authority* to perform a particular P-act and related C-acts. Two very important and ill-defined notions are *responsibility* and *competence*. Both originate from authority: the first one is expressed by the acts and facts in the C-world and the second to the acts and facts happening in the P-world. *Transactions* are patterns of coordination acts performed in steps and provide DEMO with embedded service semantics. They always involve two actor roles and aim to achieve a specific result. Particular actor roles regarding a given transaction are *initiator* and *executor*. The first initiates a transaction by requesting a P-fact and accepts the produced results. The executor promises the production of a P-fact and, after executing the transaction, states the result for acceptance.

The transaction pattern is common ground between DEMO and the Service Science concept of Service System. The Interact-Serve-Propose-Agree-Realize (ISPAR) model is represented in the left part of Fig. 1 and consists of the possible interactions between two service systems [4]. The states and their respective negative states (denoted by a minus sign) are presented, except for non-service interactions: *W - Welcome non-service interaction*; *C - Criminal interaction*; and *J - Justice realized*.

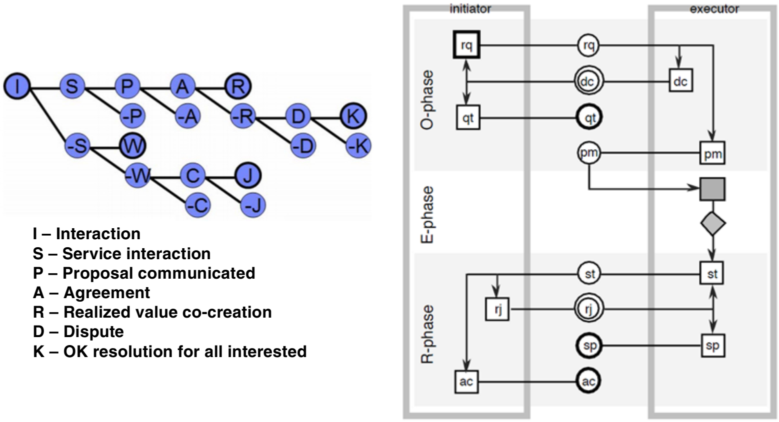

Fig. 1. ISPAR Model and DEMO's Standard Transaction Pattern [3, 4]

DEMO’s Standard Transaction Pattern is shown in the right part of Fig. 1, with C-acts represented in the middle (coordination space): *request*, *promise*, *state* and *accept*. In addition, the cancellation steps of these acts are represented: *decline*, *quit*, *reject* and *stop*. The transaction pattern has the particularity of being able to represent as a path every conceivable transaction. For this reason, it is a good model for the coordination of dual-party social activities.

Table 1. Mapping ISPAR Model Interactions and DEMO's Transactional Pattern States

ISPAR Interaction		DEMO Transactional Pattern State	
I	Interaction	rq	request
S	Service interaction	rq	request
P	Proposal communicated	rq	request
-S	Not a service interaction	dc	decline
-P	Proposal not communicated	dc	decline
-A	Agreement not reached	qt	quit
A	Agreement	pm	promise
R	Realized value co-creation	st	state
-R	Not realized value co-creation	st	state
D	Dispute	rj	reject
-D	Not disputed	ac	accept
K	OK resolution for all interested	ac	accept
-K	Not OK resolution for interested	sp	stop

The mapping shown in Table 1 results from the interpretation of the two sets of concepts involved. The analysis allowed concluding that DEMO is quite comprehensive in modeling the flows between these interactions states.

Also included in DEMO's theory set is the *Generic System Development Process* (GSDP), shown in Fig. 2, which begins with the need by a system, the *using system* (US), of a supporting system, called the *object system* (OS).

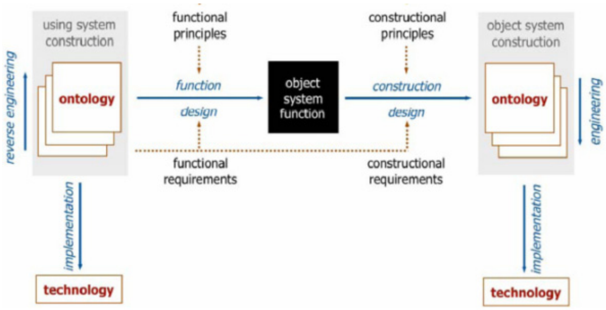

Fig. 2. Generic System Development Process [3]

From the white-box model of the US, one determines the functional requirements for the OS (function design), formulated in terms of the construction and operation of the US. Next, specifications for the construction and operation of the OS are devised, in terms of a white-box model (construction design). The US may also provide constructional (non-functional) requirements. Choices are then made with each transition from the top-level white-box model towards the implementation model.

As a note, regarding objective of eliminating the producer *vs* consumer distinction in SD-Logic, we must agree from a value perspective but must preserve the operational semantics as there is always an initiator to an exchange. Therefore, the consumer concept will still be relatable to the US and the provider to the OS.

The GSDP has articulate and clear primitive concepts that reflect the essence of system development. We chose to use it as a reference, since we believe the critical analysis is extensible to other system development processes. This is a very important point as it is applicable to the development of service systems and brings a relevant conceptual *apport* to service science objects of design and engineering activities.

To close this brief presentation of the base theory set, we note that it is important to differentiate two aspects of a system: *Teleological*, concerning its function and behavior, a black-box; and *Ontological*, about its construction and operation, a white-box [5]. This distinction is extremely important, as it forces both 1) the separation of these concerns and 2) their articulation. This issue is a present concern in service science and we believe it must be solved in order for it to mature as a discipline, both in theory and practice.

2.2 Current Challenges Identification and Analysis

In order to clarify the problem space, constituted by a large set of core concepts from different concern areas, a practical scenario based on the classical DEMO Library case

[3] will be used for instantiation. In this example, the elements of the system dealing with the membership (solid line-bounded area in Fig. 3) are not justifiable as bringing direct value to the customer, who only wants to get hold of a book. However, as it can be seen in Fig. 3, this is all but clear in the ontological (construction) model:

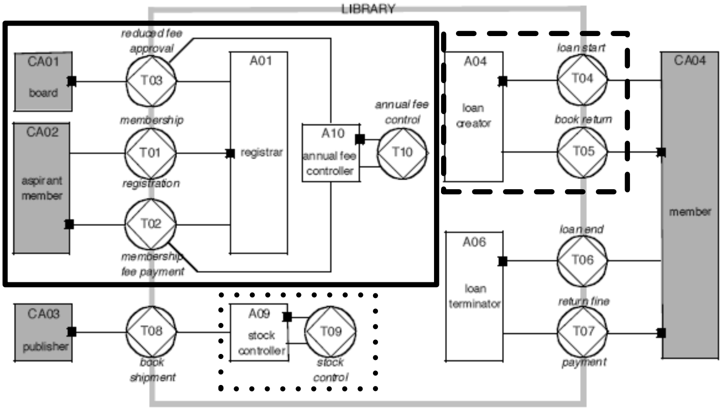

Fig. 3. Library example – Construction analysis

Regarding the core business of *providing reading content*: 1) the *core service* is concealed in the area marked by a dashed line, obscured inside a *loan transaction*; 2) inside the solid black line, a *sacrifice* of the customer in obtaining the service and its support (sub)system; finally, the area bounded by points encloses a support process that may need revision, for instance, in a change scenario of going digital.

About the Membership Management subsystem, one must ask if there is really a customer who *wants* a membership or was this subsystem included in the Library as the manifestation of a strategy to get a fixed amount of income to face, for instance, stocking management? Is this still a problem if the organization does not pay for the books and space? Is it done for profit or simply as a response to the cost of keeping a large library? Is it part of the Library concept, i.e., every library also offers it by definition? Under what conditions should this **decision** be **reviewed**?

There are a number of approaches of different nature to parts of these problems, including system development by Dietz and Hoogervorst [3], Service Design by Bell [6], Enterprise Architecture by Lankhorst [7], Goal-orientation [8, 9] and Value Management by Gordjin [10] [11], to name a few; however, none of the questions can be answered directly and fully by these or any other framework that we are aware of. Therefore, the following four problem areas were isolated.

Value Definition. Value is, by nature, dependent on the stakeholder and, thus, relative. The problems in adequately naming and scoping of a service, known in the Service Design community, are a symptom of this [6]. Regarding the Library's purpose, what is the core transaction for providing value? For instance, should the transaction be named "Loan book" or "Provide (limited-time) access to (reading) content"? Is the "Membership registration" service interesting *per se*, or is it only in the way of getting a book, that is specific to this particular construction of a library? This is why current goal-oriented modeling [8, 9] is not enough: it lacks an independent value structure to refer to. It must be understood that this structure is not subordinate to the service-providing systems, but the other way around!

System/Sub-system (De)Construction Modeling Support. The construction of a system resulting from the development process is a compiled structure that obscures the system/subsystem relations and their motivation. It is hard to separate a subsystem from its owner system, especially if it was modeled from a flat description of the operation of the organization, instead of a sequential bootstrap or an incremental design step. Assuming the stability of a value chain is generally unsafe because of change dynamics, which justify the need for a structure where to represent multiple scenarios in order to provide a flexibility point instead of a frozen solution path. How does a Library compare to a Bookstore or a Publisher, from the customer's perspective?

Lack of System Intervention Rationale Modeling. It is quite common that questions about system intervention rationale are very hard to answer, especially after sometime it happened. For instance, regarding the introduction of the Membership subsystem: 1) When was the decision taken? 2) What was its purpose? Was it for mitigating the risk of non-return? 3) What were the design principles, constructional principles, assumptions and constraints applied? Are they still valid? For any kind of content the library may want to provide, e.g., e-books?

DEMO has been extended [12] to incorporate change dynamics but, at this time, still does model the formal rationale of each change. This is particularly relevant in creating new, innovative, components of the organization, both in bootstrap and in ongoing phases. The GSDP also does not prescribe what to do with the objects supporting the rationale of the decisions made during the process. The implementation steps consist in introducing restrictions on the construction, for instance: 1) assumptions, such as assuming the customer is necessarily a reader; 2) constraints, such as available technology to offer books, e.g., physical or digital.

Conceptual Unidirectionality of the System Development Process. The unidirectionality of the system development process induces an upper limitation of the solution's value, indexed to the original functional request scope. Extra value that could be derived in bottom-up fashion, either available at the original design time or in future interventions, is not addressed. According to the GSDP, *Determining Requirements* is defined as 'The design phase that starts from the ontological model of the using system, and ends with the functional model of the object system' [3]. This approach requires full knowledge about the US, which is a serious limitation. Even if it was trivial, the solution would be irrecoverably restricted to satisfying the demand of a specific US, its value is limited from the outside instead of being allowed to expand creatively inside out. This is why the Agile [13] paradigm does not fully solve this issue, regardless of the length or frequency of the development cycles.

Again using the Library case, if e-books begin to be provided by the Library system, what are the possible USs for that new OS? For instance, a Printing on Demand (PoD) service requires no stock control of physical books.

3 Towards a Solution: Principles and Framework Overview

3.1 Principles of a Different Way of Thinking

As presented in the previous sections, there are a number of valid partial approaches to parts of these problems; however, we have found that none effectively solves them. Therefore, we are proposing a set of principles that were derived from field experience in IT Demand Management, interfacing Business Areas and IT department, at a leading Telecom operator. The methodology applied until the moment has included both Design Science and Action Research, and has consisted mainly in separation of concerns over the whole development process. The activities include analyzing motivation, impacts, cost vs. benefit, consolidation and planning of IT-related initiatives. By *post-mortem* analysis of the projects and the causes that lead to unexpected cost estimates and frustrated reuse intentions, we identified the following principle set:

- Recognize the system being developed as **one of many possible solutions** for a problem and, therefore, as a **means**, not an end;
- Integrate the **Teleological** and **Ontological** perspectives of a system by introducing the problem/solution paradigm and value concepts into system modeling activities;
- Improve **problem definition and elicitation** by using the concepts of system value, subsystem value generation and positioning the system in a demand/offer relation between consecutive nodes in a **value chain**;
- **Improve the clarity of system models**, by embedding value-semantics in the development process and **tracing** it to the relevant system elements as a structured means of expressing **purpose**;
- Look beyond the boundaries of formal organizations, into **value nets**, as a provider may serve multiple customers (n-1) with different problems and expectations, assisted by multiple suppliers (n+1) to increase design abstraction so that system value is increased as a result of greater market;
- Improve **change evaluation and decision rationale** by applying design principles, constructional principles, assumptions and constraints in a relevant, structured way that is explicitly included in the resulting model;
- Support **Innovation** by using these intermediate constructs from the development process to conceptually **reverse the development process** in a rational way during a **reengineering effort**.

This set of principles reflects the current thinking and results, and in the course of research will be further refined and validated, so we do not claim it to be complete. It is important to note that it does not imply a specific way of working and is independent of tool support - even though it can be greatly aided by it, especially according to portfolio size and change rate.

3.2 Framework Overview

In order to tackle the issues presented in the previous sections from an innovative perspective, a given system is one possible solution (out of many) to a problem; a means, not an end. The market does not request an organization; instead, it values the services that it provides and that contribute to a solution for a given problem.

Formal organizations are generally created as providers of a repeatable and stable solution to a demand, meaning there is reasonable belief that its elements will be continuously available. The rationale behind this quest for stability is, essentially, the lack of agility in procuring resources on-demand, compromising between evaluating every possible solution to each business activity and the time and effort consumed in doing so. However, with the current change pace, stability is a luxury unavailable to most organizations as the demand set itself changes. Therefore, a framework must explicitly include the concept of market, with demand/offer dynamics. Then, it is the organization that should reconfigure itself as a system to have the capacity of providing the services requested by the market, not the other way around. The service is an abstraction that fits particularly well between these two entities: system and market, and it is in fact between them in the framework we propose.

Our solution proposal consists in introducing the market concept into system modeling activities in order to support dynamics and mediate teleological and ontological visions of a system. In the Library example introduced in section 2, the system may be used by a customer to solve an *information need* problem, but it can also solve a *gifting* problem. According to the demand segments the system's owner wishes to address, and competing offers, different system design and engineering decisions are made. Modeling the intermediate steps between the formulation of a need and its fulfilling by a system is, therefore, indispensable for informed and rational decisions.

There are two mediators between a solution and the system providing it: one to abstract the outputs of the system that effectively contribute to the solution – *service* - and other, to support the service procurement in a open environment, which we will refer to as *demand* - the manifestation and explicitation of a problem by a customer in a market context. Services, which the customer (*using system*) gets from the provider (*object system*), are valued in the context of a market and may be used in multiple solution chains to a given problem. Returning to the example, the *Obtain Book Service* abstracts away any implementation choices or provisioning mechanisms. Hence, it brings the Library's production to an essential level that puts them all in the same level, which is the first step in allowing comparison to other alternatives of bringing about such item. Some examples are internet ordering, borrowing from a friend, acquiring a digital version or even downloading an illegal copy. Each of these variations introduces an offer at the solution market level with specific pricing, dependencies and risks, which end up providing different end-user experiences.

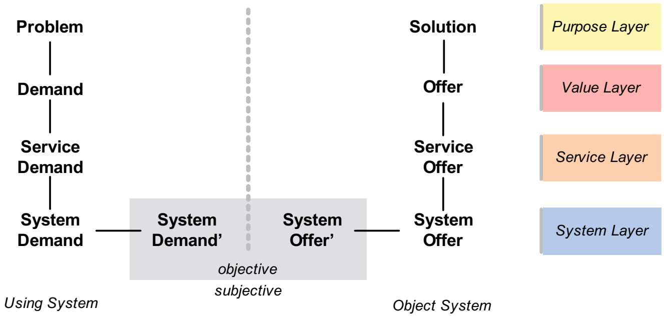

Fig. 4. Framework Overview

Our high-level solution proposal includes a four-layer framework: System, Service, Value (Market) and Purpose (Problem Solving); their relative positioning is represented in Fig. 4. The most differentiating concepts for each of these layers are presented next, in bottom-up fashion: from *system* towards *purpose*. For the purposes of this paper, we will further elaborate on system and service layers.

System Layer. For the purposes of this paper, we will focus on the *recursivity* property of our system definition, which is very important in achieving the objective of accommodating relativity for modeling any node on a value net.

We argue that any given complex system can be decomposed into more granular systems chained together; the rationale for forming each link is the same that should exist between the components of a system for, in the end, the same concepts will recursively apply. We base the last statement in the following assertion: if a single element is part of a system's *composition*, then it is connected by means of the system's *structure* to other elements; therefore, this connection must represent (but does not necessarily specify) the element's contribution to the *production*.

A single element of a system is also a system (a sub-system of the original system), with a *composition* constituted by a single element, an *environment* formed by the other elements in the original system, a *structure* linking the element to the environment and a *production* as the fact pertaining the *contribution* it makes to the production of the original system – which is its *purpose*, regarding that chain.

In DEMO, only operant resources are modeled because the composition is entirely made up of actor roles; this way, the *atomic service system* concept from SL-Logic [4] is compliant with this definition. Therefore, the modeling of purpose as the contribution of a given system's production to its environment (which populated by neighbors in a certain value net) is a very powerful teleological concept that can be incorporated in SD-Logic conceptualizations. It is important to note that 1) the concept of purpose is higher than the one of goal in terms of abstraction and 2) the later is subordinate to the former. However, purpose is frequently dismissed as a strategic concern and we are not aware of formal, structural, definitions of purpose that can be used as input to a system development purpose, neither traced back from a developed system.

Service Layer. The service layer abstracts functionality from a conceptual system in terms of inputs and outputs - it is analogous to the Hardware Abstraction Layer in modern operating systems. It also frames the system in transactional semantics, exchanging contract and operation conditions.

Due to space constraints we will not describe the structure of individual services, but refer the reader to [14], where a framework for service specification based on enterprise ontology is presented. Still, the most important conceptual aspects follow.

According to Kotler [15], a Service is: "Any act or performance that one party can offer another, that is essentially intangible". Regarding SD-Logic's Foundational Principles, from [2], FP2 *Indirect exchange masks the fundamental basis of exchange* and FP3 *Goods are distribution mechanisms for service provision* are consistent with having a service wrapper over the system: its contribution to the environment can always be modeled as service. This concept is usable even for products if their trade is regarded as the service itself, as every service is an interaction [16].

While organizational-centric modeling may seem more natural because of its formal structure, the emerging service structure is arguably more important since it is, by definition, focused in performance and value creation. The same recursively takes place at an intra-system level, as each system and sub-system is a means for providing value to some other system through services.

What we propose in terms of atomicity of system elements is a step further from the service system conception, by deliberately assuming an *economically-independent stance* between producer and consumer and associating a person (actor role) to each component. This is especially differentiating as an approach for otherwise dismissed chains of technological components, such as software applications and infrastructure. This way, one has to make value exchanges explicit and objectively define themes which are generally found on a services contract, i.e., responsibility, assumptions, performance criteria, *etc*, effectively working at both service and value layers. This explicitation contributes to answering change events by preparing, by design, system components to be swapped according to the offer. Obviously, there will be little or no return on modeling every component down to the *nuts and bolts* level in this aspect, but that capability must exist *if* there is a case for doing so. The advent of new technologies such as the Cloud justify this kind of modeling of components for which there is an increased offer on the market or any other source of change potential.

Value Layer. The value layer uses value as a driver to procure and assemble service sets complying with the solution to a given problem. In the presence of the same real-world artifacts and the corresponding conceptual system, different persons can perceive different services, as expressed in FP10 [2] *Value is always uniquely and phenomenological determined by the beneficiary*. Also, the same service can be used to different objectives – depending on the solution chain it belongs. The *Value* concept is therefore critical in establishing the relation between the services provided by a system and a specific stakeholder. In order to conform to this definition there must be someone who assumes the role of provider, who is responsible for the providing system. This means that, recursively, each system component must have a responsible social actor. *Any kind of man-made system is an service system if it is possible to initiate a transaction with some agent that assumes the role of provider.* This is to say that every resource can be part of a service system as long as it contributes to the objectives of the system and there is a person (generally its owner) who brings it into the solution market, thus fulfilling the role of *operant resource* in SD-Logic terminology.

A model focused in a single object's relation pairs does not cover every value chains it currently or potentially takes part into. Transactions that take place upstream and downstream of the Object System being developed are generally not considered. This is especially true when the Using System's actor is a single person in B2C scenarios. The concept of value chain unifies the worlds of demand and offer by focusing on a particular *service system* as a first level entity. Each system is usually a part of not one, but several different higher-level systems. Put in another way, the value chains it participates can, and generally do, ramify both upstream and downstream. Particularly, a provider usually serves many customers in parallel, which may have different problems, expectations and priorities. Indeed, a service may be a solution for multiple *demands*, participating in different solutions; in turn, these may be offered by multiple systems with different providers. Therefore, value nets end up forming from interwoven value chains. The knowledge about these holds the potential of generating significant additional value by several reasons: initiative consolidation, validating expectations or adjustment to a specific value chain, just to name a few. Modeling the problem and solution sets together, decomposed in the set of vectors that influence the matching rational, takes us closer to the generic goal of improving approaches to existing problems and innovating, discovering new applications to existing solutions.

Purpose Layer. This layer is responsible for defining the problem and matching it to solutions available in the market. These solutions are sets of services that are contextualized and presented as value exchange propositions. In order to perform meaningful modeling and reasoning it is essential to establish the *purpose* as it is the base for designing and engineering the solution providing system. Purpose is: '(...) an object or end to be attained; what one intends to do or bring about', according to the Merriam-Webster dictionary. A system's purpose is hard to formalize as stakeholders frequently formulate a high-level solution instead of the real problem, or present it in ways that induce specific solutions, such as in the classic example by Henry Ford: "*If I had asked people what they wanted, they would have said faster horses*".

Language and problem formulation is also critical as it drives the definition of the elements of the solution set [17]. An interesting model for its formal explicitation is presented in [18]. It consists of Need, Want and Demand structured in an hierarchy consisting in a transition from a *need* - a problem statement – to a high-level solution, defined as set of services that together provide a solution for that need - a *want* - and then to the formulation of a *want* in terms of value exchange proposition - a *demand.*

There are two other significant obstacles to problem solving, from the set identified by Mayer [19], that we are interested in tackling in this research:

Functional Fixedness: the tendency to view problems only in their customary manner, preventing vision over different options that might be available to find a solution. This is directly related to the upstream ramifications in a value chain.

Assumptions: when dealing with a problem, assumptions about the constraints and obstacles are often made, preventing certain solutions.

Both are conceptually addressed by using Reverse Discovery and recursion in the application of the problem solving to each engineering step. This contribution to problem solving is provided bottom-up by solid system and service-layer level theory, combined with a methodological approach that supports innovation by design.

Drucker [20] describes Innovation as both a conceptual and perceptual activity: "Because innovation is both conceptual and perceptual, would-be innovators must also go out and look, ask, and listen". Although subjective, this description clearly identifies the need to *think outside the* (system's, we add) *box*, i.e., its *frontier*. Keeping in mind that a system reflects a solution to some *demand*, it is clear to see that no meaningful innovation can be performed without examining its environment. Only operational innovation towards its components can be achieved – and even so, possibly kept from realizing its full potential due to missed synergies.

Following the limitations identified in section 2.2, we argue that the reverse engineering of the *using system*, as prescribed in the GDSP, is only one of the possible paths that may lead to designing the function of the *object system* (OS). The *Using System Set* (USS) of an Object System is defined as the set of its potential Using Systems. The USS for a given OS is infinite, since any individual may have a particular interest in the value generated by a system and have a particular conception for it. So, in order to maximize the potential value of a System, the opposite direction of the design flux must be taken into account. For this to happen, it is necessary that usable information was kept as a result of running the process in the original direction.

Changes in the implementation models should be propagated back by deriving and valuing new services and, in the end, providing different solutions. We named the concept of introducing the notion of bidirectionality in the process, effectively influencing and even creating new Demand, as *Reverse Discovery*.

4 Conclusion

This paper presents the current research results as an overview of a complex and largely subjective problem space. The presented structure and methodology is deliberately generally applicable to any human-engineered system, not only organizations, making it an ambitious modeling effort in terms of abstraction.

During literature review, we were unable to find any framework structured in a way that addresses and convincingly solves the identified problems. We are confident that they are extremely relevant since they can be reiterated at any system/sub-system relation, either at pure business level, business/ICT interface or inside complex ICT systems. The abstraction and flexibility enabled by the recursive application are especially relevant in ICT-intensive environments, as the access to components usable as pieces of a solution chain is increased and maturing technological advances, such as the Cloud, make real-time service market look plausible in a short timeframe.

Our contribution is composed by: 1) the identification of a relevant problem space in current approaches (both in academia and industry), particularly the lack of a sound structure to model purpose and serve as an ongoing referential, instead of addressing it solely at the early stages of individual system development cycles and losing track of it afterwards; and 2) the definition of a *conceptual high-level framework* that addresses, by design, the main issues identified in section 2 of this paper. It integrates the core concepts and their relative positioning in a layered manner, differentiating the concepts that characterize a problem/solution pair end-to-end, from need to implementation. The most important conceptual contributions are:

1. *Integrating the Teleological and Ontological perspectives* of system development by framing it in a *problem-solving context* and introducing the concept of *Market*;
2. Defining the *rationale of choices in terms of availability of solutions in a market*, by recursively defining purpose of a system as its contribution to a specific chain;
3. The *Reverse Discovery* concept as a different view over the GSDP, allowing structural accommodation of *innovation* dynamics.

Additionally, we have modeled part of the framework in a formal mapping ontology between DEMO and e3Value [11], and built a Protégé-based prototype for supporting a preliminary case study. This prototype has been used for instantiation of real scenarios and assisted in eliciting hidden value assumptions obscured by upfront, unguided, service design.

The definitive selection of validation methodology is still dependent on investigation outputs and on the setup of a full case study. This case study will consist in evaluating a real-world development scenario by comparing the way it occurred and how it would have occurred by using the framework, demonstrating that the extra effort is worthy in bringing about relevant qualities, such as: flexibility, reusability, clarity, coherence, effectiveness, value-orientation. The comparison will take into account hard outputs of the models produced and surveying key stakeholders.

Regarding the practical feasibility of the overall methodology, the issue revolves around the return on modeling effort. For instance, modeling the intermediate steps between the formulation of a need and its fulfilling is still ambitious and requires development process maturity. Producing additional deliverables during the development process must aim at essence, not detail, in order to avoid *analysis-paralysis*. The point is that problem elicitation and solution design activities are frequently performed without adequate systematic analysis and logging, with hard to forecast impacts, such as: wrong initiative selection and scoping, heavy maintenance/change costs and impaired reuse, leading to underperformance regarding value generation.

In conclusion, true alignment between *business* and its supporting systems can only be effectively pursued when in possession of a conceptual theory, together with the corresponding methodologies and applications, that integrates both the *motivation* (*why*) and construction (*how*) dimensions of a service system. We believe Service Science is a very promising field with contributions from many domains, such as Management, Economics, and now Enterprise Engineering. Introducing the later is a critical step towards bridging the gap between strategy and its implementation.

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The Challenge of Service Oriented Performances for Chief Information Officers

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Abstract. In the emerging service-centred economy, even the most physical product is "wrapped" in services. Businesses tend, then, to become more and more information-intensive and networked. In this scenario, the business role of Information Management is crucial. This paper investigates management literature as to the role of the highest ranking executive in charge of Information Systems, i.e. the Chief Information Officer (CIO). We found that, in the 1980s and first 1990s, most literature suggested that CIOs were to be intended as staff, strategy-making managers, similar to CFOs; but since the dot-com bubble of the late 1990s, CIOs are also expected to work side by side with line managers and to give perceivable contribution to profits. In this scenario, the active contribution of Information Management in developing value-added services may transform IT from a perceived cost center to a perceived profit center within the organization. In the Conclusions, some suggestions for further research are presented.

Keywords: CIO, information management, value-added services.

1 Introduction

The role of Chief Information Officer (CIO) was first introduced in print in 1981 by William Synott, who had been appointed as the CIO of the bank of Boston the year before [1].

Since then, the term spread during the 1980s, identifying "the highest ranking executive with primary responsibility for information management" [2].

What is the difference between the CIO and other more traditional leading IT roles?

In the last 20-30 years, there was an evolution of corporate titles, that resulted in the emergence and definition of the "Chief Officers", the so-called "C roles" or "Cs", assisting the CEO: for example, the Chief Financial Officer (CFO), or the Chief Operating Officer (COO), or more recently, the Chief Marketing Officer (CMO). According to this system of corporate titles, the Cs individually provide corporate leadership for key business functions, and, collectively, they form the top management team, integrating their functions in an overall business leadership [3].

As a consequence, according to this mainstream view, the higher ranking executive with responsibility for information management may be considered a "true" CIO if:

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- He or she is part of the corporate top management team, and
- The management of information is considered a key business function.

The role of CIOs, in other words, implies much higher responsibilities than that of the traditional IT manager: the corporate attitudes towards ICT leadership have changed, and the CIO is seen as a highly visible manager [4]. On the other hand, the ICTs are expected to solve so many problems, ranging from technological to organizational and business ones, and the complexity information management is confronted with is so high, that this job is often perceived as very tough, if not frankly dangerous for a manager's career [5].

This paper analyzes how the role of the CIO evolved in IS literature from 1980 to 2010, in order to enlighten the perceived possible contribution of Information Management to enhance the service performance of organizations.

The literature will be divided into three decades, taking the beginning of the Internet era, in 1990, and the burst of the dot-com bubble, in 2000, as turning points in the evolution of information management.

2 The Emergence of a New Concept of IT Executive in the 1980s

During the seventies, technology had advanced. The growing amount of information potentially available for improving organizational efficiency and effectiveness emerged as an issue: how should organizations strategically manage information?

This situation was soon translated in a call for new managerial concepts and roles. For example, Weaver [6] predicted the emergence of the CIO executive role in the organization: "I predict that corporate leaders will, more and more, be adding information management executives as their close associates" (p. 25).

In other words, even if many writings during the 1980s do not use the term "CIO" to identify this emerging role of strategic information manager yet, many of the main issues concerning this role are already present in this decade.

Many writings, for example, focused on the relationships between the role of information management and organizational structure, organization dimension, organizational role of IT [7] [8] [9] [10] [11] [12].

Many writings, on the other hand, focused on the evolving role of IT leaders as for responsibilities, skills and competences [13] [14] [15] [16]. Rockart et al. [14] presented one of the first writings directed at clarifying the emerging role of the IS executive. They recognized that the CIO was expected to focus on staff rather than line responsibilities, and would be concerned with strategy and policy formulation rather than with problem solving in production and sales processes. The authors, then, predicted that the role of CIO was going to be analogous to that of the CFO in organizations.

Benjamin et al. [16] confirmed that the CIO's job role was evolving from managing mundane data processing and other line activities to a more strategic role. The CIO, then, had decreasing line responsibilities and an increased staff orientation.

Miller [15] stated that the CIO role would emerge to manage the merged disciplines of strategic planning and information processing. This role would also involve educating management in the strategic use of information.

Other writings started investigating the relationships between the information management officer and his or her collaborators [17], peers, and heads [18], with particular focus on the CEO/CIO relationship [19].

When the term "CIO" spread, in the second half of the decade [20], a rich range of interpretations of this role was already present, spanning from highly optimistic (Bock et al. [20], defined the CIO as "the management's newest star") to highly sceptical (Rothfeder and Driscoll [21], published their famous acronym "CIO is starting to stand for Career Is Over" in 1990).

Donovan [22] predicted that the newborn Chief Information Officer role was bound to further evolve, and to become also a Network Manager.

In other words, even if the literature of the 1980s may appear very "old" in that it dates back to a before-the-Internet era, it is very interesting and includes seminal papers for many still topical issues involving the managerial role of the CIO.

The efforts of the 1980s resulted in the definition of the basic characteristics of the CIO, with respect to other IS management positions. This definition may be summarized using Boyle et al. (1991)'s model. They developed a matrix classifying IS executives on the basis of two dimensions: (a) responsibility for technology and (b) corporate reporting level. The true CIO has broad responsibility for information management, and reports to high level officers (fig. 1).

	Reporting Level in Company	
Responsibility for Technology	**Low**	**High**
Information Technology (Broad)	Emerging CIO	CIO
Data Processing (Narrow)	IS Manager	Small Company

Fig. 1. CIO classification Matrix. Adapted from Boyle et al., 1991. Source: Iyengar [24]

2.1 Studies on the Managerial Role of the CIO in the 1980s

The first relevant studies on the managerial role of the CIO built upon the Critical Success Factors (CSF's) Methodology, which had been proposed by Rockart [25]. This methodology aims at identifying a limited number of key factors/areas, where satisfactory performance is indispensable to success.

Martin [26] used this methodology to identify seven critical success factors for the CIO:

1. System development
2. Data processing operations
3. Human resource development
4. Management control of the MIS organization
5. Relationship with the management of the parent organization
6. Support of the objectives and priorities of the parent organization
7. Management of change.

Rockart [27]) described the results of a similar study. In his interviews of 9 companies, he identified four generic Critical Success Factors:

1. Service
2. Communication
3. Human resources
4. Repositioning the IS function .

Later, Munro [28] compared the two sets of critical success factors and concluded that they addressed very similar areas. Munro found that the few differences between Martin's and Rockart's CSF's were explained by the differences in the maturity levels of the organizations investigated in the two studies.

Rockart et al. [25] opined that the CIO must possess political/organizational skills, human resource management skills, and communication skills. The CIO must also be able to manage technological experts, and be sensitive to the impact of technology on individuals, organization and society. The CIO should be skilled in strategic planning of investments for change in the medium and long term. As a consequence, the authors suggest that the CIO should have had general management experience.

3 The Internet Era and the Dot-Com Bubble in the 1990s

In the early 1990s, the sensational importance of the Internet revolution became more and more apparent. These years witnessed an explosion of enthusiasm for the innovation potentialities of new technologies, and the CIO role rapidly grew in status and visibility both in organizations and in scholarly writings.

A large majority of practitioners, consultants and scholars understood that, in the emerging economy of knowledge, ICTs could provide (or destroy) competitive advantage. CIOs started being commonly perceived as managers with responsibility on resources, decisions and activities directly affecting the organization's success [29].

This requested new skills and capabilities. Consistently, it has been remarked that the dot-com bubble in the years before 2000 led to a pick in the visibility, prestige and compensation of the CIO [1].

3.1 Studies on the Managerial Role of the CIO in the 1990s

The 1990s witnessed a sort of explosion of the managerial roles attached to the CIO.

Many writings in this period refer to Mintzberg's work on managerial roles. Mintzberg [30] had identified ten roles for managers: three of them are Interpersonal (Leader, Liaison, Figurehead); three of them are Informational (Monitor, Spokesman, Disseminator); and four are Decisional (Entrepreneur, Resource Allocator, Disturbance Handler and Negotiator).

Scholars started wondering which ones, among these roles, could describe the CIO's core and more important responsibilities. One of the first and more cited works addressing this issue is Grover et al. [31]. They found that the more IS management matures, the more importance is placed on the roles of Spokesman and Liaison; the more centralized the IS resource, the greater the CIO's role in acting as a spokesman, environmental monitor, and resource allocator. They were surprised to find that the importance placed on the Entrepreneur role did not grow either with IS maturity, or with IS centralization.

Many studies were conducted after Grover et al. [31], and confirmed a strong trend towards a further widening of the range of expected managerial roles for CIOs.

For example, CSC [32] identified six leadership roles of the CIO: this study mentions *all* Mentzer's three groups of roles, i.e. Informational, Decisional, Interpersonal, and adds five further roles, and namely: Chief Architect, Change Leader, Product Developer, Technology Provocateur, Coach and Chief Operating Strategist. Even more, May [33] examined as many as 26 competencies of the CIO.

All such writings testify a new, enthusiastic attitude towards Information Systems: the traditional ancillary role of IT as a mere "data processing" issue needed a complete overcoming, and Information Systems were expected to bring new vision into organizations and to lead an in-depth renewal of business.

This approach, on which there was vast consensus in the 1990s literature, corresponded to a sudden and wide-spread change in hiring, empowerment and compensation policies for IS senior executives.

Applegate and Elam [29] conducted a study in the first 1990s, comparing the backgrounds, responsibilities, reporting relationships, and power of newly appointed IS executives, who had been in their position for two years or less, with established IS executives, who had been in their position for at least five years. They found that an increasing number of new IS executives reported directly to the CEO, and almost half were members of the senior management/strategic policy committee, whilst established IS executives often had lower reporting relationships and rarely took part in strategic decision making processes. They also found that more than two-thirds of the new IS executives had more than five years' experience managing a non-IS function within the past 15 years, whilst established IS executives had spent the majority of their career within the IS function. As a consequence, the authors stated that IS senior management may play a pivotal role in the emerging scenario only if they develop knowledge, experience and skills also in business strategy, management, and operations.

The idea that a solely technical background may be detrimental for a successful CIO is widespread in the 1990s literature, but not undisputed. Earl and Feeny [34], for example, opine differently. They found that CIOs transplanted from other functional areas acted as forceful managers instead of facilitators. The successful CIO needs appropriate experience in the IS function, along with integrity, good communication skills, and motivation. The authors suggest the following actions for the CIO to add value to the firm:

1. Obsessive and continuous focus on business imperatives
2. Interpretation of external IT success stories
3. Establishment and maintenance of IS executive relationships
4. Establishment and communication of IS performance record
5. Concentration of the IS development effort
6. Achievement of a shared and challenging vision of the role of IT.

Romanczuk and Pemberton [35], on the other side, stressed that a technocrat CIO would only focus on the tools, and would not pay enough attention to the information and knowledge aspects.

In other words, the debate of the 1990s did not result in an unified view of what a CIO's desired background should be. In practice, different organizations, in different moments of their competitive lives, tend to request different skills and different backgrounds to their CIOs, and this makes the generalization of scholarly surveys quite problematic.

3.2 Studies on the Relationships of the CIO with the CEO, with Peers, and with Subordinates

Many studies during the 1990s develop the seminal concerns already expressed in the 1980s about the relationships of the CIO with other executives, and with the CEO in particular.

Initial reaction of CEOs to the emergence of the CIO as a corporate role was negative. The ABA Banking Journal [36] reported that most CEOs were sceptical and resistant to the idea of a technology executive. Gupta [37] identified three problem areas in the CEO-CIO relationship: (a) Overblown expectations of the CIO; (b) Old line CEO attitudes: sceptics who are unfamiliar with the nature and capabilities of IT ; (c) fear of CIO wresting control and domination in the firm.

He suggests that the CEO and the CIO take measures to develop a partnership.

Li and Ye [38] found that there was a negative relation between the CEO/CIO distance and firm performance.

Feeny et al. [39] in their study on the CEO-CIO relationship identified nine core capabilities of the CIO, that may result very useful to define the CIO's role within corporate top management team (see fig. 2).

Other studies underlined also the importance of the relationships between the CIO and the other senior executives, because it was clear that the CIO would not be able to implement successful initiatives without the cooperation of peers [34]. It is important that the vision on IT is shared not only with the CEO, with but the entire executive team. In the evolving scenario, CIOs were expected to build relationships with line managers [40].

Fiegener and Coakley [41] suggested that the CIO's relationships with the other top management executives are negatively influenced by many factors, including (a) CIO distance from top management (b) Ambiguous performance measures, and (c) Limited top management understanding of IT.

Duffy and Jeffery [42] underlined the importance of the quality of CIO subordinates. Information specialists need to act as proxies of the CIO in order to implement the CIO's vision. Paul [43] recognized that leadership in the information technology context faces unique challenges, because technical work is qualitatively different from any other context, and such workers are less susceptible to power or charisma. In other words, leading technical people is a peculiarly challenging job [44].

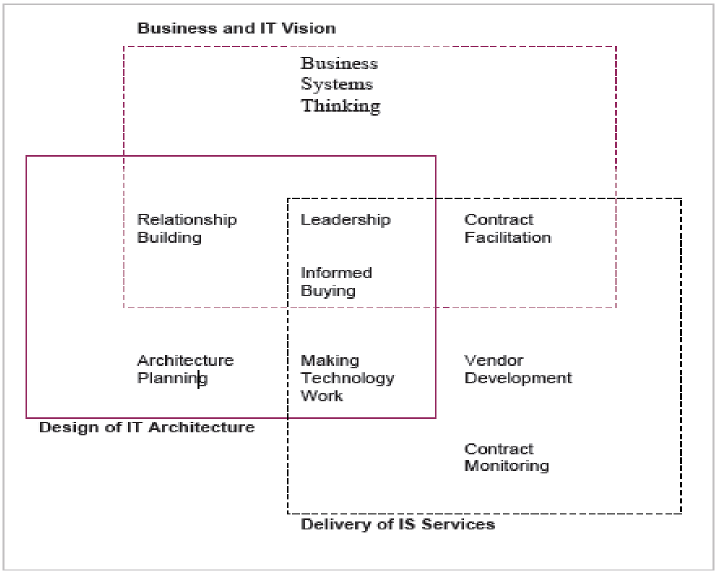

Fig. 2. Nine core capabilities of the CIO (Feeny et al., 1998)

4 From 2000 to 2010

With the swelling and burst of the dot-com bubble, the 1990s enthusiastic optimism for the role of the CIO as a sort of demiurge in charge of all corporate innovations soon collided into reality. Many authors started saying that it is very likely that something in IT management goes wrong [45], and that it is very unlikely that an individual CIO owns all of the skills and competencies identified in literature [1]: as a consequence, CIOs are subject to rapid turnover [5] [46] both for IT failures and for frequently changing needs in terms of CIO backgrounds.

After 2000, several attempts were made to establish which skill or capability is the most important for the CIO among those identified in the 1990s. Some authors emphasized that the main task for a CIO should be concentrating on business [47], whilst other authors insisted on the fact that CIOs must have a sound technological background [48] in order to understand ICT trends and possible solutions, and to be considered authoritative by the ICT staff. Some other authors focused on the importance of the CIO's leadership capabilities, because CIOs must first of all, according to this view, be capable to exercise influence on others, to overcome behavioural barriers, and to persuade the "naysayers" [49]. Moreover, some authors insisted that the CIO should contribute to innovate corporate strategies [3], whilst other authors insisted on the importance of concentrating, more traditionally, on strategic alignment of IT [50]. In other words, it seems impossible to build a consensus on a single top priority for a successful CIO: in effect, many studies and surveys confirmed that, also after the year 2000, the CIO is still expected to face an impressively wide range of issues.

For example, Gartner [51] identifies seven competencies for the CIO:

1. build and maintain the technical platform and service delivery;
2. ensure and demonstrate excellent value and performance;
3. develop IS technical, service, and management skills;
4. source intelligently from the external market;
5. create an environment of opportunity;
6. champion the impact of e-business; and
7. lead the business.

In a 2004 survey, about 500 CIOs said that their top priorities were alignment, creating a more adaptable and flexible organization, ensuring security and business continuity *and* reducing the costs – but not, trivially, the costs of ICTs: the purpose is reducing the *overall costs of doing business* [47].

Moreover, it became more and more apparent that it was not possible to assume that the context in which CIOs operate is the "classical" corporate of the Western tradition: different economic contexts, such as for example those of Eastern countries [52], and different types of organizations, such as for example Public Administration bodies or state-owned enterprises [53], pose novel problems, both at the strategic and at the operative levels. An emerging stream of studies investigates how IT management goes beyond the corporate interests, and involves the whole society: see, for example, the studies of Kang [54] on the relationships between informatization and industrialization.

In sum, we can say that the earthquake of the dot-com bubble contributed to drive the attention also on the more pragmatic facets of the CIO role, such as cost reduction and business continuity; but the CIO continues to be considered one of the Cs, involved in strategic decisions and in business responsibilities.

4.1 Different Roles for Different Chief Information Officers

The puzzle of the sometimes too many, and sometimes colliding, competencies and skills requested to the CIO may look less complicated if we look at the world of practice.

Table 1. Different types of CIOs. Elaborated from State of the CIO Report (2008).

CIO types	Responsibilities	Average comp.
Function Head CIO	Manages IT operations, personnel, and crises	$209,000
Transformational Leader CIO	Redesigns the business processes, aligns IT strategy with business goals, and leads other change efforts	$246,000
Business Strategist CIO	Works on developing business strategy, follows market trends, looks to create competitive differentiation, and develops new sales and distribution channels	$303,000

The State of the CIO Report [46], in fact, identifies three types of CIOs, with different responsibilities, different skills - and different average compensation levels (see Tab. 1).

Literature tends to identify as "CIOs" only the managers who correspond to the third CIO profile in Tab. 1,. i.e. the Business Strategist CIO; but, in the world of practice, in many organizations there are "CIOs" in charge of responsibilities that correspond to the first two roles identified in Tab. 1, i.e. Function Head and Transformational Leader.

In fact, the term "CIO" had a great success and it was widely adopted in practice, also for positions which do not correspond to the proper "textbook" definition of the role.

This led to various organizational solutions. We will cite here an example which seems particularly interesting for its "federal" approach to corporate IT: that of General Electric [55]. GE is organized in numerous Business Units. Information management in each Business Unit (BU) is run by a Divisional Information Manager (DIO). Each DIO is, then, the CIO of an individual Business Unit and is expected to act as an operationally oriented IT executive. Several Process Information Officers (PIO) report to DIOs and are in charge individual macro-processes within their business unit. A central, corporate CIO coordinates all the DIOs, providing strategic IT vision and standard setting.

In this case, then, there is a dual reporting relationship: on the one side, each DIO reports to his or her BU General Manager, and, on the other side, he or she reports to the corporate CIO. As a consequence of this organizational model, 32 people in GM were sporting the words "Information officer", IO, in their titles. "This decentralized structure can work well for big companies with a number of autonomous Business Units. The philosophy is that each division's distinct technology needs are best served not by a staff CIO but rather by a line CIO, or DIO, charged with looking out for that division's individual technology needs and interests" [55].

4.2 The Role of CIOs in Value Creation and the Emergence of Service Logic

The GE example helps us to understand that some CIOs play an hybrid role, in which they act also as line managers, committed in realizing benefits and revenues for the system [1].

In other words, whilst the "CIO revolution" of the 1980s had focused on the importance of emancipating the IT executives from line roles, to let them concentrate on staff activities (typically, advising the board and/or the top management team about technological choices), nowadays it has become apparent that in many cases CIOs are expected to give active contributions to value creation, and may act as line managers in many situations.

We suggest that the scholarly community could fruitfully concentrate on this evolution of the CIO role. We think that a key factor in triggering the evolution of the information management roles, beyond industrial sectors and corporate dimensions, is probably the emergence of *service logic* in today's globalized economy.

In fact, if an important component of what customers/users buy/use consists in services, even when they buy physical goods, this means that important processes of value adding occur during the interaction with customers/users – and then outside the IT department boundaries; often, even out of the organization's full control. As a consequence, since services are by definition information-intensive, information management is faced with new threats and new opportunities, and it requires new attitudes, new concepts and new tools.

A paper which tried to provide a framework addressing these emerging issues is Venkatraman [56].

Venkatraman introduces a framework, the Value Center, for managing IT resources. The Center consists of four building blocks of value from IT resources:

1. The **cost center** is the traditional way that companies have managed most IS activities. They allocate resources based on quantitative payback criteria, operate the infrastructure independent of business strategy, design the IS organization as a support unit reporting to finance, and assess it with cost-based indices.
2. The **service center**, is distinguished from a cost center because the expected benefit relates to business strategy. A company can assess a help desk in terms of the degree of perceived contribution to specific business processes, rather than in terms of operating costs. The degree of service orientation further distinguishes the service center.
3. The **investment center** has a strategic focus and tries to maximize business opportunity from IT resources. It focuses on scanning, selecting, evaluating, and transferring emerging technologies to the business.
4. The final building block, the **profit center**, focuses on delivering IT products and services to the external marketplace.

5 Conclusions

Our literature review demonstrated that the CIO's role is perceived as a highly challenging, tough job since this corporate title was created, in the early 1980s.

Studies have identified an impressive number of capabilities and responsibilities of the successful CIO; moreover, it has become clear that the CIO plays an hybrid, uneasy role, being often subject both to the challenges of staff managers (justify costs) and to those of line managers (give perceivable contribution to profits). Internal relationships and negotiations of the CIO with the CEO, with peers and with subordinates have been identified as key success factors.

New organizational and educational solutions are being developed to face the ever-evolving challenges of information management, and this issue is a powerful source of research questions for both scholarly and management oriented writings.

Since in the emerging service-centred economy even the most physical product is wrapped in services (let's think, for example, to customer care), more and more businesses tend to become, then, information- and network-intensive: in this scenario, the business relevance of information management goes far beyond what was thinkable when the corporate title of "CIO" was created, thirty years ago.

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Conceptualizing Cloud-Platforms as Service Systems

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Abstract. Cloud-platforms are of increasing importance for the provisioning of computing services because they enable the co-creation of value in an unprecedented way. To fully leverage the benefits it is necessary to know about the sources of value co-creation. The sources for value co-creation in cloud-platforms can be identified by conceptualizing cloud-platforms and analyzing operations on the conceptualization entities. To properly conceptualize cloud-platforms, configurations and configuration items are introduced as new entities. The set of operations on configuration items mirrors the value-co-creation capabilities of cloud-platforms. Thus, by enumerating the operations on configuration items, the value-co-creating capabilities of cloud-platforms can be determined and compared.

Keywords: Cloud-platform, cloud-service, configuration item.

1 Introduction

Cloud-computing [1], [2] started with the provisioning of single, isolated web-services such as the Amazon Web Services [3]. Over the time, cloud-computing evolved to cloud-platforms. Cloud-platforms are bundles of cloud-services [4] and resources selected to fulfill the requirements of a certain group of customers. Wide-spread examples are Office365 [5] and Google Apps [6]. They provide a bundle of services such as text-processing, email, spreadsheet calculation and provide storage resources for texts, spreadsheets and offer resources as show in Fig. 1. Examples for such resources are storage for documents, spreadsheet. They can be either used by the cloud-services or accessed directly, e.g. to store files on the cloud-platform. Cloud-platforms also manage human resources by providing a user administration. Users allowed accessing the cloud-platform are managed. The access of users to services and resources can be configured individually.

The huge success of cloud-platforms compared to earlier approaches is caused primarily by enhanced capabilities to co-create value [7]. Therefore, to analyze and further optimize the co-creation of value by cloud-platforms it is necessary to identify the sources of value-co-creation. An important factor in the co-creation of value by cloud-platforms is their flexibility. The flexibility of cloud-platforms embraces the dimensions configurability and extensibility. Configurability is the adaptation of cloud services and resources by the cloud user. Extensibility is the capability to integrate external services and import resources. The high degree of configurability and extensibility allows to tailor

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cloud-platform to individual requirements and to implement business process changes in a very flexible way. By using the configuration and extensions mechanisms of cloud-platforms, the cloud-user is capable to co-create value.

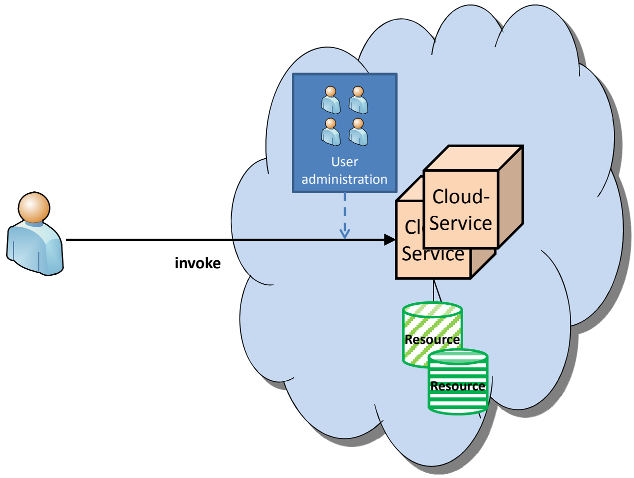

Fig. 1. Cloud-Platform

The contribution of this paper is to identify the sources of value-co-creation by conceptualizing cloud-platforms as services systems [7], [8] and deriving configuration and extension operations on the conceptualization. To properly conceptualize cloud-platforms, configurations and configuration items are introduced as new entities. The set of operations on configuration items mirrors the value-co-creation capabilities of cloud-platforms. Thus, by enumerating the operations on configuration items, the value-co-creating capabilities of cloud-platforms can be determined and compared.

The paper proceeds as follows. First service systems are described and conceptualized. Static cloud-platforms are analyzed and more enhanced types of cloud-platforms classified. Then these enhanced types of cloud-platforms are conceptualized. In particular, configuration items and configuration item types are introduced into the conceptualization of the cloud-platforms. In section 5, the value-co-creating operations on these entities are identified. To show the progress achieve by this paper, related work is discussed. Finally, a conclusion and outlook is given.

2 Service Systems

For a long time, the understanding prevailed, that services should be provided in the same way as industry produces goods. This school of thinking is also called Goods-Dominant Logic [9]. Following the ideas of Taylorism [10] and Fordism [11], [12], services are produced separately from the customer in order to achieve high economies of scale. The client receiving a service had been regarded as a passive consumer.

However, this approach differentiating strictly between an active, value-creating producer and a passive, value-destroying consumer is questioned increasingly. Instead, the producer interacts with an active consumer, called prosumer. Both create value. In this way, the former unidirectional structure of service provisioning is transformed to a bidirectional and dynamic one. Service consumers have an increasingly active role in service provisioning. Thus, the former service consumer becomes an actively involved prosumer [13]. The so-called Service-Dominant Logic [9] promotes this approach. An important concept of Service-Dominant Logic and service science [14], [15] are service systems [7], [8] . In J. Spohrer, et. al. [7]. a service system is defined as a configuration of services and resources supporting the value co-production. Therefore a service system shall be conceptualized as shown in Fig. 2. A service system co-creates services and is itself a resource. Service systems may be either atomic or composite. Composite service systems may be organized either hierarchical or market-based. The services are co-created using a configuration of operant and operand resources. Supporting services are regarded as operant resources [7], [8]. Passive resources are name operand resources. To make operant and operand resources easier to distinguish, operant resources shall be named t-resources ad operand resources shall be name d-resources.

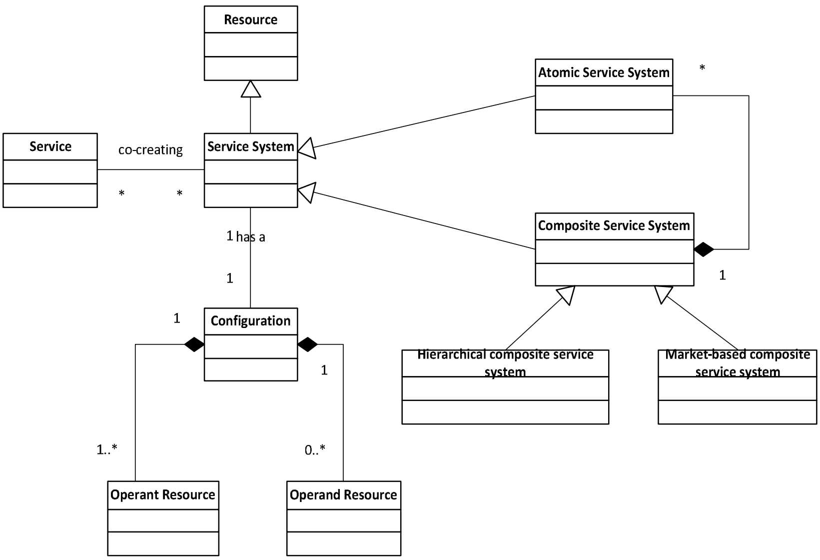

Fig. 2. Service System

3 Cloud-Platforms

Cloud-platforms are bundles of services and resources. They are increasingly used by enterprise to support their business processes, because they offer a huge potential of value-co-creation. Up to now, scalability and cost have been regarded as the primary factors for the success of cloud-platforms. Cloud-platforms offer a high degree of scalability and are nearly immediately available as shown in Fig. 3. They can be used with nearly zero upfront investments and have a proportional cost structure.

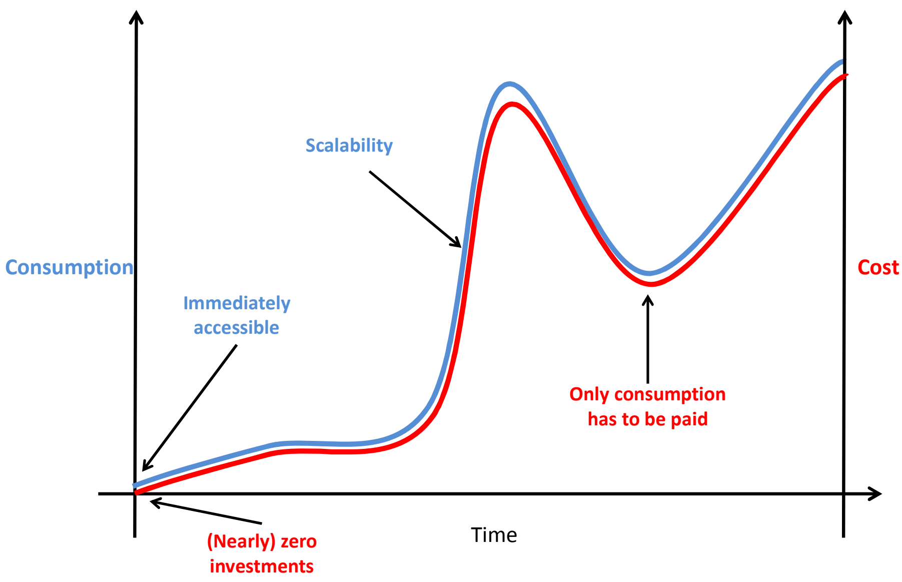

Fig. 3. Non-functional properties of cloud-platforms enabling value-co-creation [own graphics]

Nowadays, it becomes more and more obvious, that additional factors strongly influence the co-creation of value by present cloud-computing platforms. The first cloud-platforms had no means for configuring services and resources. They also lacked any possibility to extend or change the predefined bundle of services and resources. Such static cloud-platforms (SCPs) did not allow tailoring them according to individual customer requirements. Static cloud-platforms quickly create a number of problems. Because services cannot be integrated into an existing cloud-platform, the user needs multiple separate cloud-platforms. In this way, a "jungle" of isolated cloud-platforms arises. Each of them has an own password, resource administration etc. Furthermore, it is difficult to exchange information between the static cloud-platforms. Often, this has to be accomplished manually. Very quickly redundant data are created in the different cloud-platform and thus the danger of inconsistent information arises.

To overcome the problems identified above, cloud-platforms have been enhanced by configuration and extensibility capabilities, as shown in Table 1. Configurable cloud-platforms (CCPs) allow configuring services and resources. Extensible cloud-platforms (ECPs) provide the possibility to extend and change the set of services and resources. Dynamic cloud-platforms (DCPs) provide both the capabilities of CCPs and ECPs.

Table 1. Classification of Cloud Platforms

Configurable	Configurable Cloud Platform (CCP)	Dynamic Cloud Platform (DCP)
Not configurable	Static Cloud Platform (SCP)	Extensible Cloud-platform (ECP)
	Not extensible	**Extensible**

4 Cloud-Platforms as Service Systems

To identify the sources of value-co-creation by cloud-platforms, it is necessary to properly conceptualize cloud-platforms. A crucial role in this effort plays the introduction of configuration and configuration items that are necessary to represent the configuration and extension capabilities of cloud-platforms. To develop a conceptualization of dynamic cloud-platforms, a step-by-step approach shall be applied. First, configurable cloud platforms (CCEs) and extensible cloud-platforms (ECEs) shall be conceptualized separately. Then, the conceptualizations shall be merged in order to create a conceptualization for dynamic cloud-platforms. To create a more detailed view on cloud platforms, configurations and configuration items shall be introduced into the conceptualization of the cloud-platforms (CCP, ECP and DCP).

4.1 Configurable Cloud-Platforms (CCP)

Configurable Cloud-platforms allow configuring cloud-services and resources according to individual requirements. Thus, a CCP is defined as a configuration of services and resources, as shown in Fig. 4. A configuration consists of a set of configuration items representing operant resources (t-resources) and operand resources (d-resources). Configuration items can be assigned in different ways. By introducing the entities configuration and configuration item, it is possible to separate abstract specifications from the real services and resources. Thus, a layer of indirection is created that allows assigning real services and resources.

Every service is associated with a t-resource configuration item representing the configuration of the service. Service configuration items can be assigned with other service configuration items to represent the composition of services from sub-services. D-resource configuration items can be assigned with other resource configuration items to represent part-of relationships between resources. For all configuration items, a modify operation is defined which allows to change the configuration item itself. Furthermore, it is possible to indicate the use of a resource by a service.

Examples of configurable cloud-platforms are many cloud-based e-mail systems. They allow tailoring the e-mail service to individual requirements.

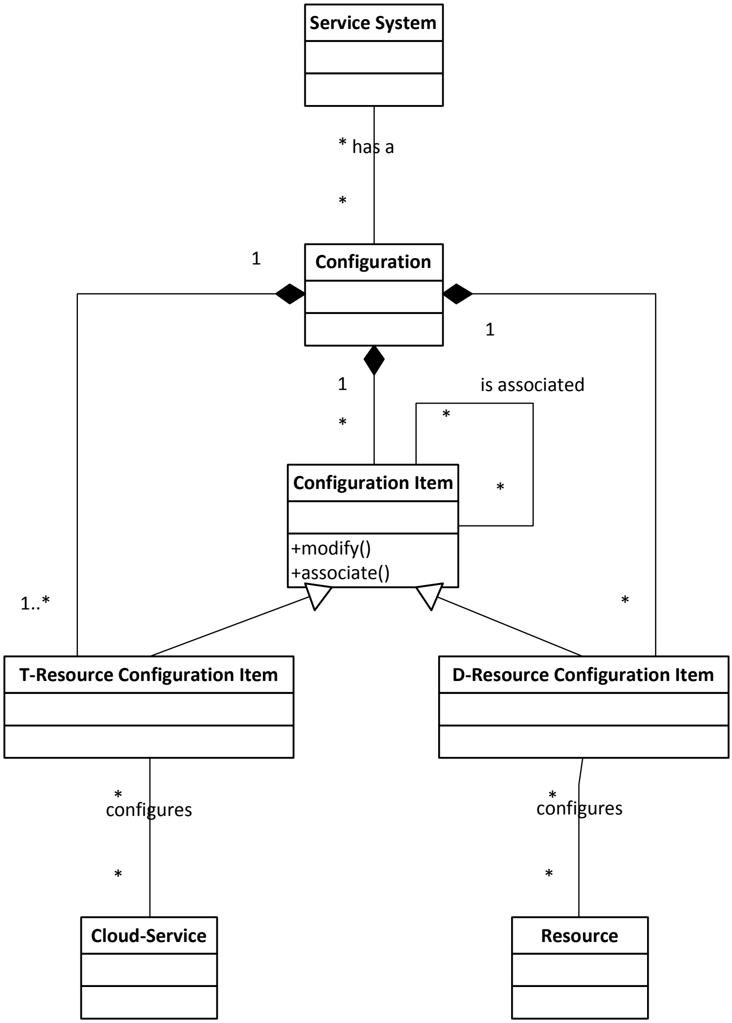

Fig. 4. Configurable cloud-platform (CCP)

4.2 Extensible Cloud-Platforms (ECP)

Extensible cloud-platforms (see Fig.3) achieve extensibility for services and resources on different ways. Services are integrated, resources are imported. Services remain outside the sphere of control of the cloud-platform. On the contrary, the extension of cloud-platforms by resources is achieved by importing them. That means they are moved into the sphere of control [16] of the cloud-platform. Moving a resource into the sphere of control of the cloud-platform allows to manage it more efficiently, e.g. change it in the context of a transaction [17].

To represent the integration of services and the import of resources of arbitrary type, new t-resource or d-resource configuration items are created and services or resources assigned to them. To represent the type, t-resource configuration items are assigned to a service configuration item type and d-resource configuration items are assigned to resource configuration item types respectively.

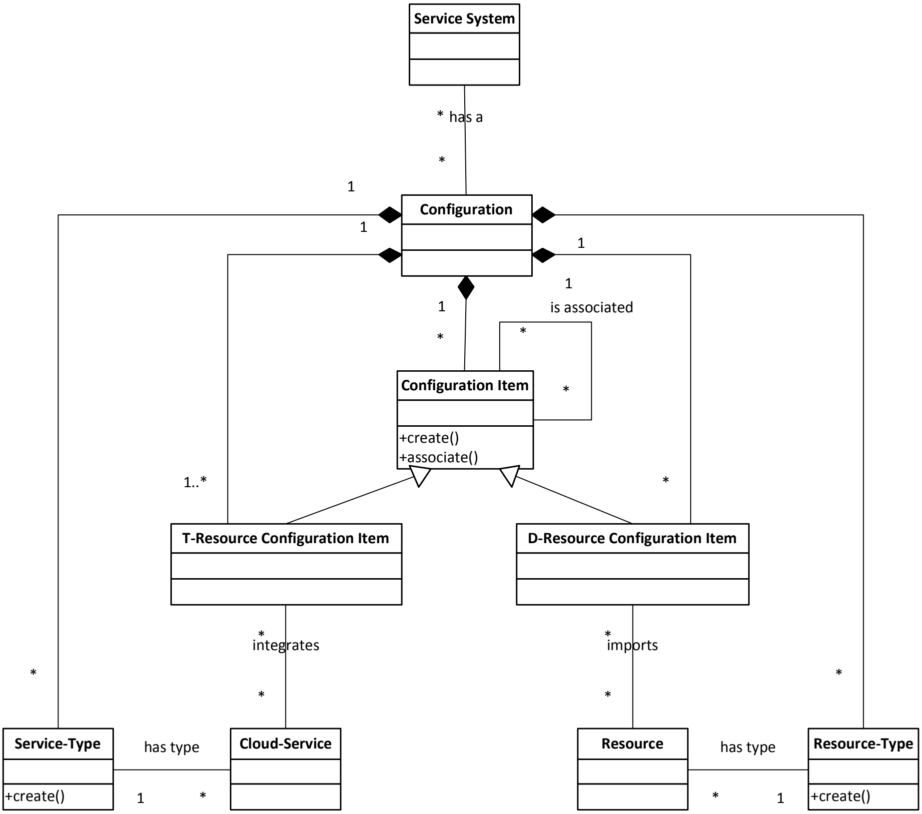

Fig. 5. Extensible cloud-platform

Examples for extensible cloud-platforms are many wiki-like systems such as Google Sites [6]. They allow integrating external services into the sites.

4.3 Dynamic Cloud-Platforms (DCP)

Dynamic cloud-platforms are the most flexible cloud-platforms by combining the capabilities of configurable and extensible cloud platforms. Their conceptualization is shown in Fig. 6. The configuration items offer the union of the operation of CCPs and ECPs: create, modify and assign. The service-configuration items can be used to configure and integrate services, the resource configuration items allow to configure and integrate resources.

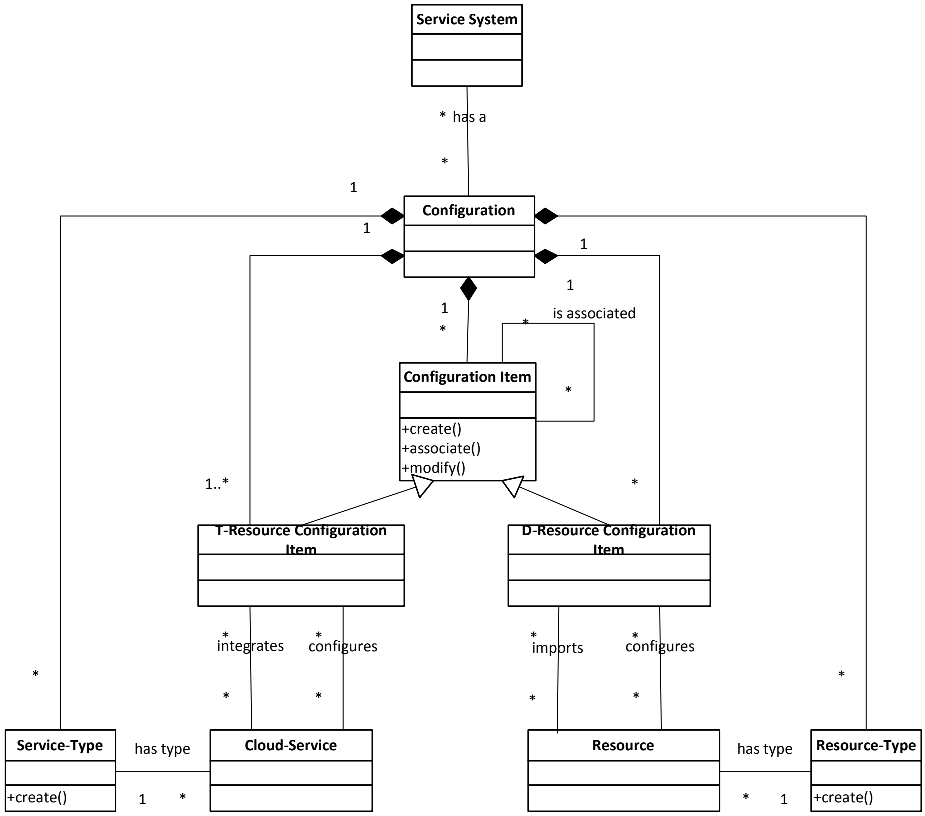

Fig. 6. Dynamic cloud-platform (DCP)

5 Identifying Value Co-creating Operations of Cloud-Platforms

The conceptualisations developed and the operations defined are the foundation for identifying value co-creating operations of cloud-platforms. The degree of value-co-creation can be expressed by the availability of operations on the conceptualization of the cloud-platform.

5.1 Integration

First the operations representing the extensibility of cloud-platforms shall be investigated. The capabilities of a cloud-platform to integrate services and import resources can be differentiated into three levels. The three levels of integration and import capabilities are shown in Table 2.

1. First, it may be possible to integrate or import every type of service or resources respectively. This can be expressed by the creation of new entities

of service or configuration item types in addition to the creation of service and resource configuration items. Concrete services are assigned to the newly created configuration items. An example is the integration of services from the Google Marketplace into Google Apps [6].

2. Second, only the integration of services and resources of predefined types may be possible. This is expressed by the creation of configuration items only. The integration of so-called gadgets into Google Sites [6] is an example.
3. Third, also the cardinality may be restricted. In this case, it is only possible to assign services and resources to already existing configuration items. Office 365 allows to integrate one active directory service [18].

Table 2. Levels of integration and import

	Create service configuration item type	Create service configuration item	Assign services
Integrate / import arbitrary types	+	+	+
Integrate / import predefined types		+	+
Integrate / import with predefined type and cardinality			+

5.2 Configuration

The configuration capabilities of cloud-platforms can be expressed by operations on configuration items, too. By changing a configuration item, the configuration of a service or a resource can be changed. By changing an assignment of a service or resource, the capability to replace services and resources is expressed. If this capability is missing, the set of cloud-services may be extended, but the assignment of the already existing services may not be changed. The disintegration of a service or resource can be described as deletion of a configuration item. The configuration of services and resources is denoted by the modification of configurations items and their relationships.

5.3 Comparing Office365 and Google Apps

The framework created is now used to compare two popular cloud-platforms Office365 [5] and Google Apps [6] (see Table 3). Both are dynamic cloud-platforms, but they differ in the degree of extensibility. Office 365 does not allow the integration of services of arbitrary type only the integration of one Active Directory Service [18]. Thus, there are type and cardinality constraints. Integration may take several ours due to the configuration effort. Google Sites allows integrating arbitrary services via its marketplace. The integration takes place immediately.

Table 3. Comparing Office365 and Google Apps

Cloud-platform	Extensibility		Configurability	
	Service (Integrate)	Resource (Import)	Service	Resource
Office 365	Only Active Directory	Only files of predefined types,	Yes	Yes
			Immediately	*Immediately*
Google Apps	Yes, via Marketplace	Only files of predefined types	Yes	Yes

Both Office365 [5] and Google Apps [6] allow to import resources, however there are type constraints: Only files of pre-defined types may be imported. The import takes place immediately. Office 365 supports the import and export of documents either manually or in batch mode. Google Apps supports the import and export of documents both manually and automatically. Office 365 and Google Apps allow changing the configuration of the services and resources. Changes become effective immediately.

6 Related Work

Related work can be classified into several areas. First, there are approaches for describing the properties of single services. Second, some approaches try to identify management interactions accompanying services. Third, there are some approaches to conceptualize service systems.

The functional properties of technical services such as defined in Service-Oriented-Architectures (SOA) [19] can be described using the Web Service Description Language [20]. More complex functionality can be described using the Unified Service Description Language [21]. The non-functional properties can be defined in so-called service level agreements and implemented in WSLA (Web Service Level Agreement framework) [22]. The Web Service Modelling Ontology [23] provides the semantic description of web services in order to facilitate the discovery, combination and invocation of web services. It is limited to the static properties of web services. OWL-S [24] is an ontology describing web services by a profile, a grounding and a process. The service profile describes what the service does in three dimensions. The functional aspect contains inputs, outputs, results etc. The classification aspect defines how the service is embedded into business taxonomies etc. The non-functional aspect covers quality parameters. The process model describes how to interact with the service in the operational phase. However, it does not cover the other phases. The grounding defines how to interact with the service. To do so, a mapping between the process of the process model and concrete operations in WSDL is defined.

Up to now, there are only some ad-hoc approaches for identifying management operations in the context of services such as integration and configuration. In [25], a first approach for capturing interactions in the context of cloud-services is developed. However, this approach only considers operations for defining services and does not support other kinds of interactions. The approach in [26] provides means to model conversations within complex web-services. In particular it allows specifying valid operations in every status of the web service. However, it handles the operating phase only. The WSDM-standard created by OASIS (Web Services Distributed Management) [27] is based on the OASIS Web Services Resource Framework (WSRF) [28] for modelling and accessing stateful resources using web-services. The WSDM-standard consists of a first part, called management using web services (MUWS), is devoted to the management of resources [29]. The second part, called management of Web Services (MOWS) [30], is used for the management of web services. Unfortunately, this approach is constrained to functional and non-functional properties of web-services. The WSDM-standard manages the operational status of web services, but not the interactions outside the operation phase of the web service.

In [31] the resource-event-agent enterprise ontology (REA) is used to conceptualize service systems. To do so, REA is interpreted with a Service-Dominant-Logic perspective. As a result, the Resource-Service-System model is defined. In [32] the Resource-Service-System model is used as conceptual model of service systems. In [33] a tool for the conceptual design of service systems is developed. In [34] a concept for service systems is defined.

7 Conclusion

Cloud-services are more and more bundled with resources into cloud-platforms. Cloud-platforms provide value co-creating capabilities in an unprecedented way. To analyze and further optimize the co-creation of value by cloud-platforms the sources of value-co-creation have to be identified. This has been done by conceptualizing cloud-platforms as services systems [7], [8] and deriving configuration and extension operations on the conceptualization. Configurations and configuration items have been introduced into the conceptualization.

The operations identified are of particular importance because their availability within a cloud-platform strongly influences the value provided by a cloud-platform offered. To a customer not only the functionality provided by the cloud-platform is important, but also the flexibility in tailoring the cloud-platform to individual needs or to adapt it to changed requirements.

Further work will have to give more details on the framework. E.g. the integration of resources may be further differentiated. There may be a read-only access, a write access and there may be a transaction-protected integration.

Another area is the identification of inverse operations. For some operations inverse operations can be identified. E.g. the import of resources can be inversed. Such an export operations may be of high importance to avoid a vendor lock-in [35]. Only if the customer is capable to get back quickly his resources, he can move to another cloud-service vendor easily. That means, the possibility to export resources facilitates the change of the cloud-platform provider.

The capability to integrate services should be mirrored by the possibility to disintegrate the services when no longer needed. However, it may also be useful to disintegrate services which have been part of the pre-defined configuration. E.g. some services provided by cloud-platforms may distract the employees from their work.

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Designing 3D Virtual World Platforms for E-Learning Services. New Frontiers of Organizational Training

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Abstract. The World Wide Web is, amongst the several different media available, the most global, interactive, and dynamic medium to share information. World wide web services were used in the last decade for e-learning applications, both in academic and business settings. E-learning services, provided through e-learning platforms, allow individuals to develop competences that might turn into organizational competences and eventually lead to competitive advantage. The development and usage of 3D virtual world platforms for e-learning services is an emerging phenomenon that challenges and enlarges the very idea of *learning environment*. Within this context this paper sheds light on this new frontier of e-learning services analyzing relevant literature on the application of 3D virtual world platforms in this context.

Keywords: 3D Virtual Worlds Platforms, E-learning Services, Human Resources Training.

1 Introduction

Nowadays the Internet has a user base of 2 billions. It reaches roughly one third of the world population, with a growth rate of 444,8% over a ten years period [1]. Thanks to this evolution the Internet allowed the World Wide Web to be, amongst the several different media available, the most global, interactive, and dynamic medium to share contents and information. Internet services have been used for a plethora of different applications, and new ones are continuously being produced.

In the last decade, Internet services were extensively applied to e-learning applications, both in academic and in business settings [2, 3]. E-learning services are provided through e-learning platforms, and provide virtual spaces capable of distributing course-related contents [4], using either the Internet, or other media like satellite transmission, interactive TV, or audio/video media (tape, CD-Rom) for communication [5]. In this paper we use e-learning as a broad term that encompasses several possible alternative synonymous: Web-Based Learning (WBL), Internet-Based Training (IBT), Advanced Distributed Learning (ADL), Web-Based Instruction (WBI), Online Learning (OL) and Open/Flexible Learning (OFL) [6].

When e-learning is applied to human resources training, a different paradigm enters into play. According to the *Bucket Theory* the mind of the learner is a container inside which the lecturer deposits part of his knowledge. The teacher is the sole owner

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of the knowledge, while the learner is a passive receiver [7]. E-learning instead usually brings into play interactions, and promotes communication into team works, groups' activities, peer interaction, and cooperation into the learning process. The lecture is no longer the only key actor. He is now rather the member of a new community, which includes lecturers, tutors, and learners, all acting as a *knowledge building community* [8, 9, 10, 11]. The application of 3D virtual world platforms to e-learning services is a new and emergent phenomenon [12] that potentially challenges and enlarges the very idea of *learning environment*.

In public and private business settings, during such learning processes, human resources can develop individual competences and skills that might turn into a competitive advantage for the organizations they work for. The interactions among members of the same organization are a crucial starting point to turn individual competences into organizational ones [13]. Fostering the development and the reinforcement of organizational competences [14] managers can guarantee continuous improvements of organizational performances [15]. As a matter of fact, a source of competitive advantage lies in the ability of top management to consolidate technologies and productive capacity into core competences that allow each business to quickly adapt to continuously changing scenarios and to capture potential market opportunities [16]. Competences are specific characteristics of the individual human resource. They are connected to an effective superior performance within specific tasks, which can be measured on the basis of pre-established criteria [15].

Learning is indeed a deep and global activity that produces an intellectual, physical, and moral change within the individual. Learning can be an effective mean to develop human resources core competences [17]. E-learning has been defined as a suitable learning strategy to develop, improve, and transfer competences, especially at managerial level [18].

This paper aims at investigating, from a theoretical point of view, how the potential use of 3D virtual worlds platforms might affect e-learning services for human resources training. A design research approach is followed in the paper with the intent of providing requisites for the design of 3D virtual world platforms suitable for e-learning applications.

The structure of the paper is as follows: after this introduction section 2 will describe the research design pointing out the objectives of the paper, and the methodology followed. Section 3 will discuss kernel theories related to e-learning strategies, and section 4 will instead discuss the application of 3D virtual worlds platform to e-learning. Section 5 will describe the meta-requirements of a 3D virtual world platform for e-learning services. Final considerations and brief information on future steps of the research will conclude the paper in section 6.

2 Research Design

The problem of providing requirements for the design of a 3D virtual world platform for e-learning applications is, following Walls et al. [19], Simon's [20], and Dubin's [21] works, an "IS design theory". In this article, and in the later review and assessment of their original contribution [19] Walls et al. state that a design theory is composed by: a design product, and a design process. The design product is in turn composed by:

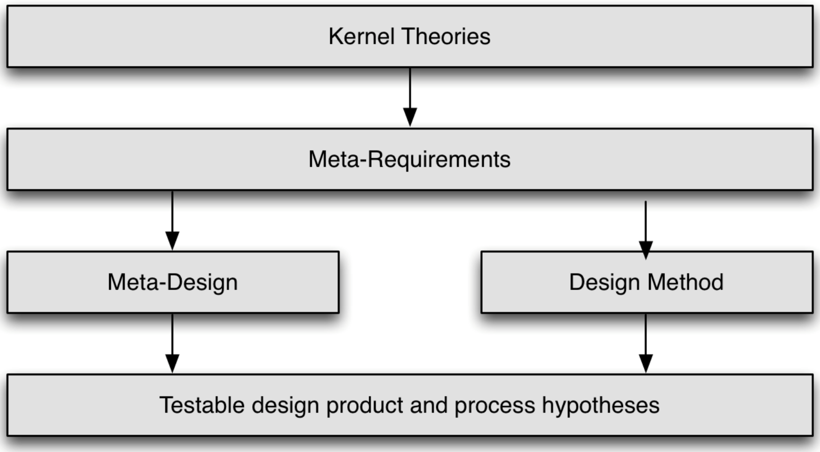

Fig. 1. Relationships among IS Design Theory components – Personal adaptation from [22]

meta-requirements, meta-design, kernel theories, and a set of testable design hypothesis. The design process is composed by the design method, the kernel theories, and a set of testable design process hypothesis. Wall's et al. model has later been extended by Gregor and Jones [22] who have proposed a new skeleton for IS design theories based on eight components.

The model to formulate design theories adopted for this paper lies on both the above-mentioned framework and is depicted in Fig. 1. The definitions of the terms mentioned in Fig. 1 are provided in Tab. 1.

Following this research framework, kernel theories compose the justificatory knowledge [12], and are the core of the entire design research effort. The clarification and the identification of the scopes and purposes of these theories is a necessary intermediate step for the definition of a design theory for the application of 3D virtual worlds platforms for e-learning applications. The kernel theory adopted for this paper will then be described in the following section. The description of the kernel theories will be the basis on top of which prescriptions for meta-requirements, meta-design, design process, and testable design product and process hypothesis can be formulated. The kernel theories we are addressing in this paper refer to the different strategies of e-learning applications (described in section 3), and to the usage of 3D virtual world platform for collaborative e-learning strategies (described in section 4).

The design research effort is supported with the empirical setting of the LiVES (Learning in Virtual and Extended Spaces) project, a technology transfer project that involves an Italian University and an Italian company. The LiVES project aims at studying the potential application of 3D virtual worlds to lifelong vocational training through the definition, creation, integration, and experimentation of an innovative platform based on an interactive virtual class. In this class professionals and/or students can discuss, share experiences, and learn. The project aims at reaching this goal through the following activities:

- Customization of a 3D virtual world platform to the needs of human resources training activities;
- Creation of a virtual environment managed by the platform, where training activities shall take place;
- Adoption of avatars to support users' interaction and learning activities;
- Creation of specific areas for learners and tutors, as well as common areas for free discussions;
- Creation of software tools useful for training activities.

Table 1. Components of an IS design theory – cfr. [21] and [19]

Components	Description
Kernel Theory	The underlying knowledge or theory from the natural or social or design sciences that gives a basis and explanation for the design
Meta-Requirements	The class of goals to which the theory applies
Meta-Design	The abstract "blueprint" or architecture that describes an IS artifact, either product or method/intervention
Design Methods	A description of processes for implementing the theory (either product or method) in specific contexts
Testable Propositions	Truth statements about the design theory

3 E-Learning Strategies

E-learning can be applied following different strategies [23]. Each of these strategies differs not only for the roles of the actors into play, but also for the characteristics of the underpinning learning process [24]. An overview of the e-learning strategies available in literature is provided in Fig. 2. There are three e-learning strategies: open and flexible learning, distributed learning, and learning communities. The latter strategy is subsequently split in communities of practice, and knowledge building communities [25].

The *open and flexible learning* strategy describes a distant learning process. In this strategy, the objective is to create an immediately available learning environment (here and now) [26] to satisfy learners' needs, on a given curriculum. This is a student centred model focusing on learning rather than teaching. The learning process is in this case autonomous and the student has no interaction with other subjects.

The *distributed learning* strategy is based on the possibility of providing training at any time, any place thanks to an appropriate mix of different technologies [27]. Within this contest, learners can complete courses and study programs at home or at their workplace, by communicating with lecturers and with colleagues via e-mail, forum, videoconference, or other IT-based forms of communication. In this strategy tutors and lecturers enter into play, and students interact with them. The learning process is assisted.

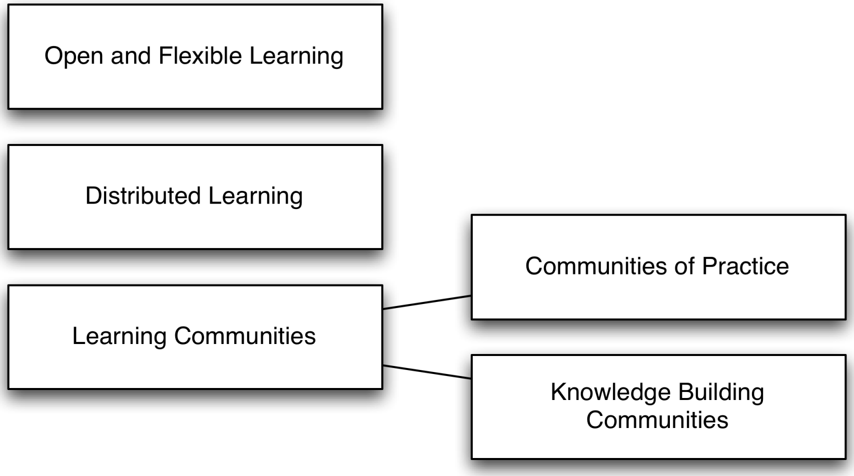

Fig. 2. Different e-learning strategies

Finally a *learning community* is a group of people supporting other people in their learning activities, by working together on collaborative projects. Following this strategy, learners learn from each other's through a collective socio-cultural experience where participation leads to learning [28, 29]. Learning communities provide participants the opportunity to make experiences on interdisciplinary topics, by promoting connections among them, between learners and lecturers, and among all the different subjects involved [30]. Learning communities are informal learning environments, where emphasis shifts from teaching to learning, and the learning process is collaborative. As per any kind of online community, in learning communities every participant shall have both the opportunity and the motivation to participate and contribute [31 citing 32].

The term *learning community* includes any social network that puts people together in order to share knowledge. For this reason, *learning communities* can be further detailed in *communities of practice*, and *knowledge building communities* [25].

The *communities of practice* are groups of people who are informally united by sharing experiences and passion for a common task [33]. Such communities are common in academic and business environments where knowledge is seen as an intellectual capital [34].

The *knowledge building communities* are learning communities where communication is perceived as a transformation (meaning a new learning experience) through knowledge sharing and building. Participants share a common goal to build and share knowledge through activities, projects, and discussions. Within this setting the lecturer and the tutor are active participants [35].

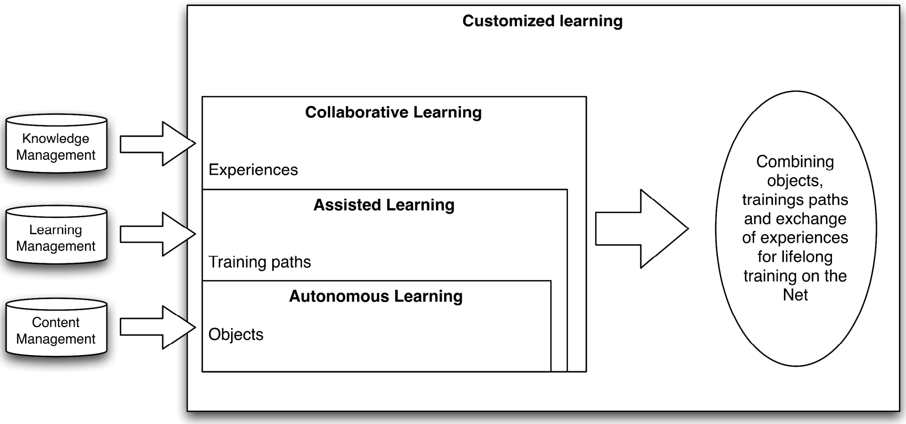

Fig. 3. E-learning strategies – Our adaptation from Salis et al. [36]

The three different e-learning strategies are mixed with different requirements the platform used to deliver these services has to fulfil [36]. These requirements, and their relations, are shown in Fig. 3.

The open and flexible learning strategy is basically targeted to support autonomous learning processes. The platform used to deliver e-learning services in this case is basically a content management system that provides learners with different learning objects.

When moving to a distributed learning strategy the platform shall be capable of managing training paths. A training path connects among them different learning objects in a specified relation that is suitable to achieve a learning objective. In this case the learning is assisted, and the platform shall act as a learning management system. Distributed learning is inclusive of autonomous learning, therefore the learning management system shall also work as a content management system, and manage learning objects.

Finally when learning communities are brought into play a collaborative learning paradigm is used. In this case the platform shall allow the exchange of knowledge and experience among participants, working mainly as a knowledge management platform.

4 Collaborative Learning in 3D Virtual Worlds

In the last years, technological innovations contributed to create new methods of interaction among individuals. These have been applied in many fields, including learning and training. The kind of technological innovations we are talking about allow the design and deployment of 3D virtual worlds. These 3D virtual worlds can be defined as a set of nodes (PC desktops) connected in a network, where users move and interact in a 3D environment [37]. A software platform is responsible of managing the virtual world with all its objects, rules, and actors. Within the 3D environment, avatars represent users. By using these avatars users can interact with other avatars (i.e. other users), and with objects located in the 3D virtual environment. When used for these purposes, these technologies set new challenges and enlarge the very idea of *learning environment* [37].

According to the experience of the authors, and to information available over the Internet, the most popular 3D virtual world platforms are listed in Tab. 2. Each of these platforms has different functions. Anyhow, as testified by the last two columns in Tab. 2, they share some common contact points. They all implement basic features like: interactive 3D environments that allows users to interact with objects (in some cases also to create new ones), avatars for representing users, interactive chat-rooms to allow users to communicate among each other.

Even if 3D virtual words are still in evolution, they provide communication opportunities supported by text/chat/audio-based applications, such as Multiple User Domains (MUD) Object Oriented (MUD Object Oriented, MOO). Usually, these latter support constructive learning, and allow the development of knowledge building communities [38] by promoting interactive learning, cooperation and commitment opportunities in space and time, both within and among classes [39].

According to Monahan [40], 3D virtual worlds replace "text-based online learning environment" with "immersive platforms". Unlike MOOs, they provide 3D visual representations of space and allow learners to interact with information from their own point of view, supporting learning activities based on constructivism [41, 42, 43]. According to Winn [44], during a traditional course, information is often provided like a "third person symbolic experience". On the contrary, the most effective way to learn is through a direct experience. 3D virtual worlds can contribute to fill the gap between experiential learning and the symbolic representation of information [44].

Moreover 3D virtual worlds when applied to e-learning settings can also deliver another contribution. In any e-learning strategy the interaction between learners and teachers, and the interaction between them and the learning objects, always take place in a *virtual* (different from reality) environment. Even when this environment is not a virtual world, is anyhow different from the reality since it might use a mix of different digital media (i.e. web, chat, audio conferences, video conferences). Each of these media is characterized by a different richness in the message it is capable of delivering [45]. According to the media richness theory, Fig. 4 shows how the richest medium is the face-to-face interaction, where verbal communication is enriched by behavior, presence, and other factors. On the other opposite, unaddressed written communication (like in the case of bulk e-mails or posters) is the less rich medium since it totally lacks the physical interaction between the recipient and the sender. All the other media (chat, audio conference, video conference) are positioned between these extremes since they allow more and more reduced parts of physical interaction to enter into communication process. 3D virtual worlds are not listed in the media richness theory. Anyhow we argue that they can allow a communication and an interaction richer than those of written documents, and of voice based channels, if they allow audio broadcasting among users or they just rely on text chats, and more close to the face-to-face experience.

Table 2. Most famous 3D virtual world platforms

Name	Operated by	Released in	Objects Creation	Notes
Adobe Atmosphere	Adobe Systems	2001	Yes	Worlds explored with a free browser plugin
				Discontinued commercial project
Active Worlds	Active Worlds Inc.	1997	Yes	Comprehensive platform for delivering real-time interactive 3D contents over the web
Blue Mars	Avatar Reality	2009	Yes	Avatars and real estate customization
				Objects have to be purchased
Club Cooee	Cooee GmbH	2009	No	Avatar customization
				Basically a 3D chatting client
Football Superstars	Cyber Sports Ltd	2008	No	Avatar customization
				Football MMORPG with a social virtual world aspect outside of playing games
Frenzo	Frenzo.com	Not yet (beta)	Yes	Avatar and room customization
				3D chatting client soon expanded
FriendsHangout	Evolver.com	2009	Limited	3D chatting client
	FriendsHangout.com			
Gojiyo	The Godrej Group	2010	No	Simple avatar customization
IMVU	IMVU Inc.	2008	Yes	3D chatting client
				No free areas to explore
				Includes a social network system
Kaneva	Kaneva Inc.	2007 (beta)	Limited	Limited avatar customization
				Includes a social network system
Moove	Moove	2001	Limited	Old graphic engine
				Rooms hosted on users computers
				No central virtual world to visit
OnLive! Traveler				Mix of free and paid objects
OpenSim	Open Simulator community	2007	Yes	Open source multi-platform, multi-user 3D application server
				Worlds can be accessed through a variety of clients and protocols
OpenWonderLand	Activeworlds Inc.	1997	Yes	Land building, free world
				Simple customizable avatars
OSGrid	OSGrid.org	Not yet	Yes	Project started in 2007 built over OpenSim and contributed by IBM
				Open Source 3D virtual platform
SecondLife	Linden Labs	2003	Yes	Largest 3D virtual world in terms of membership and activity
				Land can be purchased or rent

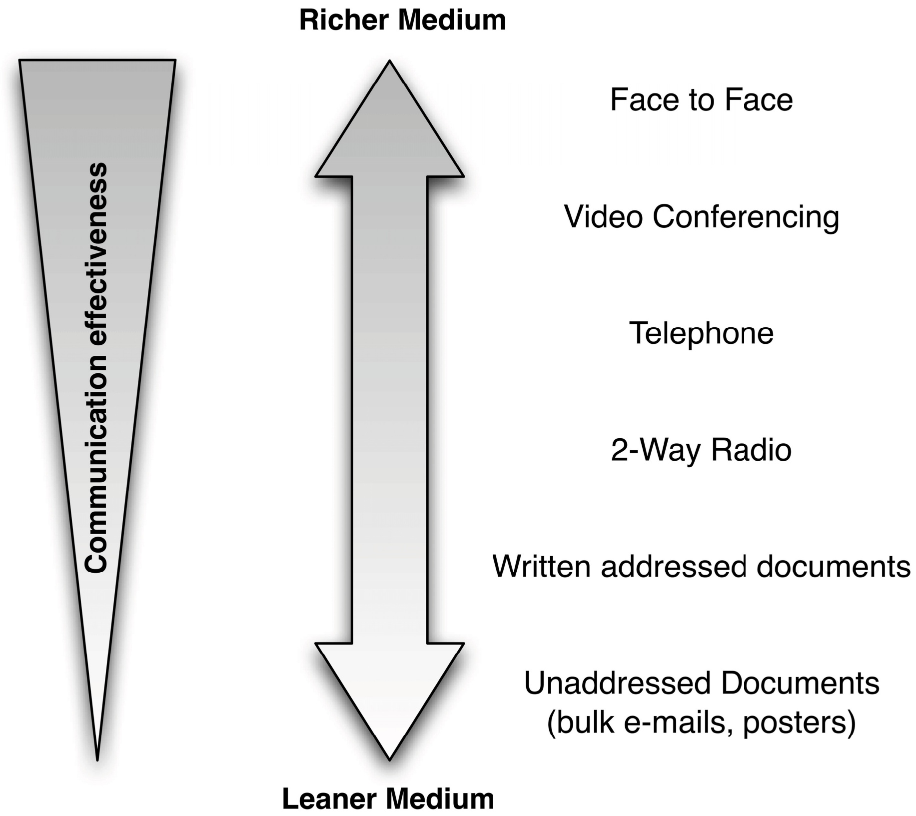

Fig. 4. Media richness theory [45]

A final aspect to be taken into consideration is the naturalness of the different media. According to the media naturalness theory [46], the different media are not only characterized by a different degree of richness of the communication they allow, but also by a different perceived naturalness. The most natural mean is again the face-to-face interaction. All the other means have a lower degree of naturalness in two different directions: on one side they represent reductions of the reality (e-mail, chat, video conference), on the other, amplifications ad artificial reproductions of the reality (super-rich virtual reality media).

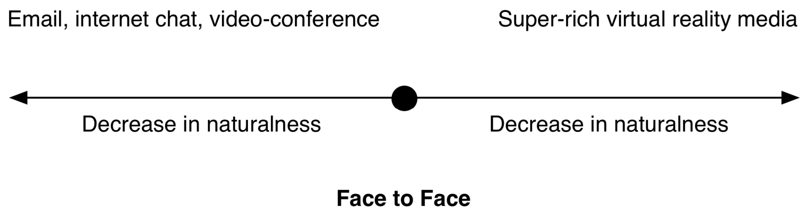

Fig. 5. Media naturalness theory [46]

Taking both theoretical stances together, 3D virtual worlds might allow for richness but less natural users interaction.

5 Meta-requirements for 3D Virtual Word Platforms

In the light of the literature discussed in the previous sections we can summarize that e-learning is a viable strategy that is currently used to transfer individual competences both in academic and business settings. E-learning has traditionally made use of a set of technologies as media of communication to put learners, lecturers, and tutors in contact. 3D virtual world platforms emerge as potential new technologies to run e-learning strategies. The application of 3D virtual world platforms to e-learning constitutes a new frontier in the field of human resource training, since these technologies challenge and extend the very concept of *learning environment*, offering a more rich, even though probably less natural, medium of interaction.

Anyhow 3D virtual world platforms have not been created with e-learning applications in mind. They nonetheless possess feature that promote the interaction among users, represented by avatars, and objects in the virtual world. Therefore, according to the kernel theories discussed in section 3 and 4, we argue that a 3D virtual world platform to be used for e-learning strategy shall be capable of:

- Managing learning objects amongst the several different kinds of other objects usually managed;
- Managing virtual spaces (rooms) where interaction and learning take place;
- Allowing lecturers or tutors to create learning paths connecting the different learning objects;
- Allowing learners to follow such learning paths;
- Allowing learners or tutors to grant users access to the virtual spaces where interaction and learning take place;
- Allow interaction and experience sharing among actors (both learners and teachers) to generate and disseminate knowledge among them.

The capability of building contents and objects that some 3D virtual world platforms offer can also contribute to enrich the learning experience of participants. In this case not only teachers can create learning objects or learning paths, but also learners can do so. This is necessary to implement collaborative learning strategy or peer tutoring.

In the end, the interaction with the users and the 3D virtual platform shall:

- Allow learners to actively take part to training activities in a more natural, effective and pleasant way;
- Stimulate social interaction through an interactive information/communi cation flow among users in real time, even when users are in different places;
- Improve the approach to problem-solving through innovative tests;
- Allow users to create contents;
- Support, protect, respect, and stimulate the specific potential of every participant, such as originality and creativity in the professional practice through three-dimensional graphics and interactive objects;
- Enlarge access to lifelong training also to professionals with less mobility (e.g., disabled people).

6 Conclusions and Further Steps

Following a design research approach, this paper analyses, from a theoretical perspective, the problem of designing a 3D virtual world platform for innovative e-learning strategies for human resources training. On the basis of the kernel theories discussed, the paper contributes with the definition of meta-requirements for a 3D virtual world to be used for e-learning for human resource training. Such contribution has been supported by the activities of the LiVES project.

Due to the current state of project activities we have only been able to formulate meta-requirements for 3D virtual world platforms to be used for e-learning. This can be seen, so far, as a minor limitation of the current paper since it does not address evaluation. These requirements will anyhow be evaluated in future steps of the research, when the LiVES platform will be experimented during training activities with IT professionals. Within this context it will be possible to observe a specific 3D virtual world used as a learning environment, and to investigate the interaction of avatars and users in the middle of an e-learning process.

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Towards a $\mathcal{Q}$uality of $\mathcal{S}$ocial $\mathcal{N}$etwork ($\mathcal{Q}$o$\mathcal{SN}$) Model in the Context of Social Web Services

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Abstract. This paper proposes a set of criteria used to establish the $\mathcal{Q}$uality of $\mathcal{S}$ocial $\mathcal{N}$etwork ($\mathcal{Q}$o$\mathcal{SN}$) of a social network connecting social Web services together. These latter are quite different from (regular) Web services since they can, for instance establish and maintain networks of contacts, count on their contacts when needed, and form with other peers strong and long lasting collaborative groups. A social Web service can sign up in three social networks referred to as competition, collaboration, and substitution. Prior to signing up the social Web service checks the privacy, trust, fairness, and traceability criteria that constitute the social network's $\mathcal{Q}$o$\mathcal{SN}$. The interpretation and evaluation of each criterion vary from one social network to another.

Keywords: Selection criteria, Social network, Social Web service.

1 Introduction

In [5] we established three types of social networks to support the discovery of Web services. This establishment was built upon the `functionalities` of Web services. *checkWeatherForecast* and *convertExchangeRate* are functionalities that illustrate what Web services can do for users and other peers as well. We referred to these three social networks as *collaboration*, *substitution*, and *competition*. In the collaboration social network, the functionalities of Web services are different and sometimes complementary[1], e.g., *checkWeatherForecast* and *bookOutdoorVenue*. Contrarily, in the substitution and competition social networks the functionalities of Web services are semantically similar, e.g., *bookTrainSeat* and *reserveTrainTicket*. There exist different techniques and approaches to compare Web services' functionalities in term of either difference or similarity [12], but this is outside this paper's scope. We argue in the following that basing the decision of a Web service to sign up in a certain social network on functionality, only, is not enough as other criteria affect this decision and hence, need to be

[1] Functionality complementarity can result into developing composite Web services.

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considered. For instance, a Web service has to assess the risk to expose itself to other competing peers before it signs up in a competition social network. How this assessment should occur and what criteria to include in this assessment are some questions that are not addressed, yet, in our research.

Injecting social computing principles into service-oriented architecture is part of our long-term research project on *social Web services* [5,7]. These latter can establish and maintain networks of contacts; count on their (privileged) contacts when needed; form with other peers strong and long lasting collaborative groups; and, know with whom to partner so that reconciliation is minimized with regard to ontology and policy disparities. We demonstrated that collaboration, substitution, and competition networks permit to a social Web service to, respectively, recommend the peers that it likes to work with in case of composition, recommend the peers that can replace it in case of failure, and be aware of the peers that compete against it in case of selection.

By being part of a social network a Web service is exposed first, to the authority responsible for managing this network and second, to the existing members of this network. Both can check the Web service's credentials through its profile with the risk of altering these credentials and hence, jeopardizing its reputation and correctness levels. This risk could be tackled subject to setting up appropriate means. For this purpose we define a set of criteria like privacy, trust, fairness, and traceability that should back the decision of a Web service to sign up or not in a social network. The interpretation and importance of each criterion depend on the type of social network whether collaboration, substitution, or competition. To establish these criteria we look at how existing Web-based social networks like Facebook and LinkedIn "control" the exposure of their members' profiles through a list of rights and responsibilities that these individuals, respectively, avail of and are responsible for. We define similar rights and responsibilities that cater for the particular needs, requirements, and characteristics of Web services.

Section 2 discusses what functionality analysis means and provides an overview of social Web services. Section 3 discusses the way social Web services select the appropriate social networks to sign up in. Section 4 presents the policies for managing these social networks. Connecting the selection criteria and management policies together is analyzed in Section 5. Prior to concluding in Section 8, some illustrations of the selection criteria use and related work are provided in Section 6 and Section 7, respectively.

2 Background

2.1 Functionality Analysis

As stated in Section 1 functionality between Web services is either (semantically) similar or different. On the one hand, similarity refers to Web services that offer homogeneous functionalities (e.g., *bookTrainSeat* and *reserveTrainTicket*) to users and other peers independently of how these functionalities are implemented. Competition and substitution social networks that we suggest in [5] capitalize on the similarity of functionalities. On the other hand, different refers to Web services that offer heterogeneous functionalities (e.g., *checkWeatherForecast* and *bookOutdoorVenue*) that can be put together to offer new added-value composite Web services to users, only. Collaboration social network that we suggest in [5] capitalizes on the difference of functionalities.

Besides the functionality that drives the development of social networks of Web services, other elements like Quality of Service (QoS) and (data) semantic and policy matching contribute to assessing the links (or edges) that connect the Web services in these networks (Fig. 1).

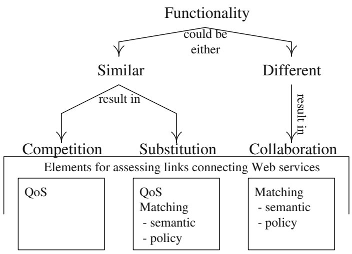

Fig. 1. Functionality-driven development of social networks ([5])

In a competition social network, QoS establishes the competitiveness level of Web services when their respective non-functional properties (e.g., response time and reliability level) are compared. From a user's perspective the competitiveness level permits to narrow down her search of Web services by clustering those that can satisfy her non-functional requirements. From a service engineer's perspective the competitiveness level is a "wake-up call" to review and probably improve the non-functional properties of her Web services with respect to other peers' similar properties. The higher the competitiveness level, the less opportunities a Web service might have to be selected by users.

In a substitution social network, QoS and semantic and policy matching permit to identify the perfect substitute Web service. Perfect means that (i) a substitute such as *MenuWS* offers a similar QoS compared to the failing Web service such as *CateringWS*. This permits to continue satisfying the user's non-functional requirements for which *CateringWS* was initially selected; and (ii) matching reduces the efforts to put into addressing semantic and policy conflicts between the substitute and existing peers, which could lead into developing highly-compatible composite Web services.

In a collaboration social network, semantic and policy matching permit to lead into developing highly-compatible composite Web services like in the substitution social network.

2.2 Social Web Services Overview

Our work on social Web services is at the cross-road of two main research thrusts namely social computing (exemplified with Web 2.0) and service-oriented computing (exemplified with Web services). Existing research works either adopt Web services to support social networks of users or develop social networks of Web services. In this paper we focus on the latter type of social networks.

In the category of social networks of users, we cite the following works. Maaradji et al. propose a social composer that advises on the next actions to take in response to certain events such as Web services selection [9]. Xie et al. introduce a framework for semantic service composition based on social networks [15]. Wu et al. rank Web services using non-functional properties and invocation requests at run-time. A Web service's popularity as analyzed by users is the social element that is considered during the ranking [14]. Last but not least, Nam Ko et al. discuss the social Web in which a new type of services called "social-networks connect services" help third party develop social applications without having to build social networks [10].

In the category of social networks of Web services, we cite our works in [6] and [8]. In the first reference we suggest a method to engineer social Web services. Questions that are addressed in this method include what relationships exist between Web services, what social networks correspond to these relationships, how to build social networks of Web services, and what social behaviors can Web services exhibit. In the second reference we use social networks to address the specific problem of Web services discovery. Different social networks permit to describe the situations in which Web services engage for instance collaboration and recommendation. We emphasize that Web services should not be treated as isolated components that respond to user queries, only. Contrarily, Web services compete against other, similar Web services during selection, collaborate with other, different Web services during composition, and may replace other, similar Web services during failure despite the competition.

3 Supporting Web Services Select Social Networks

Due to lack of space we focus on competition and substitution social networks that Web services can sign up in. To support the sign-up decision we consider *privacy*, *trust*, *fairness*, and *traceability* criteria that Web services should take into account on top of the functionality criterion (other criteria can be used as well.). The rationale and interpretation of each criterion depend on the type of social network. We assume that a social network is headed by an authority component (sn_{auth}) that connects new Web services to existing members in the network, assesses the weights of edges in the network, enforces the management policies of the network, etc. Examples of policies are discussed in the next section.

3.1 Competition Social Network

By accepting to be part of a competition social network, a social Web service (sws_i) is exposed to its competitors and *vice-versa*, which makes them all aware of each other.

1. Privacy is extremely important. A social Web service needs to ensure that appropriate means in this network guarantee the protection of its sensitive details (e.g., non-functional properties (QoS)) from unauthorized accesses of competing members in the network. If some members access these details they could use them for instance to beef up their capabilities and hence, become better competitors. We measure the privacy level of a competition social network ($Privacy_{Comp}$) by:

$$Privacy_{Comp} = \min_{i \in [1,n]} \left(\frac{|failedAttacks_{sws_i}|}{|Attacks_{sws_i}|} \right) \quad (1)$$

   where $|failedAttacks|$ represents the total number of attacks that sws_i was subject to but failed, $|Attacks|$ is the total number of attacks on sws_i, and n is the number of social Web services in the network. Traditional intrusion detection and prevention techniques can be used to detect attack outcomes (whether failure or success) [13]. A lower value of $Privacy_{Comp}$ indicates a poor privacy level in the network.
2. Trust is extremely important. A social Web service needs to be ensured about the trustworthiness of the authority component of this network so that it does not leak private details to other members in the network. Some of these details might have been requested by the authority component to approve the membership request of the Web service in the network. We measure the trust level of a competition social network ($Trust_{Comp}$) by:

$$Trust_{Comp} = 1 - \frac{1}{n} * \sum_{i=1}^{n} \sum_{j=1}^{m} \alpha_{sws_i,j} * LeakProb(privateDetail_{sws_i,j}) \quad (2)$$

   where $LeakProb()$ is a function that returns the probability that the authority component reveals sws_i's $privateDetail_j$ to other peers, $\alpha_{sws_i,j}$ is a weight factor reflecting the importance of a private detail, m is the number of private details per social Web service, and $\sum_{j=1}^{m} \alpha_{sws_i,j} = 1$.
3. Fairness is relatively important. A social Web service needs to be sure that the authority component of this network treats all the members equally by for instance letting them avail the same benefits, e.g., knowing the members that join and leave the network. In the network community, Jain et al. propose a well-known fairness index [4] that we adopt to measure the fairness level of a competition social network ($Fair_{Comp}$) as follows:

$$Fair_{Comp} = \frac{(\sum_{i=1}^{n} Benefits_{sws_i})^2}{n * \sum_{i=1}^{n} (Benefits_{sws_i})^2} \quad (3)$$

   where $Benefits_{sws_i}$ represents the number of "services" made available by the authority component to sws_i. $Fair_{Comp}$ equals to 1 corresponds to the best case where all social Web services avail of the same benefits. $Fair_{Comp}$ equals to $\frac{k}{n}$ corresponds to the case where k social Web services, only, avail of the same benefits, and the rest (i.e., $n-k$) do not avail of any benefit.

4. Traceability is relatively important. It permits to keep track of the social Web services' operations and interactions so that the authority component can hold them accountable for these operations' and interactions' outcomes in case of conflicts (e.g., exchanging contradicting details) or irregularities (e.g., flooding the network with unnecessary details). The authority component can, also, analyze these outcomes to verify the quality of social Web services' self-details. This would increase the confidence level of the authority component in the social Web services in the network as well as the trust among these social Web services. Traceability process runs according to a certain frequency and for a certain duration over operations (op) and/or interactions (int). We measure the traceability level of a competition social network ($Trace_{Comp}$) by:

$$Trace_{Comp} = \frac{1}{2} * (\beta_{op} * freq_{op} + \beta_{int} * freq_{int}) * d \tag{4}$$

where $\beta \in \{0,1\}$, $\beta_{op} + \beta_{int} = 1$, and $freq$ and d are frequency and duration parameters, respectively. Traceability value can be ranked as low, average or high with respect to some min and max values. For instance high traceability means that a social Web service can rely on the authority component to generate an accurate trace of the operations that were executed. When the authority component detects irregularities, traceability permits for instance to pin down the responsible social Web services.

3.2 Substitution Social Network

By accepting to be part of a substitution social network, a social Web service knows the peers upon which it can count when it fails so that the completion of the business processes that this social Web service implements is not jeopardized. Moreover the social Web service can compare its non-functional properties to other peers' properties so that a successful substitution is achieved.

1. Privacy is extremely important. A social Web service needs to ensure that negotiations with other peers in this network regarding substitution details (e.g., compensation and penalties in case of no-compliance) are kept confidential. Some of these details can be used by malicious social Web services to be selected instead of appropriate substitutes. We measure the privacy level of a substitution social network ($Privacy_{Subs}$) as $Privacy_{Comp}$ with focus on negotiation:

$$Privacy_{Subs} = \min_{i \in [1,n]} \left(\frac{\sum_{j=1}^{n} |failedAttacks_{sws_i, sws_j}|}{|Attacks_{sws_i, sws_j}|} \right) \tag{5}$$

where $|failedAttacks|$ represents the total number of attacks on the negotiation details involving sws_i and sws_j but failed, and $|Attacks|$ is the total number of attacks targeting these two social Web services.

2. Trust is extremely important. Since business process execution continuity is critical, a social Web service needs to be sure that the members in this network will take over the completion of these processes as expected. We measure the trust level of a substitution social network ($Trust_{Subs}$) by:

$$Trust_{Subs} = \min_{i \in [1,n]} (\frac{successfulSubs_{sws_i}}{Subs_{sws_i}}) \tag{6}$$

where $successfulSubs_{sws_i}$ represents the total number of substitutions requested by sws_i and that were complete and $Subs_{sws_i}$ is the total number of substitution requests.

3. Fairness is relatively important. Social Web services need to be sure that the authority component of this network allows them all to act as substitutes without favoring some. We measure the fairness level of a substitution social network ($Fair_{Subs}$) by:

$$Fair_{Subs} = (\sqrt{\frac{1}{n}\sum_{i=1}^{n}(rf_{sws_i} - \mu)^2})^{-1} \tag{7}$$

where $rf_{sws_i} = \frac{ass_{sws_i}}{ass}$ (relative frequency of substituting sws_i), $\mu = \frac{1}{n} * \sum_{i=1}^{n} rf_{sws_i}$ (mean of all relative frequencies), ass_{sws_i} is the number of substitution assignments to other peers in case of sws_i's failures, and ass denotes the total number of substitution assignments in the social network.

4. Traceability ($Trace_{Subs}$) interpretation is similar to the interpretation in the competition social network ($Trace_{Comp}$). A social Web service can rely on the authority component to generate accurate traces of the interactions that took place before, during, and after substitution.

4 Policies for Managing Social Networks

In Section 3 we mentioned briefly the role of a social network's authority component in enforcing the implementation of this network's management policies. This enforcement requires making the social Web services aware of the policies so they can first, avail of the network's benefits and second, comply with the policies to avoid violations and hence, penalties (Section 5). In this section we propose some policies per type of social network and criterion.

4.1 Competition-Driven Policy Definition

Privacy (*priComp*). It aims at restricting the access to the social Web services' details. The following policies propose ways of achieving this aim.

1. $P_{priComp,1}$: a social Web service should label its details (e.g., self like ID and non-functional like reputation level) as either private, protected, or public.
2. $P_{priComp,2}$: a social Web service should announce its credentials (e.g., ID and reputation level) to a peer prior to requesting details from this peer. The announcement is done regardless of these details' access levels whether private, protected, or public.

Trust (*truComp*). It aims at encouraging the social Web services share their details with the authority component (or other peers) upon request. The following policies propose ways of achieving this aim.

1. $P_{truComp,1}$: a social Web service will expect requests from the authority component on its details including the private ones.
2. $P_{truComp,2}$: a social Web service should send the authority component valid no-functional details so that its competitiveness level to other peers is assessed properly.

Fairness (*faiComp*). It aims at making the social Web services "feel" that they are all treated equally. The following policies propose ways of achieving this aim.

1. $P_{faiComp,1}$: a social Web service will be kept informed about any detail shared by the authority component with the rest of peers.
2. $P_{faiComp,2}$: a social Web service should ensure that it shares the same details with all peers in the social network.

Traceability (*traComp*). It aims at tracking the social Web services' operations for quality assurance purposes. The following policies propose ways of achieving this aim.

1. $P_{traComp,1}$: a social Web service will be probed regularly by the authority component as part of the monitoring operations that this component performs.
2. $P_{traComp,2}$: a social Web service will be informed by the authority component about any necessary action that it has to take in response to this probing.

4.2 Substitution-Driven Policy Definition

Privacy (*priSubs*). It aims at keeping substitution details between the social Web services confidential. The following policies propose ways of achieving this aim.

1. $P_{priSubs,1}$: a social Web service that may be subject to failure should agree with the authority component on the substitution details that need to be labeled as either protected or private; public details are not subject to privacy restrictions. Examples of details include compensations and penalties in case of no-compliance.
2. $P_{priSubs,2}$: a (substitute) social Web service should report to the social Web service that it replaced its performance details that need to be labeled as either public, protected, or private.
3. $P_{priSubs,3}$: a social Web service should check the credentials of a peer before it lets this peer act as a substitute.

Trust (*truSubs*). It aims at ensuring that the social Web services have full confidence in the potential substitutes so that execution process continuity is achieved. The following policies propose ways of achieving this aim.
1. $P_{truSubs,1}$: a social Web service should share with the substitute peer all the necessary details that guarantee execution process continuity.
2. $P_{truSubs,2}$: a (substitute) social Web service should replace the failing peer as agreed upon between this peer, this social Web service, and the authority component.

Fairness (*faiSubs*). It aims at making the social Web services "feel" that they are given the opportunity to act as substitutes equally. The following policies propose ways of achieving this aim.
1. $P_{faiSubs,1}$: a (substitute) social Web service will be evaluated by the authority component with the same criteria used with other peers.
2. $P_{faiSubs,2}$: a social Web service will be kept informed by the authority component about all substitution opportunities.

Traceability (*traSubs*). The aim of traceability and corresponding policies is similar in all social networks.

5 Linking Selection Criteria to Management Policies

The purpose of linking criteria for social networks selection to policies for social networks management is to monitor and assess the adoption and efficiency of these policies with respect to the values that these criteria take (Equations 1−7). Indeed a low value taken by a certain criterion in a certain network can indicate the inappropriateness of some policies or the lack of compliance with some policies. Corrective actions are deemed appropriate such as reviewing some existing policies or developing new ones. In the following we discuss the links between criteria and policies per type of social network.

5.1 Competition Social Network

1. Privacy criterion is associated with two policies that refer to labeling social Web services' details and checking social Web services' credentials, respectively. A poor privacy level (i.e., $Privacy_{Comp}$ close to zero) raises concerns about the efficiency of the means that assess these credentials as stated in $P_{priComp,2}$. To improve the privacy level corrective actions consist of checking the currently used assessment means or using better, new means so that, attacks on social Web services' details are prevented.
2. Trust criterion is associated with two policies that both refer to exchanging details between social Web services and the social network's authority component. A poor trust level (i.e., $Trust_{Comp}$ close to zero) raises concerns about the credibility of this authority component as these social Web services can be reluctant to sending their details as stated in $P_{truComp,1}$. To improve the trust level corrective actions consist of addressing the deficiencies of the authority component by, for example, examining this authority component's motivations in revealing private details and identifying the beneficiaries of these details.

3. Fairness criterion is associated with two policies that both refer to sharing details between social Web services and between social Web services and the social network's authority component. A poor fairness level (i.e., $Fair_{Comp}$ close to zero and $\frac{k}{n}$ less than a threshold) raises concerns about the efficiency of the means that let these social Web services be aware of the available benefits as stated in $P_{faiComp,1}$ and $P_{faiComp,2}$. To improve the fairness level corrective actions consist of identifying the social Web services that had limited access to the benefits and improving the communication means so that, all social Web services are informed of the benefits.
4. Traceability criterion is associated with two policies that refer to probing and advising social Web services by the social network's authority component. A poor traceability level (i.e., $Trace_{Comp}$ close to zero) raises concerns about the quality of the monitoring means that this authority component uses as stated in $P_{traComp,1}$ as well as the willingness of these social Web services in implementing the advices of this authority component as stated in $P_{traComp,2}$. To improve the traceability level corrective actions consist of improving the monitoring means and warning the social Web services. We define two additional policies for punishing and promoting social Web services, respectively, as follows:
   - $P_{traComp,3}$: a social Web service is penalized by the authority component when the corrective actions (or advices) it recommends are not implemented by this social Web service.
   - $P_{traComp,4}$: a social Web service is rewarded by the authority component when the corrective actions (or advices) it recommends are implemented by this social Web service.

5.2 Substitution Social Network

1. Privacy criterion is associated with three policies that refer to labeling substitution details, reporting performance details following substitution, and checking substitutes' credentials. A poor privacy level (i.e., $Privacy_{Subs}$ close to zero) raises concerns about the efficiency of the means used first, to protect these details as stated in $P_{priSubs,1}$ and $P_{priSubs,2}$ and second, to assess these credentials as stated in $P_{priSubs,3}$. To improve the privacy level corrective actions consist of improving the protection and credential checking means so that, unauthorized requests over substitution and performance details can be prevented.
2. Trust criterion is associated with two policies that refer to sharing details between failing and substitute social Web services and guaranteeing execution process continuity, respectively. A poor trust level (i.e., $Trust_{Subs}$ close to zero) raises concerns about the appropriateness of these details as stated in $P_{truSubs,1}$ and the confidence that these failing social Web services have in these substitute peers as stated in $P_{truSubs,2}$. To improve the trust level corrective actions consist of reviewing the means to select substitute social Web services. We define an additional policy for penalizing the substitutes as follows:

  - $P_{truSubs,3}$: a (substitute) social Web service is penalized by the authority component when it does not take over from a failing peer.
3. Fairness criterion is associated with two policies that refer to evaluating substitute social Web services and sharing substitution opportunities between failing and substitute social Web services and the social network's authority component. A poor fairness level (i.e., $Fair_{Subs}$ close to zero) raises concerns about the disparity in the criteria used for evaluating these substitute social Web services as stated in $P_{faiSubs,1}$ and the efficiency of the means that inform these substitute social Web services about the substitution opportunities as stated in $P_{faiSubs,2}$. To improve the fairness level corrective actions consist of revising these evaluation criteria and improving the communication means so that, all social Web services are informed of the substitution opportunities.
4. Traceability criterion is similar in all social networks.

6 Illustration

The previous sections worked out three main elements that are, how social Web services use criteria to select which social networks they can sign up in (Section 3), how social Web services need to comply with the policies that manage these networks (Section 4), and how the assessment of these criteria permits reviewing these policies (Section 5). In the following we illustrate how these elements are put into action. To this end we choose the competition social network to exemplify its selection criteria. We, also, adopt some techniques discussed thoroughly in the related-work section to address issues raised during this network use. Due to lack of space we discuss privacy and trust, only.

- Privacy is mainly assessed through the capacity of the competition social network to resist to attacks on social Web services' private details. Gao et al. discuss privacy breach attacks in the specific context of online social networks of persons [3]. Breaches due to service providers' access rights apply perfectly to our social networks of Web services. Indeed the authority component acting as a service provider requires details from the social Web services so that it grants them access to the competition social network. Gao et al. mention encryption as a defense to these attacks, which seems to be appropriate for protecting private details of social Web services. Examples of encryption techniques are public key and attribute based [1]. The first technique permits to share private details with any member of a social network (i.e., the social Web services except the authority component). The second technique encrypts data based on some attributes that characterize groups of members like location and protects these data against other peers that do not belong to these groups.
- Trust is mainly assessed through the capacity of the competition social network to prevent leaks of social Web services' private details to other peers in the network. While these details can be encrypted as proposed earlier, the

competition social network's authority component can still leak these details after decryption. It needs these details to grant the social Web services access to the network. Measures against these leaks could be (1) to remove the motivation factors like extra income that the authority component can make by leaking details to other peers so they can enhance their capabilities or (2) to decrease the trust criterion.

7 Related Work

Establishing criteria to assist Web services decide whether or not they sign up in a social network has made us think of characterizing social networks with a new model, which we refer to as $\mathcal{Q}$uality of $\mathcal{S}$ocial $\mathcal{N}$etwork ($\mathcal{Q}$o$\mathcal{SN}$). Similar models exist in other fields through the use of $\mathcal{Q}$uality of $\mathcal{S}$ervice ($\mathcal{Q}$o$\mathcal{S}$) that is built upon non-functional properties. Our literature review did not reveal explicit works on $\mathcal{Q}$o$\mathcal{SN}$ but aspects related to quality social network, software quality assessment using social networks, and relationship between quality of social networks and investment decisions. Murton in his online post advises companies on how to choose the best social media platform[2].

In [11] Perego et al. discuss the quality social network as part of a collaborative environment to personalize Web access. The notion of quality social network is different from our quality of social network. The authors use social tagging to evaluate the quality of Web resources based on users' preferences and opinions. The safety and trustworthiness are among the aspects that the quality social network addresses. The quality social network provides end-users the possibility of associating labels with Web resources as well as using rates to express their dis/agreement on existing labels. This notion of quality social network is quite different from our quality of social network in the sense that we do not evaluate the members accessible through our networks but the networks themselves.

In [16] Zuluaga analyzes the role of the quality of social network in the educational decision making process. Though this work does not really fit into our vision of a $\mathcal{Q}$o$\mathcal{SN}$, it is worth mentioning that Zuluaga uses the schooling level and labor position of the members in a social network to establish the quality of this network. It was noted that the higher the quality of the network, the higher the probability of investing in education. However, the authors do not consider the policies that regulate this social network and their impact on the quality of the social network.

In [2] Dasgupta and Dasgupta shed the light on the obstacles that users have to wrestle with when they sign up simultaneously in different social networks. Duplicate information, privacy loss, and redundant information flow result from this simultaneous sign up. Today's social networks applications are almost the same in terms of features provided to users. To alleviate these obstacles Dasgupta and Dasgupta propose the Social Network as a Service (SNaaS) model. It is kind of single counter that offers specialized services such as blogging, mentoring,

[2] http://www.jeffbullas.com/2011/03/11/how-to-choose-the-best-social-media-platform-for-your-company/

and community management. These services will then give access to specific social networks applications, e.g., LinkedIn that concentrates on corporate social network aspects. However, users decide to sign up in specific social networks based on functionality criterion, only, but not on quality criteria.

In [3], Gao et al. identify four categories of attacks against online social networks namely privacy breaches, viral marketing, network structural attacks, and malware attacks. These categories are representative of the most common threats reported today. Gao et al., also, discuss the appropriateness of the available defense mechanisms for these attacks. The four categories of attacks are compared using four measures namely attack difficulty, server/user defense effectiveness, and threat to user. However, the authors do not specify how the social network will change/add existing/new policies related to, for instance privacy criterion.

8 Conclusion

This paper presented a model for assessing the quality of service of social networks populated with social Web services. This model is referred to as $\mathcal{Q}o\mathcal{SN}$ standing for $\mathcal{Q}$uality of $\mathcal{S}$ocial $\mathcal{N}$etwork. Three social networks were proposed, namely collaboration, substitution, and competition. Four criteria for assessing the $\mathcal{Q}o\mathcal{SN}$ were discussed, namely privacy, trust, fairness, and traceability. The interpretation and definition of each criterion varied from one network to another, which permitted to emphasize the intrinsic features of each network. Besides the selection criteria, policies guaranteeing the proper management of the social networks were defined. Upon signing up in a social network, social Web services have to fully comply with these policies. The connection between the selection criteria of social networks and the policies for social networks management was discussed in the paper. This connection permitted to review the efficiency of the existing policies calling for new policy definition in some cases. In term of future work we plan to develop a proof-of-concept tool.

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The Grey Box: How Understanding the Functioning of a Mobile Device Affects the Success of a Mobile Service

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Abstract. Mobile devices such as smartphones are becoming an important point of access for a large number of services. Accordingly the interaction between the device and the mobile user is changing towards a mutual adaptation. In this paper we present a set of empirical results to support our claim that an interdisciplinary framework is required to build mobile interfaces that increase mobile user perceived added value. The main contribution of this paper lays in its adaptation of technology adoption models towards mobile devices to derive a set of design guidelines and its test design to derive relevant outcomes.

Keywords: Design, Human Computer Interaction, Technology Acceptance Model, Mobile Services.

1 Introduction

In the last years mobile devices have evolved beyond their previous limitations: screen sizes are bigger, and they can display high resolution color content [1]. Location has become more precise through the broad availability of GPS and AGPS integrated into the devices. The major remaining limitations are battery capacity and the heterogeneity of the multiple platforms available.

If, on the one hand, multiple platforms assure innovation, on the other hand this diversification is a challenge for adoption. As a consequence of an aggressive and appealing marketing campaign and company mergers (e.g. Nokia and Microsoft) and change in firm strategy (e.g. HTC), users are required to switch from one operating system (e.g. Symbian) to another (e.g. Android).

Marketing strategists and applications designers therefore need a framework to support mobile services with applications that increase user retention rate [2, 3]. Our target audience needs to understand how to use those applications to capture new clients and to retain old ones. Theoretical approaches for technology adoption exist for electronic devices, but they still lack the necessary extensions to fit the new functionality of a context-aware mobile device in a highly turbulent ecosystem.

This type of problem recalls the large set of previous works on technology adoption and this study aims at extending it by underlying the importance of acknowledging the problem of common method variance while assessing user intention to adopt a

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technology. Therefore our research question is: **What is the contribution of the design of artefact interface over user acceptance of mobile services?**

The rest of the paper is organized as follows. In the next section we briefly recall a set of papers in techniques to assess technology adoption, from which we build our model described in section 3. Section 4 highlights how we have tested the model, whereas section 5 comments on the preliminary results we have obtained. Section 6 concludes the paper discussing its limitations and suggestions for further directions of investigation.

2 Literature Review

This section briefly addresses technology adoption with an interdisciplinary approach, by briefly recalling works from management information systems and human computer interaction communities. We initially started by defining a protocol to assess the existing literature: we looked at recent works published in the last five years using “artefact”, “interface design”, “mobile” and “technology acceptance” as keywords on Google Search. While assessing the forty results obtained we focused on articles published in journals, possessing concepts and operationalized variables in their theoretical models. For sake of simplicity below we present only two works, which best represents the articles we have reviewed.

The technology acceptance model and its variations can be used to explain user choice to adopt an artefact. Although there is a large set of works inspired by that of Davis [4] we will refer here to the recent paper by Venkatesh et al. [5] since its model has obtained the highest explanatory power. According to the Unified Theory of Acceptance and Use of Technology by Venkatesh et al. behavioral intention explains up to some 45% of variability in technology usage behavior, which depends on effort expectancy-age-gender and social influence-age-gender-Voluntariness and experience. The power of this model comes from its explanatory power. Its weakness derives from the difficulty to translate the constructs of the model into software design criteria.

The model proposed by Mcnamara and Kirakowski [6] is meant for human-computer interaction specialists and it is grounded on the psychological theory of attitude. The model identifies three constructs that affect user satisfaction (efficiency, utility, transparency) and translates these constructs into a set of questions to be tested by survey. Two constructs (efficiency and helpfulness) recall the constructs of the Unified Theory of Acceptance and Use of Technology (UTAUT), making us wonder what the correlation between satisfaction and intention is to adoption and the explanatory power of the transparency construct. If, on the one hand, this model extends the technology acceptance model, on the other hand, it does not consider the socio-technological environment surrounding the mobile user.

The UTAUT has high explanatory power but it gives little direction concerning design criteria. The eleven components of the transparency construct can be used as design criteria, but their link to behavioral intention to use a new mobile phone has not been explored yet. Therefore our first research sub-question arises:

SRQ1: What is the contribution of the artefact interface described by the Mcnamara and Kirakowski model in user acceptance of artefacts?

In this experiment we addressed common-method variance. According to Antonakis et al. [7], x may cause y because they both depend on q. In our case q is the evaluation given by the user. It is noteworthy that the common source/method problem does not only inflate estimates as most researchers believe; it could bias them upwards as well as downwards. In other words, it could be possible that a large part of significant results found in previous works could be due to the test design itself. Therefore we wish to address this point with the second research sub-question:

SRQ2: What is the contribution of the artefact interface described by the Mcnamara and Kirakowski model in user acceptance of artefacts measured by UTAUT?

In the following section we present the theoretical model we intend to use to address these research questions.

3 Model

The model presented in figure 1 combines elements of UTAUT together with the concept of user satisfaction. Accordingly we obtain the following set of constructs. *Transparency* is concerned with the extent to which the user feels that he/she understands how to operate the product in order to get it to work in the way he/she wants it to and it is operationalized by 15 items. Our choice to limit ourselves to the transparency construct is because the three constructs used by Mcnamara and Kirakowski appear to be highly correlated, as shown in the preliminary results. Hence we decided to choose one of three the constructs that does not appear.

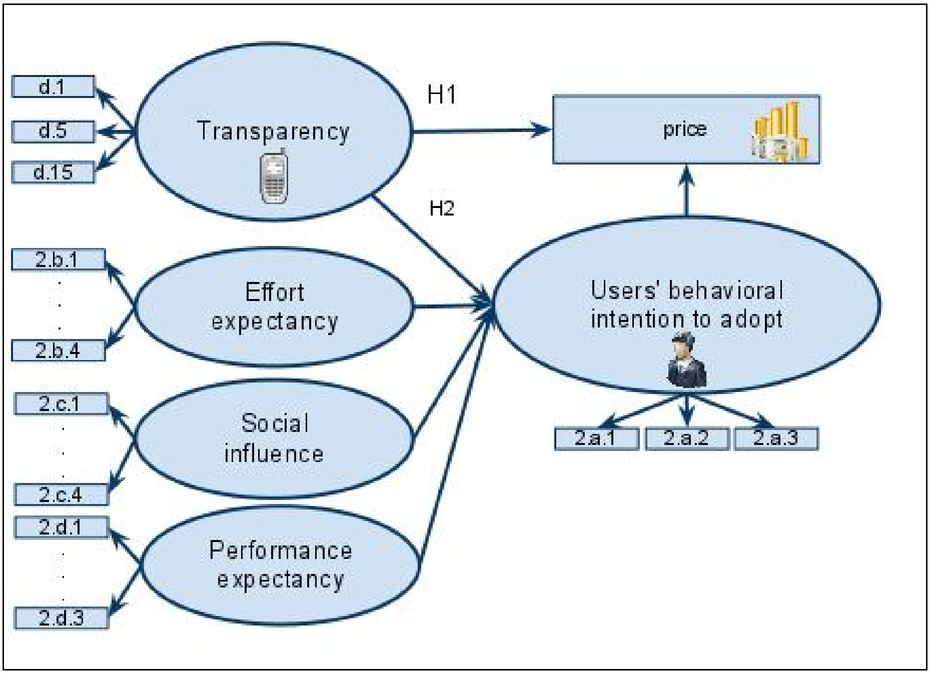

Fig. 1. The constructs of the model (represented as oval) and the variables (shown as rectangles)

The *behavioral intention* to use the system is derived from Venkatesh et al. [5] and it is operationalized using 3 items. In the same way *effort expectancy*, *social influence* and *performance expectancy* are operationalized using the variables in Venkatesh et al.

Our main assumption is that there is a relationship between transparency and user behavioral intention to adopt a new mobile. To do so we look for fixed effect, defined as a parameter that results in heterogeneity among tested groups, which is constant over time and correlated with our independent variable (transparency). Therefore we clearly state a null hypothesis: **There is a fixed effect of transparency over user's behavioral intention to adopt the system**. (H0)

Once the constructs and the null hypothesis are defined we derive the following hypotheses to address our two research sub-questions:

1. **Transparency increases user's behavioral intention to adopt a new mobile, measured as user's perceived fair price** (H1). This proposition is grounded on our intuition that the model in Mcnamara and Kirakowski [6] links to the model in Venkatesh et al. [5] since "efficiency" already maps to "effort expectancy" and "helpfulness" maps to "performance expectancy". In our model we use "fair price" as an alternative measure of behavioral intention. Although this measure is often used for studies in behavioral economics, it is still absent in most research in information systems.
2. **Trasparency adds explanatory power to user's expected effort, expected performance and social influence** (H2). This proposition is grounded on our intuition that the model by Mcnamara and Kirakowski [6] extends to the model by Venkatesh et al. [5] since transparency does not map to any constructs of the TAM model although they are grounded on the same theories of planned behavior and reasoned action.

4 Test Design

This section presents how we test our model by addressing common method variance, as required by the second research sub-question.

4.1 Pre-Tests

The first sample set is composed of some 15 university employees from two departments: information systems and clinical pharmacology. This allows testing the effect of difference of average age, gender, technology proficiency, and chosen operating system. No consistent differences are found amount groups.

The second pre-test aims at reducing the number of independent variables. The second sample set is composed of 31 university students from a Master class. We asked the students to assess the efficiency, helpfulness and transparency of their current phone. Then we asked the students to choose a possible candidate to replace their smartphone and to assess its expected effort, expected performance and social influence. Finally we asked the students to define their behavioral intention to adopt the possible candidate as their smartphone. From this analysis we noted that the three constructs from Mcnamara and Kirakowski (efficiency, helpfulness and transparency) were highly correlated. Hence we limited our attention to the transparency construct.

The correlation matrix shown in table 1 describes the correlation among the 15 items belonging to transparency. d9 (‘Sometimes I can’t tell if I’ve made a mistake while using this product’) seems to be statistically correlated to all other items. If one focuses on the starred correlation with p<0.01 that leaves:

- d1 (‘Sometimes I can’t tell if I’ve made a mistake while using this product’)
- d5 (‘I am reluctant to try out features other than those I am familiar with’)
- d15 (I understand what all the selections do’)

Table 1. Statistically significant correlation among the transparency items (only the correlations with p<0.05 are shown. A star implies that p<0.01)

	d1	d2	d3	d4	d5	d6	d7	d8	d9	d10	d11	d12	d13	d14	d15
d1	1														
d2		1													
d3			1												
d4		0.47*	0.41	1											
d5		0.41		0.46*	1										
d6				0.37	0.44	1									
d7		0.50*	0.43			0.41	1								
d8		0.46*	0.44		0.41		0.48*	1							
d9	0.36	0.52*	0.47*	0.44	0.42	0.61*	0.65*	0.47*	1						
d10			0.52*			0.53*	0.46*		0.66*	1					
d11			0.42	0.40		0.53*	0.38		0.66*	0.85*	1				
d12			0.56*						0.51*	0.73*	0.63*	1			
d13			0.55*			0.44			0.69*	0.78*	0.79*	0.79*	1		
d14						0.44		0.43	0.44	0.40	0.49*		0.55*	1	
d15							0.52*		0.38			0.38			1

4.2 Survey Tests

The third sample set is composed of some 120 university Bachelor students. While the master students belonged to a master in information systems, it is safe to assume that most of these students did not have a special interest in information systems, since only 8 among them eventually enrolled in the information system master. Hence, we prepare 8 different descriptions of products obtained by combining d1, d5 and d15 as shown in table 2.

Table 2. By combining d1, d5 and d15 we obtain 8 different product descriptions

	d1	d5	d15
Product 01	no	no	no
Product 02	no	no	yes
Product 03	no	yes	no
Product 04	no	yes	yes
Product 05	yes	no	no
Product 06	yes	no	yes
Product 07	yes	yes	no
Product 08	yes	yes	yes

The students are split into eight groups of some 15 students. There are no significant differences among groups concerning age, nationality and sex. The first student group receives the product 01 description. The second group receives the product 02 description, and so on.

The dependent variable *user's behavioral intention to adopt a new mobile* is obtained by asking the students to estimate the change in price a user is expected to pay for the new features. Assuming that the three variables have the same effect, one could expect product 08 to have the greater change in price, which should be the sum of the change in price of product 02 product 03 and product 05. We induce the effect of transparency over intention to adopt a new mobile by measuring the difference among differences.

We also use a standard UTAUT questionnaire from Venkatesh et al. as control with intention to adopt as dependent variable whereas effort expectancy, social influence and performance expectancy are independent variables.

We obtained 74 responses, among which 59 were considered as valid. To address common-method variance we use transparency as an endogenous variable in our experiment. All UTAUT constructs have a significant Chronbach's alpha test result (i.e.0 >.80).

5 Preliminary Results

To address our null hypothesis we start by testing whether the scenario has a fixed effect over the "intention to adopt" construct and the variable "price". To do so we used the xtreg function in Stata 11. Both effects are statistically significant ($p<0.01$). Therefore **H0 is supported**.

Table 3 represents the multiple regressions we are going to test. We performed robust regression to account for skewness of most variables' distribution. We also tested each regression using the bootstrap function (10000 repetitions) to account for the small sample size and no significant difference was found. The adjusted R2 of each regression is given in the last line.

In step 1, 2 and 3 we test each effect of the design guidelines over the price, finding that d5 and d15 have a statistically significant effect although the explanatory power of these models (i.e. the adjusted R2) is fairly low. In step 4 we test the combined effect of the three design guidelines and we obtain a good R2 (0.55), which becomes 0.51 after being adjusted for the number of variables used in the model. It turns out that all design guidelines have a significant effect in the combined model, although their combined effects are negative when two guidelines are involved. Therefore **H1 is supported.**

In step 5 we test the explanatory power of the UTAUT model and we find that in this case the explanatory power is low and the three constructs are not statistically significant ($p >0.01$). After these results we again test step 1, 2, 3 and 4, this time with "adoption" as dependent latent variable. The results are not statistically significant for all steps and the adjusted R2 is lower than 0.10. On the other hand, "social influence" and "expected performance" become statistically significant and the adjusted R2 of the 5th multiple regression is 0.21. Therefore we consider that **H2 is only partially supported**.

Table 3. Testing our model. (N=59; ** p>0.05; *** p>0.01)

Dep var= Price	Step1	Step2	Step3	Step4	Step5
d1	89.85			505.56 ***	
d5		188.25 ***		603.10 ***	
d15			148.92 ***	638.89 ***	
d1*d5				-544.31 ***	
d1*d15				-580.10 ***	
d5*d15				-640.56 ***	
d1*d5*d15				599.89 ***	
effort					-38.04
soc. Inf.					50.01 **
perf.					21.33
constant	679.15 ***	612.26 ***	653.22 ***	211.11	703.78 ***
Adj. R^2	0.02	0.12	0.07	0.51	0.03

Further investigation is required to explain the discrepancy between the results of the two models, assessing to what degree common method variance could be at the root of such an anomaly.

6 Discussions

We recall the research sub-questions identified in the literature while we tried to answer our research question.

SRQ1: What is the contribution of the artefact interface described by the Mcnamara and Kirakowski model in user acceptance of artefacts?

Our test results show that there is a fixed effect of the transparency construct proposed by Mcnamara and Kirakowski [6] over user's perceived fair price. Detailed analyses show that there is a statistically significant effect of the three design guidelines (d1, d5, d15) over the user's proposed price. Hence transparency is an important construct missing in the UTAUT in Venkatesh et al. [5], which underlines the role of interface design.

SRQ2: What is the contribution of the artefact interface described by the Mcnamara and Kirakowski model in user acceptance of artefacts measured by UTAUT?

Detailed analyses show that there is a statistically significant effect of the three design guidelines (d1, d5, d15) over the user's proposed price. Hence transparency is an important construct missing in the UTAUT, which underlines the role of interface design.

With regard to the limitations of our study, we stress two important factors. The first concerns sample selection: we have tested the model with different samples taken from the same university. Hence further analyses are required. The second concerns common method variance. By introducing a dependent variable we obtained unexpected discrepancies. Therefore we believe that further analyses are required to assess the cause of such an anomaly.

Building on those two answers and acknowledging the limitations of the preliminary results we can tackle the initial research question:

RQ: What is the contribution of the design of artefact interface over user acceptance of mobile services?

- Considerations for application designers: If you want to increase the retention of your mobile users, prioritize clear representations of available options and explanations of new functionalities, and find new ways to support the user in tasks to reduce the feeling of frustration.
- Considerations for marketing strategists: Find new ways to convert negative feelings (fear and frustration) into positive mood as a competitive advantage.
- Considerations for researchers: Focus on new ways to combine UTAUT and satisfaction model in order to increase its explanatory power. Test the effect of interface design actions over the three transparency items.

Finally, this study reveals that nowadays users appreciate understanding what happens inside their mobile service and being easily informed. This point implies opening the black box of technology to users and putting forward the idea that all things, including all practices have a shared being and a mutual constitution in this sense.

Indeed, we claim that users and technology are interconnected. Their very qualities, and properties, cannot stem completely from what is inherent or "inside" them but must depend on how they are related to each other.

This conclusion may be a paradox. Users want both to understand a complex system (opening the black box) and to have a simple and clear interface. Thus the goal of interface designers is to find the right balance between simplicity and complexity. But this equilibrium evolves with the dynamics of usages and the new skills of users. This is why a competitive position is never permanently acquired. In addition, it's hard to know who, among IOS, Android and Windows Phone, is going to win this race.

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Annex: The Survey Used for Scenario 8

The original version was done in French. The other scenarios have different combinations of the bullet points

"An improved version of the iPhone 4 has arrived. Apple's marketing department needs you to determine its selling price.
Some new improvements over the standard iPhone 4 to ensure that the smartphone works the way you want:

- *Detection System to alert you if you made a mistake using this smartphone*
- *System support to help you trying other features as you know*
- *System support to give you more information on the operations of the selected application*

Assuming that the iPhone currently 4 is sold in Switzerland to 750 CHF without subscription, at what price do you propose to sell the modified version of the iPhone 4?"

Once the students answered this question they were asked to answer some questions used for control.

- *Write your phone model (e.g. Nokia N95) in the box below* [Open question]
- *I've been using my phone since ...* [4 items from "less than 3 months" to "over one year"]
- *I use this phone becuase my job requires it* [Likert scale]
- *I use this phone because my mobile operator requires it*
- 2.b.1) *My interaction with this new version of the iPhone4 would be clear and understandable*
- 2.b.2) *It would be easy for me to become skillful at using the new phone.*
- 2.b.3) *I would find the new phone easy to use.*
- 2.b.4) *Learning to operate the new system would be easy for me.*
- 2.c.1) *I believe that people who influence my behavior think that I should use the new phone.*
- 2.c.2) *I believe that people who are important to me think that I should use the new phone.*
- 2.c.3) *I believe that the university will be helpful in the use of the new phone.*

- 2.c.4) *In general, the university would support the use of the new system.*
- 2.d.1) *Using the new phone would enable me to accomplish tasks more quickly than before*.
- 2.d.2) *Using the new phone would increase my productivity.*
- 2.a.1) *I intend to use this new version of the iPhone 4 in the next 2 months.*
- 2.a.b) *I predict to use this new version of the iPhone 4 in the next 2 months.*
- 2.a.c) *I plan to use this new version of the iPhone 4 in the next 2 months.*

Emerging Service-Based Business Models in the Music Industry: An Exploratory Survey

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Abstract. During the last decade the incumbent companies in the recorded music industry had severe difficulties in adequately reacting to technological improvements and changes in consumers' needs. Which business models are best suited to the new circumstances is not yet clear. Thus, experiments with alternative business models are essential. The omnipresence of music in the digital era means that, the product "recorded music" is loosing it's value and is instead reinforcing the service aspect of music. Many product-based companies are seeking to improve their competitiveness by moving toward service-based business models. However, incumbent firms face severe barriers to conducting business model experiments with such service-based offers. This is why entrepreneurial startup companies are the leading force in steering business models toward a service-dominant perspective. In this article we will analyze and categorize the service-based business models of recently founded music companies to identify some of the generic characteristics of innovative business models in the recorded music industry.

Keywords: business model, innovation, music industry, service transformation, startups.

1 Introduction

The problems with the recorded music industry are well known. The traditional business model is in crisis and it is not yet clear what potential new business models will look like. In this situation, experiments with alternative business models are essential to identify new approaches and create the data necessary to justify them [1]. The recorded music industry needs to innovate in its business models to incorporate the increased consumption of music on mobile devices, pervasive social networks, peer-to-peer technology, and the internet as its main distribution channel [2]. Consumers benefit from all possible aspects of the digitalization on the music market [3]. The key element in understanding the market development for digital music is the fact that through digitalization and the rise of peer-to-peer networks, music has regained its public good characteristics [4].

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The fundamental problem the recorded music industry needs to solve is how to derive value from a product that users expect to get for free. Many product-based companies are seeking to increase their competitiveness by moving toward service-based business models [5]. Moving from product-based to service-based business models might be a way to recoup some of the revenue losses in music sales.

During the last decade, the remaining major labels have faced severe difficulties in adapting their business models to changes in consumer preferences and technology. Over the same period, a huge number of entrepreneurial startups with music-related services have come into being, some of them with innovative business models that differ in many aspects from the traditional industry models (e.g. Kickstarter, Spotify, Soundcloud) and could offer potential new revenue streams. The phenomenon that older, established organizations often encounter difficulties in adapting to external technical advances (especially when they are radical) is widely accepted in the literature on technological change [6]. Established firms also face severe barriers when trying to move from a product-dominant to a service-dominant perspective [7].

Thus, by analyzing the business models of recently founded entrepreneurial startups that offer music related services, we will shed light on what new service-based business models look like in the music industry. In this article, we try to identify generic types of business models that are used by recently founded companies in the music sector. The paper is divided into three parts. The first part explores the concepts of business model innovation and explains the barriers that established firms face when moving from a product-dominant to a service-dominant perspective. The second part of the paper explores the business models of entrepreneurial startups in the music industry and tries to identify the generic types of approaches used. Finally, we provide a short summary of our findings.

2 Business Model Innovation and Service-Based Business Models

2.1 Business Model Innovation

New communication and computing technology lowers the cost of providing information and customer solutions in many sectors. Therefore, many businesses need to re-evaluate the value propositions they present to customers and become more customer-centric [8]. Business models have to be adapted to external technological advances and changing consumer preferences. The term business model innovation refers to business model replacements that offer a product or service to customers that was not previously available in a similar manner [9].

Chesbrough and Rosenbloom [10] pointed out the following aspects as key elements of business models: A business model has to show the value proposition for the customer. The customer has to see as clearly as possible where the additional value is delivered in the companies offer. Additionally, the business model has to identify market segments and specify the revenue generation mechanism, as well as the structure of the value chain. Furthermore, the revenue mechanisms used have to be considered. The cost structure has to be estimated as well as the profit potential of the given value proposition and value chain structure. The company's position in the value network, which links suppliers and customers has to be described. This also includes an analysis of potential complementors and competitors. For the long-term success, a competitive strategy has to be formulated which aims at permanent advantage over rivals [10] [1]. Using these points as a guideline, the following questions have to be answered to ensure the clear formulation of a business model [1]:

– Where is value created for users?
– Who are the users the technology or product is useful for and for what purpose?
– Where is the company's position in the value chain to create and distribute the offering?
– How is the company paid?
– What does the cost structure look like and which profit potentials exist?
– What is the company's position in the value network?
– How will the company gain and hold an advantage over its rivals?

The recorded music industry has undergone radical change due to the technological innovations of the last decade [3]. Peer-to-peer technology and pervasive social networks led to consumers linking the online distribution of music with the idea of receiving content free of charge. Thus, with traditional business models it became impossible to maintain the revenues and profits of the pre-internet era [11] [12] [13]. What is needed are business models that can translate the technological advances affecting the distribution and consumption of recorded music into a commercial success.

2.2 From Product-Based to Service-Based Business Models in the Music Industry

Is music a product or a service? A general answer to this question is not that easy. We argue that, before the advent of the technological means to record, distribute, and consume music in the private domain, music was only available as a service. The recording industry made music a widely available product around the middle of the 20th century. The omnipresence of music in the digital era means that, once again the product "recorded music" is loosing it's value and is instead reinforcing the service aspect.

Many product-based companies are trying to increase their competitiveness by moving to a service-based business model [5]. Kindström reported that competition, new customer demands, and technological changes are forcing many manufacturing companies to transform their traditional business models based on product sales into service-based models, or solutions that include both service and product aspects [5]. We argue that this is also true for the recorded music industry, whose traditional product-based models are challenged by consumers and technological developments. The remaining major labels have not been able to adapt their business models to changes in the environment, namely the increased consumption of music on mobile devices, pervasive social networks, peer-to-peer technology, and the internet as the main distribution channel [2]. Why is it that often some of the smallest firms play a crucial role in industries with a high degree of technological opportunity?

2.3 Size and Age of Companies as Barriers to Business Model Innovation

Established corporate culture and organizational structures often stand in the way when companies try to move to a service dominant perspective [7]. For companies with mature product-based business models in particular, moving toward services means a significant change [5]. In order to move toward a service-based business model, companies need to tackle all areas of their business model [5]. Only changing the value proposition would not be enough to capture new value. As services become more dominant, the focus needs to shift away from product development to other areas of the business model [5].

The phenomenon that older, established organizations often encounter difficulties in keeping up with external technological advances is accepted in the literature on technological change [14]. In rapidly changing environments, the match between organizational capabilities and environmental demands declines with age. Interestingly, according to Sørensen and Stuart [6], the competence of organizations to produce innovations (in this particular study measured with patents) improves with age, but these gains come at a price. The price is the increasing difference between organizational competence and current environmental demands [6].

Levinthal, March, and Center [15] argue that once a company is in a leading position, this position can be maintained and solidified for a reasonable period of time through exploitation. However, this advantage is then very likely to be lost due to the exploratory behavior of others. Although it is sometimes beneficial to encourage exploitation and restrain exploration, more often it is exploitation that tends to drive out exploration [15]. We believe that this is also the case in the recorded music industry. One reason for this might be that established firms do not want to make their own products obsolete. Levinthal, March, and Center [15] propose the following answer: exploitation generates clearer, earlier, and closer feedback than exploration. It is able to correct itself sooner and yields more positive returns in the short term. As a result, companies may grow increasingly inward looking and ignore external knowledge as they grow.

Therefore, it is more likely that new business models in the music industry will emerge from small entrepreneurial firms, rather than from established companies. By analyzing and categorizing the service-based business models of recently founded music companies we will identify some of the generic characteristics of innovative business models in the recorded music industry.

3 Emerging Business Models of Music Startups

3.1 Startups in the Survey

The list of entrepreneurial startups used in the categorization was selected using the CrunchBase database. CrunchBase is a free database that offers the basic profiles of startup companies, including a list of their key employees, funding and acquisition news.[1] The initial list of 654 startups was obtained by searching for all companies within the categories "Consumer web" and "Games, video, and entertainment" that were founded after 2005 and have the keyword "music" in their description. Furthermore, we delimited the result set by only taking into account companies that had received at least $500000 of funding[2]. The resulting 97 companies were then manually edited to make sure the list only included companies with a primary focus on music, and no companies that had already given up. The remaining 50 startup companies were then categorized according to their value proposition and revenue mechanism.

Table 1. Categories of value propositions

Value proposition	Description
Content streaming	Streaming licensed musical content to desktop applications, mobile applications, or browser-based interfaces.
Artist promotion	Social platforms for the self promotion of unsigned and/or major artists, sometimes include online music stores.
Infrastructure service	Technical services and Application Programming Interfaces (API) to create, store and share audio recordings on the internet, statistical analysis of audio usage
Interactive sonic content	Producers of interactive musical content, development of music formats tailored to the capabilities of mobile devices
Rights management	Help media creators to find and clear music, e.g. for television, movies, advertising, video-games.
Project funding	Platform for artists, designers, filmmakers, and musicians to crowd-fund their projects
Content download	Download musical content to a personal desktop computer or mobile device

[1] CrunchBase is available on the web at http://www.crunchbase.com/ and is part of TechCrunch, a network of web publications that offers technology news and analysis.

[2] Data on CrunchBase is partly incomplete for small-scale startups, but of good quality for higher profile startups.

Table 2. Categories of revenue mechanisms

Value proposition	Description
Freemium	Offer a basic version for free, while charging for premium features.
Advertising	Rely mainly on advertising to pay for copyright licenses and infrastructure.
Subscription-based	Customer have to pay a subscription price to get access to the service.
B2B	Transactions occur only between businesses, details of revenue mechanisms are not publicly available.
Revenue split	Company splits the revenue customers generate by using their services with the right holder.
Not decided yet	Startups that haven't implemented a revenue mechanism yet.

Table 3. Number of startups in each value proposition category

Value proposition	Number
Content streaming	18
Artist promotion	11
Infrastructure service	6
Interactive sonic content	5
Rights management	5
Project funding	3
Content download	1

Table 4. Number of startups in each revenue mechanism category

Revenue mechanism	Number
Freemium	18
Advertising	11
Subscription based	8
B2B	6
Revenue split	5
Not decided yet	1

3.2 Categorization of Business Models According to Value Proposition and Revenue Mechanism

By grouping the companies according to their value proposition, we identified seven clusters of business models. Those companies that utilized a combination of models were categorized according to the category that constituted the center of the firm's activities. Table 1 displays the list of categories and the number of

Table 5. Startups analyzed in the survey

Value proposition	Company name	Revenue mechanism
Artist promotion	RootMusic	Freemium
	Earbits	Freemium
	OurStage	Freemium
	Rank Productions	Freemium
	TuneCore	Freemium
	Taltopia	Freemium
	official.fm	Freemium
	Reverbnation	Freemium
	VibeDeck	not decided yet
	Fifty100	Revenue split
	Songkick	Revenue split
Content streaming	Grooveshark	Advertising
	Goom Radio	Advertising
	muzu tv	Advertising
	Radionomy	Advertising
	Project Playlist	Advertising
	Deezer	Advertising
	YouTube	Advertising
	Tudou	Advertising
	Rockola Media Group	Advertising
	Jelli	Advertising
	Spotify	Freemium
	Spreaker	Freemium
	Red Karaoke	Freemium
	rdio	Subscription based
	Mog	Subscription based
	TuneWiki	Subscription based
	Slacker	Subscription based
	simfy	Subscription based
Content download	Guvera	Advertising
Infrastructure	The Echo Nest	B2B
	Next Big Sound	B2B
	3G Multimedia	B2B
	Soundcloud	Freemium
	musiXmatch	Subscription based
	Musicmetric	Subscription based
Interactive	Music Mastermind	Freemium
	Musicshake	Freemium
	Smule	Freemium
	RjDj	Revenue split
	MXP4	Freemium
Project funding	Kickstarter	Revenue split
	SellABand	Revenue split
	Slicethepie	Revenue split
Rights management	Music Dealers	B2B
	Jingle Punks Music	B2B
	Audiosocket	B2B
	Tunesat	Freemium
	RightsFlow	Subscription based

companies in that particular category. Companies within one category can vary quite substantially with regard to revenue mechanism or market segment. The only category that is not clearly service-based is *Interactive sonic experiences.* Startups in this category offer software products (mostly mobile applications) with services on top. The service parts mostly consist of social and sharing components.

We identified seven groups of different value propositions (see Table 1) and six groups of different revenue mechanisms (see Table 2). The revenue mechanisms considered are only those used in transactions between the company and the end-user. All companies dealing with licensed music will have a model of revenue spilt with the music right-holders. There are eighteen startups offering a content streaming service and only a single one offers content for download. The large number and popularity of music streaming services indicates that owning music is becoming less import to consumers. Content streaming services and artist promotion platforms account for more than the half of the analyzed startups (see Table 3). The most popular revenue mechanism is Freemium (see Table 4). Freemium is a model that works by offering a basic version of a service for free while charging for premium features. More than twenty percent of startups rely on advertising as their main source of income. None of the startups in the survey is charging for music on the basis of single tracks or albums, which is still standard in the established industry. A list of all startups in the survey is to be found in Table 5.

4 Conclusion

Business model innovation is extremely important for established companies in the music industry wishing to adapt to changes in music consumers' preferences and technological developments. The challenge is to find new business models that manage to create value for consumers that expect to get music free of charge. The omnipresence of digital music causes the product "recorded music" loosing it's value and is instead reinforcing the service aspect. Moving from product-based to service-based business models might be a way to make up for some of the revenue losses in music sales. Established corporate culture and organizational structures often stand in the way when companies try to move toward services, which means a particularly significant change for companies with a mature product-based business model. Entrepreneurial startup companies have been far more innovative in terms of initiating service-based business models in the recorded music industry. The large number and popularity of music streaming services indicates that owning music is becoming less import to consumers. A single startup in the survey still offers musical content for download. Therefore, generating additional value creating services is vitally important for innovative business models. Most startups offer a basic version of their service for free, while charging for premium features (Freemium) or rely on advertising as their main source of revenue. None of the startups analyzed is selling music on the basis of single tracks or albums. which is still the dominant model in the industry.

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Linking Services Design to Strategy

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Abstract. Services Design can be a key asset for competitive advantage, as an instrument for operational excellence or strategic positioning. As the activity aimed to create meaning, design plays a pervasive role on strategic positioning. From the need to develop the design discourse according to the strategic position and vice-versa. This paper focuses on the conceptual connections between both, defining a framework for their simultaneous development and definition, in straight connection to the company´s activities. We present and describe the use of a specific methodology tool, the Strategic Design Opportunity Matrix (SDOM), that allows a visual description of the areas of design on which to perform, according to selected value attributes linked related to the company's activities. This will contribute to the definition of the Design Discourse that will support the strategic positioning statement.

Keywords: Services Design, Strategic Design, Design Discourse, Value, Customer Experience, Activity Systems, Positioning, Competitive Strategy, Meaning, Uniqueness, Strategic Design Opportunity Matrix (SDOM).

1 What Is Strategy?

In 1996, Michael Porter wrote the most enlightening article about strategy, stating the importance of connecting it to the company's activities, versus the traditional paradigm of Positioning as the heart of strategy [1]. He explains that rivals can quickly copy any market position and undermine competitive advantage's durability. Competitive advantage relies on the pillars of operational excellence and strategy. Strategy itself settles on the uniqueness of the value proposal, and for uniqueness we need to perform activities in a different way or perform different activities. Porter states that strategy is the creation of a **unique** and **valuable position**, involving a different set of activities, otherwise, a strategy is nothing more than a market slogan. Porter's framework opens a meaningful vision of how services must be engineered and delivered for long term competitive advantage. It connects ideation the of a company's activities with competitive advantage in an extremely clever way, conferring the taking of decisions regarding what we do, or how we do it, to strategic positioning for competitive advantage, beyond operational excellence.

How come, the evolution of strategy, from positioning to activities?
In 1972 Jack Trout and Al Ries introduced the concept of positioning [2] as a winning marketing strategy for the extremely competitive market conditions of those days.

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Limited mass media forced big struggles through reduced broadcasting offerings in television primetimes. Gaining a place in consumers' minds required extremely direct and impacting communication strategies and languages. Product features and company reputation were relegated to straightforward slogans for consumers to easily place products and brands in their mental maps, and it worked. Remember, Avis' "Nº2, we try harder".

Competition is still tough today, or even worse, but it is obvious that media have evolved substantially. There was already a significant difference between television publicity offerings, in 1972, when Jack Trout and Al Ries introduced the concept of positioning, compared to the ones at the date of Michael Porter's above mentioned article. Cable television, satellite TV and the beginning of internet has widened the communication window between brands and consumers, and new languages have aroused, generating an acceleration of new styles for marketing and communication in the last ten (10) years. Today, Marshall Mcluhan's statement: "the message is the media" [3], reveals itself more true than ever, as we see products and services, being promoted in so many different ways (directly and indirectly), through news spots, web sites, social networks, blogs, or inserted publicity, of diverse areas and meanings. Service/product commercialization and branding today relies on a wide range of media and channels that make possible a variety of positioning messages able to confer a more accurate idea of what people are going to get when hiring or buying a service. In other words, today we communicate more and it is retained more deeply because of the wider logical, emotional and experiential connections that media enhance. Nevertheless, many companies continue today basing their communication strategy on direct and simple positioning slogans, and it still works, but the real opportunities are for those who say what they do, do what they say, and what they do is unique and has value for the potential customers. Apple could have remained positioned as "the other personal computer manufacturer", as they were perceived by a vast majority of us in the early nineties (90s), but their strong drive for identity and uniqueness, has not only positioned them outstandingly and generated fabulous earnings, but has actually given Apple a main player role in the definition of market rules regarding what people really want. For sure, technology and product design have been pervasive in Apple's success, but the addition of a structure of intertwined innovative activities that confer an adding up of value layers, has configured a positioning statement very difficult to copy, signifying Apple as, not only the computer market reference, but an icon of modern business good practices.

Porter`s article finally introduces the reader into an interesting tool called the Activity System, (see Figure 1) [4], that illustrates how activities link to the main strategic positioning statements (see the dark big ellipses). These statements announce the specific and unique characteristics of the business model, i.e. strategy. It is a statement, of what we are unique in, by what we do or how we do it. The Activity System diagram shows the interconnections between activities, and how they support each other, as a way of checking the strategic fit of our business model.

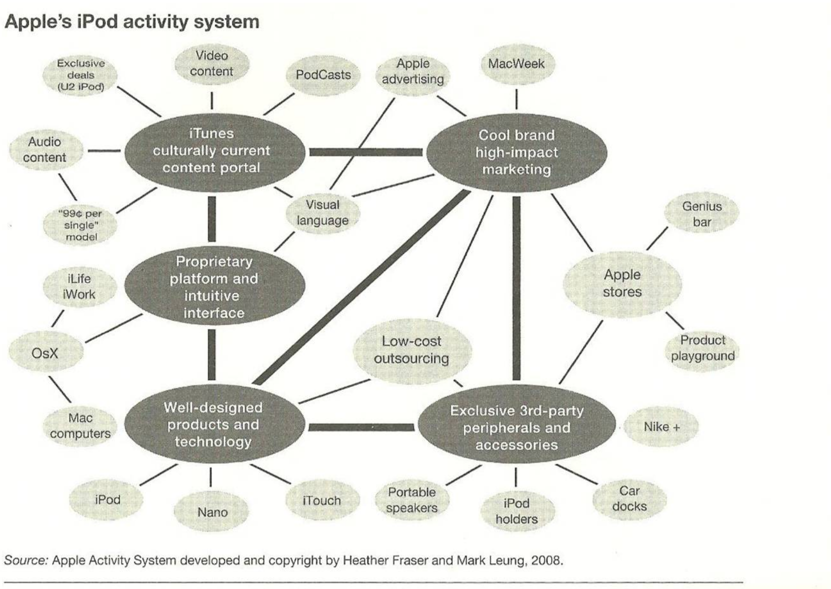

Fig. 1. Apple Activity System (Source: Martin, R.: The Design of Business: Why Design Thinking is the Next Competitive Advantage. Harvard Business Press (2009))

2 Creating a Valuable Position

Activity Systems reflect the uniqueness of our position, but unfortunately do not reach to inform accurately about its value. A valuable position is evidenced when a product or service appears in the first places of customers' awareness or first choice lists. It is therefore connected to the place and space our product or service takes in people's minds. Service and product meaning is a vehicle in which we may get on to travel upward in people's conscience and awareness. As you may recall, slogans work like tags on products as meaning attributes. An essential task of publicity for many years has been, and will continue to be, placing tags that stick to products and make them run up people's minds. As a corollary, and linking with Porter's article, strategy is determined by the real market through uniqueness, and the virtual market, formed by people's subjectivity through or in terms of meaning.

Creating a valuable position is all about building a unique and meaningful **brand promise** developing an identity interface, expressed through design [5]. But brand meaning is also a function of increased brand satisfaction within time [6] (see Figure 2). Managing the gap between expectations and experiences is of key importance to acquire a valuable position within customers, especially in services, where brand touch points occur continuously and what occurs in each is decisive for customer's continuity [7] [8] and business sustainability. In products, this is of extreme importance while in the purchasing process. Consequently to sustain the brand meaning, services must be designed for customer satisfaction at each touch point.

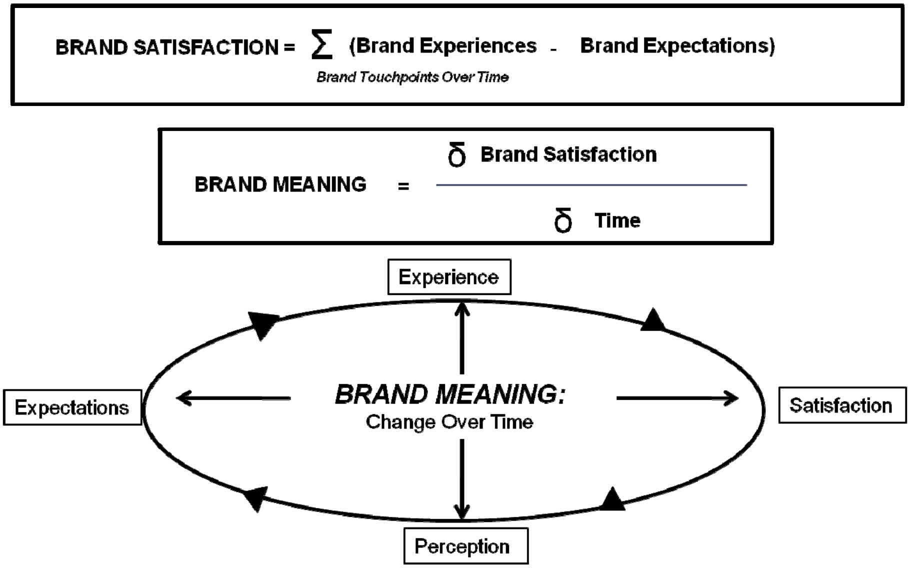

Fig. 2. Brand Meaning (Source: ROCKWELL, C.: "The Mathematics of Brand Satisfaction" Design Thinking, pag. 221-229, Thomas Lockwood editor, Design Management Institute 2010)

Design intervenes for each touch point in the creation of interacting objects, environments, communication and identities [9] plus two additional dynamic areas: people interaction and processes [10]. Design is meant to make things work and deliver meaning [11] and value, making things relevant, as synonymous of significance, and desirability. Designing in these six (6) areas at each touch point and activity will determine, and finally create, a valuable position. Each of these areas has its own materials, media and languages. Objects speak through sound, smell, texture, material and style, as environments express through, space, sound, light, materials or temperature, and not to mention people. In this same way, the service co-creation process carries implicitly a language in rational and emotional codes for waiting times, filling application forms, selecting options, etc.. A harmonic orchestration of these performing areas, under a common design discourse, will confer fit in terms of consistency, reinforcement and optimization effort, for a powerful brand meaning and valuable position.

3 Creating Strategic Value through Design

The International Council of Societies of Industrial Design defines design as “a creative activity whose aim is to establish the multifaceted qualities of objects, processes, services and their systems in whole life cycles. Therefore, design is the central factor of innovative humanization of technology, and the crucial factor of cultural and economic exchange”[14]. The capability of design to establish qualities of services, where a service is a business or industry, with its own life cycle, relates to the same purpose of industrial design, aimed to determine the formal qualities of objects produced by industry [15], becoming a sister field.

In design, form follows function and meaning, and the two latter are in the essence of both, customer value proposal and strategic position. The function determines the strategic position relating to the company's activities, and the meaning determines strategic position relating to customer's satisfaction. The value driver of function is uniqueness (doing other activities, or the same in a different way) as Porter says, and the meaning is delivered by design, as its value driver, like Roberto Verganti [11] proclaims.

It is essential that value proposals and strategic positions are aligned, and this requires specific insights and tools. I call the approach of putting design to work for strategy and value proposals simultaneously Strategic Design, as an essential domain of Design Management and a consistent approach to brand building, connecting what we do and how we do it (value proposals), with who we are and what is our role (brand). It considers a continuous checking of the alignment of both offers, and a simultaneous innovation and design approach. It shares with Design Thinking, the introduction of concurrent business analyses in the design process [16], as an improved, holistic, approach to services design and innovation, in the aim of long term consistent value. But how to create value and how to deliver what people want?

4 What Is Value, and What Do People Want?

On the basis of a review of previous research and on an exploratory study, Zeithaml [12] suggests that "perceived value is the customer's overall assessment of the utility of a product based on perceptions of what is received and what is given". Value therefore involves a tradeoff between a customer's evaluation of the benefits of using a service and its costs:

Perceived Value = (What customer gets) – Price – (Other costs for acquiring the Service)

What customer gets is naturally the sum of objective and subjective concepts of different kinds and natures, related to basic needs, personal interests, expectations, opportunities, imitation, symbolism, etc. Many are conscious and others may be not. The same thing happens with the last term of the equation, where the other costs for acquiring the service may be objective, subjective, conscious or unconscious, and of many natures. If we eliminate price from the definition, we can define the value of a product/service as the reflection of the owner's/user's desire to retain/continue or obtain a product/service [13]. Reflection of the user's desire derives from balancing the two remaining terms. This is where design plays its role, and it's still a tradeoff.

The service designer needs to disclose value to set the performing aims. Cagan and Vogel [17] developed a value opportunity analyses (VOA) that breaks down consumer value opportunities into seven categories: emotion, aesthetics, identity, ergonomics, impact, supporting technologies, and quality. All these concepts can be considered indistinctly in terms of consumer services or products at this level, but differ when we go downwards describing their attributes. One of the categories subject to profound specific separate analysis is service quality [18], for which SERVQUAL methodology was developed and continues as a reference model. Going forward in more explicit, but still subjective value categories, is utility as a basic attribute of service value referring to its capability to solve customer needs in terms of form (usability and accessibility), place (distance and mobility to the service), time, possession (services are not possessed, rather we may use the concept of demand availability), information (full use capacity due to adequate information). They reflect the service ex-ante value perception category and therefore, we do not consider them as an experience value, as the ones described by Cagan and Vogel. See Figure 3 for a more detailed description of these value categories and its attributes.

Value Categories and attributes	Descriptions
Emotion	Essence of the experience
Sense of adventure	including sense of excitement and exploration
Feeling of Independence	including freedom from constraints
Sense of Security	including safety and stability
Sensuality	a luxurious feeling
Confidence	including self-assurance, motivation to use the service
Power	including authority, control, feeling of supremacy
Aesthetics	Sensory perception.
Visual	
Tactile	
Auditory	
Olfactory	
Gustatory	
Identity	Support to the user's statement about his or her individuality and personality
Personality	The ability to differentiate from the competition; connection to the rest of the products produced by tha company and brand image
Point in time	Clear and powerful expression of the time, situation or moment of use of the service
Sense of place	Fit to the context of use
Ergonomics	experience of physical comfort due to forms
Usability	experience of form utility and accessibility
Ease of use	experience of information utility and service operation process
Safety	
Impact	Connection with the user's personal value system
Social	service effects on the lifestyle of a target group, from improving the social wellbeing, to creating a new social setting
Environmental	Effect on the environment, green consumers,
Supporting Technologies	Enable service to perform properly and according to expectations, consisently and reliably
Enabling:	appropriately advanced to provide sufficient features
Reliable:	consistently and at high level of performance over time
Quality	SERVQUAL framework
Reliability:	Ability to perform promised service dependably and accurately
Assurance:	Possession of required skill and knowledge to perform service
Tangibles:	Appearance of physical facilities, equipment, personnel, printed and visual materials
Empathy:	Making the effort to know customers and their needs.
Responsiveness:	Willingness to help customers to provide prompt service

Fig. 3. Service Value Categories and Attributes (Source: Own Adaptation to Consumer Services from CAGAN, J., VOGEL, C.: Creating Breakthrough Products. Princeton N.J. Prentice Hall (2002))

5 The Strategic Design Opportunity Matrix (SDOM)

Linked to the above concepts, we hereby describe a tool that we call the Strategic Design Opportunity Matrix (SDOM), aimed to describe the value attributes to be implemented in each design performing area, as a foundation for each design area briefing, linked to the strategic positioning statements. It delivers information about our design management model related to both our activities and brand promise. It relates three main concepts: activities, design performing areas and value attributes. On the basis of this information, we will be able to generate a design discourse that will link to the areas where design will perform according to our activities.

We will use the Apple's iPod Activity System to describe the tool and ways of use.

Step 1; Listing your Activities:

Analyzing the business model proposition: List all the activities that you consider unique or that you perform in a different way than others:

Nano, iPod, iTouch, MacComputers, OsX, iLife, iWork, Low Cost Sourcing, Portable Speakers 3rd Party, iPod Holders, Car docks,, Nike +, Apple Stores, Product Playground, Genius Bar, Visual Language, Model 99 cent per single, Audio Content, Exclusive deals, Videos, Podcasts, Apple Advertising, MacWeek…

Step 2; Listing your Strategy Positioning Statements:
List not more than seven (7) strategy positioning statements connected to those activities. Each activity may respond to more than one statement.

- #1 iTunes culturally current content portal
- #2 Cool brand high impact
- #3 Proprietary platform & Intuitive Interface
- #4 Well Designed Products & Technology
- #5 Exclusive 3rd Party Peripherals & Accessories

You have just finished your Activity System diagram (See Figure 1).

Step 3; Marking your Desired Value Attributes:

In the Desired Value Attributes column (See Figure 4), mark which value categories and attributes you consider necessary for your company to achieve through your value proposal. This is an intuitive first approach to a value list.

Step 4; Matching each Positioning Statement to its Design Areas:
Take strategy positioning statement number 1, and select the design areas that perform for that statement according to the activities it relates to.

Step 5; Matching each Positioning Statement to Value and Design:
Mark with a number "1" each space that relates to a selected design area and a value attribute that you consider fits for positioning statement #1.

Execute Steps 4 and 5 for each positioning statement #1 through #7.

Step 6: Checking Value Attributes with the Desired Ones
Check that there is at least one space with a number on each value attribute marked in the Desired Attributes column filled in Step 3, if it is not so, reconsider the options chosen initially, or rethink your activities.

What you have now is a matrix with a first approximation or scheme of the design briefings for each strategic positioning statement by performance areas.

If you consider there are specific value attributes, not included in the list of Figure 3, for your activities, or not described with sufficient precision, you can introduce them to configure your own SDO Matrix Value Attributes List.

Value Categories and attributes	Desirable Value	Design Performing Areas					
		Processes	Objects	Environments	Identities	Communication	People
Emotion							
Sense of adventure							
Feeling of Independence	x				1	2	
Sense of Security	x	3			1		
Sensuality							
Confidence	x	1,3	4, 5		1	1, 2	
Power						2	
Aesthetics							
Visual	x	1	4, 5		1	1, 2, 3	
Tactile	x		4, 5				
Auditory			4, 5				
Olfactory							
Gustatory							
Identity							
Personality	x	1	4, 5		1	1, 2	
Point in time	x	1	4, 5				
Sense of place	x			2			
Ergonomics	x	1	4, 5				
Usability	x	1	4, 5				
Ease of use	x	1	4, 5				
Safety	x		4, 5				
Impact							
Social							
Environmental	x		4, 5				
Supporting Technologies							
Enabling:	x	1, 3	4, 5				
Reliable:	x	1, 3	4, 5				
Quality							
Reliability:	x	1	4, 5			1,2	
Assurance:	x	1	4, 5			1,2	
Tangibles:	x			2,5			
Empathy:							
Responsiveness:							

Fig. 4. Service Design Opportunity Matrix based on Apples iPod Activity System

The Matrix is a reference document on the basis of which to develop a design discourse previous to enter hands on details of design, useful for management and interpreters discussion, as it defines the skeleton of the foundations on which to settle a design driven innovation [11] process.

Each space in the Matrix is an area for the discussion of how design can create value in each strategic positioning statement.

For the validation and development of the tool we consider it necessary to run test applications in at least three (3) service companies, in direct collaboration with their managers. We will request their appraisals, improvement suggestions and expanded applications potential to other design management and marketing activities.

6 Conclusions

Services Design is a contributor to competitive advantage within two (2) approaches: Operational Excellence and Strategic Positioning. This article has focused on the second. Creating a competitive strategic positioning is all about building a powerful brand promise. The brand promise relies on uniqueness and meaning. On one hand uniqueness is defined by our activities, and we gain it by doing different ones or performing them in different ways than others. On the other hand, brand meaning depends on a dynamic cycle in which perception, expectations and experiences define customer satisfaction, and the increase of customer satisfaction strengthens brand meaning.

Strategic Services Design, as a Design Management framework, consists of a simultaneous approach to the creation of the brand promise and the services value proposal under a common design discourse, covering six (6) interrelated design performance areas (identities, communication, object, environments, processes and people) as an enhancer of consistency, reinforcement and optimization.

For such an approach we present the Strategic Design Opportunity Matrix (SDOM) as a tool for this design approach process that connects activities to desired value concepts and design performance areas. The matrix serves as a reference document to begin an iterative design discourse creative process, leading a reinterpretation of our activities in order to reach our objectives in terms of creating valuable services in consistency with a powerful brand promise.

Figure 4 shows a resume of this article's discourse.

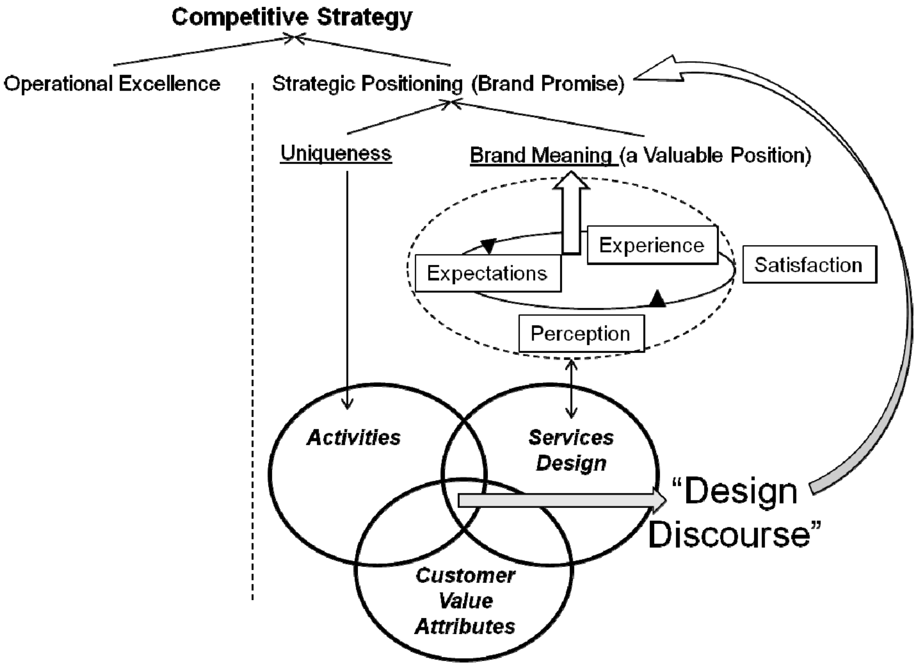

Fig. 5. Linking Services Design to Strategy, main concepts of this article

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The Meaning of the University Experience: A Service Science Approach

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Abstract. This paper focuses on the concept of experience design with the purpose of reflecting on how to create meaning from the experience of studying at university. The first part translates certain concepts based on service design to the field of Higher Education and the second describes the making of a questionnaire which intends to find the keys used by students to describe the university experience, from an exploratory point of view. The outcome of a first application of this questionnaire is analyzed and the most relevant conclusions are highlighted.

Keywords: Service science, experience design, higher education.

1 Introduction

Pine and Gilmore's pioneer work [13] showed that the market evolves towards what we know as experience economy in which mere service delivery is enhanced by means of a series of elements that cause interaction to generate a memorable personal experience in the customer.

Thus while the second half of the twentieth century focused on brands and the emotional, identity or status benefits that customers attained when using them, with the beginning of the following millennium, the customer seeks experiences that provide meaning [3].

The trend is that more and more customers do not buy products for what they are in themselves, or use services merely to benefit from their features, but they create meaning relations with these products or services. That is, they acquire or use them for what they *mean* to them. People set their experiences within their autobiographical narrative so that it all makes sense as a whole in the end [9, 10]. This is presumably the context frame of the trend mentioned above: a product or service is acquired inasmuch as it is substantively attached to the meaning each person gives to their existence.

Therefore there is a link between customers and the products and services they consume which plays an increasingly important role. Lemley [6] pointed out that customers organize themselves around the brands they value more in the way that tribes used to worship their idols in their time. Consequently, it is not trivial for a customer to choose between one product or service or another since it is not only a matter of creating an emotional bond with a brand, but this bond is now part of the way in which this person describes his/her existence.

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For this reason it is ever more important to have procedures and instruments to help us gather information on how customers describe the experiences they have with the products and services they use, namely the role they play in their lives. This is the only way to contribute to experience design effectively, which in turn can provide capital value to Service Science.

The university sector should not be an exception to the advance in this field's research. The view of the student as a consumer of Higher Education institutions from the service perspective is not new [5]. Firstly, because their activity is considered as pure service due to the high degree of personal interaction that is involved [16]. Secondly, because strategic thinking has become an imperative in the context of Higher Education [4] and that is why it is necessary that Higher Education institutions provide themselves with competitive intelligence in order to guarantee their survival [7].

In a previous paper we suggested that a research line that can help service design to develop without destroying the value that arises from an excessive industrialization has to do with getting more information on the way the interaction between service and customer takes place [2]. Above all, we add, if a description of the meanings s/he perceives can be done out of this information.

Within the Higher Education context the research on the student's information has generally focused on two overlapping categories [15]: on the one hand, quality evaluation of both teaching and learning, and on the other, quality evaluation of the student's global experience, being the first one much more analyzed [12]. Some of these studies are based on a purely educational approach as in the case of Marsh's SEEQ questionnaire [8]; however others have proposed that teaching quality can be measured through service evaluation scales as in the case of SERVQUAL [11].

Nevertheless, from the point of view of experience design and evaluation, these instruments have some limitations:

- They mainly focus on teaching related issues. There is no doubt that key processes at university institutions have to do with this dimension, but university campus training must necessarily provide a much richer experience.
- They are usually set, though with some exceptions, at a single teacher or subject level, since their aim is evaluating them, not the whole university experience.
- Broadly speaking, they intend to establish a ranking, namely, the scores are used to determine how good or bad the teaching is, but not to describe how the experience is in itself.

Under these three considerations, it is clear that university management must widen its aims since it is a known fact that there is a difference between operational efficiency, which means doing things better, and strategy, which is doing things in a different way [14]. From this perspective it is important that universities focus not only on providing quality teaching, under the approach mentioned before, but on considering how to develop in their students the principles declared in their mission statement or their foundation documents [1]. In other words, it is not only a matter of efficiency, but also of effectiveness. If, as it can be easily seen, going to university is one of the most important experiences in a person's life, an in-depth analysis is required on how to design and actively manage this experience instead of letting it just happen untended. Today, the meaning is still attained by the student from their particular experience but perhaps in the future research may provide Higher Education university institutions with enough knowledge so that they make the experience of *living the university* a coherent experience with the messages they address to society.

Taking these approaches into account this paper aims at designing a questionnaire as a first exploratory step that allows us to start a reflection on how university students describe their interaction with university life, from the meaning it has for them as life experience. By doing this we are introducing a new concept, *university experience*, defined as the set of life meanings that a student captures and integrates in his/her personal narrative as a consequence of his/her learning period at university. Our intention is to contribute to open new ways that will make the active design of the university experience, as described above, possible in future studies.

2 Method

2.1 Questionnaire Design

It was considered that two main issues should be taken into account: firstly, how the university experience is in general, that is, how the students would describe it from a broad perspective. Secondly, it would be interesting to see if the students are capturing and integrating the main values that a particular university tries to develop in them.

So that the questionnaire was designed in two parts: the first one deals with aspects related to the university experience in itself and what it provides the student with in general. The second part evaluates learning aspects but not regarding a program in particular, it rather focuses on those aspects that any university student should develop at the college where the questionnaire was applied (values and general competences chiefly).

Finding a suitable consistent theoretical framework for this study was not an easy task due to the fact that service science and experience design are quite new disciplines even in the business world. Because of that, research about these topics in the University sector, which normally applies business concepts with delay, at least with the information we have, is inexistent. We selected what we considered as relevant works in order to design the first part of the questionnaire, which consisted in a series of questions organized in three sections:

- The first one showed a series of words from which the student had to mark those evoking their experience at the college. This list of words was taken from Diller, Shedroff and Rhea’s work [3] as they consider them as the most common basic meanings people attribute to the experiences they live in their interaction with products and services.
- The second section offered a series of statements for the student to evaluate in a four-level scale how their experience at the college provided them with different values. These categories used belong to the above mentioned work [3] and they are the basic values according to their authors.

- The third section aimed at drawing information on how the university experience provided any of the three key areas of service design we have summarized in a previous work [2] and that are based on the studies by Pine and Gilmore [13] and Treacy and Wiersema [18].

The second group included a series of questions arranged in the following sections. Those questions were based in university college internal documents:

- Firstly, the student was asked if s/he was familiar with the educational philosophy and values of their university college.
- Next, and regardless what the answer of the previous question might have been, the student was asked which values they considered essential at the college. These values were to be chosen from a list of them that the college wants to develop in all its students.
- The following question asked the students to evaluate how much, in a four-level scale; they were developing each of a series of competences that the college aims at developing in each student regardless the program they are following.
- A final question asked the student to state the kind of learning that takes place primarily at their college.

The questionnaire went through two processes for its validation and adequacy before being applied in its final version:

- It was validated by a group of six researchers at the university college where the study was carried out.
- It was applied for its adequacy to a group of twelve students' representatives of different courses and degrees.

2.2 Participants and Procedure

The questionnaire was applied in May 2011 to 233 first-year students at the *Centro Superior de Estudios Universitarios La Salle* in the available study degrees (belonging to the areas of Education and Health Sciences).

When choosing first-year students at the end of their academic year the objective was, on the one hand, to gather information in a period which is particularly significant for them for what it means in terms of transition to university life (and therefore where the experience can be more intense). On the other hand, we intended to give the students enough time to be familiar with the keys the university was aiming at.

The questionnaire was applied by a group of teachers who was asked to interrupt their class sessions momentarily in order to deliver it. Both teachers and students were involved voluntarily.

2.3 Outcome

Due to the exploratory character of this first paper we have only carried out a descriptive analysis of the results. The goal is to find data that might encourage subsequent studies.

Regarding the first question, table 1 shows, from higher to lower, the words the students chose as those who had more to do with their university experience. As it can be seen, *responsibility, respect* and *accomplishment* are among the most chosen ones (by a discreet majority of students) and *justice, relief* and *beauty*, among the least chosen ones[1].

Table 1. Words describing the university experience
Own source

Responsibility	67%
Respect	55%
Accomplishment	53%
Community	43%
Security	38%
Freedom	36%
Creativity	32%
Balance	31%
Connection	27%
Truth	24%
Inspiration	21%
Wonder	15%
Justice	12%
Relief	9%
Beauty	7%

With regard to the value studying at university provides, table 2 shows the average and standard deviation of the values as given by the students. As it can be seen, the scores are rather similar and the existence of high standard deviations indicates an overlapping in the scores suggesting that there are no significant differences.

Table 2. Values provided by the college (min=0, max=3)
Own source

	AVG	SD
Functional value	2,14	0,72
Economic value	1,79	0,77
Emotional value	1,97	0,81
Identity value	1,62	0,91

The nine issues related to the three key areas of service design (*interaction, immersion* and *customization*) show, as it can be seen in table 3, high averages and also high standard deviations. This suggests again, as in the previous case, a score

[1] Slight differences from the words in the original can be found due to an adaptation to the context.

overlapping. It seems, however, that the three items concerning *immersion* (the three items in the middle of the table) indicate a lower score. This fact should be confirmed by more detailed studies.

Table 3. Interaction, immersion, customization (min=0, max=3)
Own source

	AVG	SD
This college creates an interactive communication with the students.	2,22	0,66
In this college you can decide how to do things.	1,84	0,74
This college favors participation.	2,37	0,64
You feel involved at this college.	1,88	0,75
Being a student is an important part of your life.	1,80	0,89
When you are at the college you forget about everything else.	1,05	0,90
This college offers you a personalized approach.	2,20	0,75
The programs at this college offer you the training you seek.	2,09	0,69
This university adapts to your needs	1,89	0,73

Regarding the knowledge the students have about the university college they are studying at, particularly as far as their educational philosophy and values are concerned, table 4 shows that there is a moderate knowledge of both aspects.

Table 4. Awareness of the college philosophy and values (min=0, max=3)
Own source

	AVG	SD
You know the college educational philosophy.	1,69	0.75
You know the college values.	1,83	0.80

As we have mentioned before, the following question focused on the values the students considered as a priority at the college, choosing from a list with all the values the college aims at developing. Table 5 shows these values from higher to lower according to the percentage of students that selected them as main ones.

As it can be appreciated, there is an unequal perception of the values the college develops, ranging from a 77% of students who perceive coexistence as a prime issue, to a 16% of students who find interiority is an essential value for the college.

Table 5. College values (min=0, max=3)
Own source

Coexistence.	77%
Person’s dignity.	58%
Social justice.	39%
Interiority.	25%
Transcendence.	16%

In regard to the competences the students perceive as being developed, table 6 illustrates moderately high averages in all cases, sharing all of them very similar values, as confirmed by the standard deviations.

Table 6. Competences developed by the college (min=0, max=3)
Own source.

	AVG	SD
Positive attitude towards interculturality and diversity.	2,23	0,72
Moral and ethics.	2,15	0,69
Responsibility.	2,32	0,67
Person-oriented approach.	2,15	0,68
Ability of reflection.	2,16	0,71

Finally, students were inquired about the type of learning that is given priority at the university according to them. In this case, they could only mark one option. Table 7 shows that the type of learning the students marked as higher priority is the one dealing with *being*, in almost half of the cases. *Knowing* and *doing* are placed at quite a distance, sharing a similar score between them.

Table 7. Most common type of learning at the college (min=0, max=3)
Own source.

Being	44%
Doing	26%
Knowing	20%

3 Conclusions

3.1 About the Outcome

A first comment on the outcome is related to the way in which it should be interpreted. As it has been said before, the questionnaires that students usually fill deal with the extent in which a teacher is efficient in his/her work. From this perspective it is easy to interpret the results because, when compared, as it is actually done, with those from other teachers teaching the same group or at the same college, it is easy to see if the score is higher or lower. However this questionnaire does not have a similar interpretation.

On the one hand, there is some data that deals with the way in which students perceive their university experience. The value of this data lies only in giving tentative information about where research should focus when analyzing in depth the description or design of university training experiences. That is to say, the fact that a group of students from a certain university has mainly chosen the word *responsibility* as the one that has more to do with their training experience is not positive or negative in itself, but rather indicates that this is a term with which students relate the experience of studying at that particular university. Likewise, the word *beauty* in the last position is not in itself positive or negative: the key issue would rather be analyzing the reasons why this is so. In fact, it is highly probable that if the students had been studying Design or Art History this word would have got a different score, and the same would have happened with the word *justice* if the students had been at Law school.

On the other hand there is some data on how the student notices certain values or develops these or those other competences. This data can only be interpreted depending on what the university seeks. That is, it is again not positive or negative that students think that they learn to *be* above all, more than they learn to *know* or *do* at this college: such score will depend on what the college looks for.

Having clarified this, firstly, it is relevant to comment on the outcome of the words that the students feel as more connected to their experience at this college. Among the most chosen, we can find *responsibility, respect and accomplishment.* From the three words, *respect* draws our attention inasmuch as the others seem to fit naturally within the university student's work. In future research it would be interesting to attempt at revealing what this word means for the students and why for them it has to do with their experience in this college.

Regarding the type of value that studying at university has for the students, the score is fairly similar, possibly indicating that the complexity of university life provides the student with various values simultaneously. In any case, this aspect would require a study in more depth.

The college seems to be offering a sufficient degree of interaction, customization and immersion, although the results in this last one seem to be lower. This point needs to be confirmed by subsequent studies, though it is clear that another kind of experiences, such as going to an amusement park or playing a video game, can be much more absorbing. Nevertheless, from the point of view of active design of university experience it is also evident that there are few experiences so lasting for an adult human being as studying at university. Perhaps for this reason an excessive immersion may not be desirable. Further research is required in order to clarify the way in which these concepts can be applied to the university environment, as well as their measurement. It would also be interesting to analyze how interaction, immersion and customization have an impact on the rest of elements that are at stake within the university experience. For instance, if those students declaring to find higher interaction, immersion or customization in the university context, share in addition a higher learning perception

It is remarkable that, despite the effort made by the college for the students to know their educational philosophy and values, surely not different from other institutions, the score obtained in the degree of knowledge of those issues is not higher. On the other hand, as far as values are concerned, there is a difference between some values and others regarding the degree of importance the students attach to them. With no doubt, this is a fact that should make university managers think about how to provide the necessary means to overcome this fact and make students become aware of the values they transmit in a more homogeneous way. It should also be considered that because of cultural and generational issues some values can be more difficult to develop than others. Thus, the registered differences cannot be considered only a result of the college efforts, but also to the fact that values vary in complexity themselves.

Perhaps as a consequence of the fact that competences are more easily translated to class life than values, the score in this part of the questionnaire is similar and moderately high. In general students declare to be developing the college competences.

3.2 About the Study Subject

As we have stated before, the aim of this paper is to create an instrument to favor the development of knowledge of how students describe their university experience. Our perspective is that Higher Education institutions should not only be efficient in the design and development of training programs, but they should also progress in the field of differentiation, making real what they declare in their mission statement or foundation documents. In this endeavor it is of our interest to consider the whole life experience of the university context rather than merely focusing on learning processes.

From this point of view, the questionnaire's first application has revealed some directions that might be interesting to study in more depth in order to know the meaning the student attaches to university experience. Although it is difficult to extrapolate the results of this questionnaire outside of the college it was applied in, these first findings are an encouragement to study in depth what it means to study at university. Surely, as it can easily be imagined and is supported by the data gathered here, students have many more experiences in the campus as well as studying a subject. It is essential to know and analyze these experiences, under the perspective of service design, but also from an education point of view of the person's integral development.

This is the line where we set the instrument we have presented, whose results will surely lead us to deepen in the keys revealed here, possibly in the shape of a study based on in-depth interviews or focus groups that allow not only a more accurate definition of the issues raised here but also the questionnaire's improvement. In this next step we should focus on issues such as:

- How students define the concepts we have used in the questionnaire.
- Why the importance they give to the concepts used presents significant differences.
- What they expect from the University from a personal point of view, apart from earning a degree.
- Which differences they see in interaction, immersion and customization when they compare the University and other services.

We conclude that Higher Education, which has undergone a substantive advance in the field of quality assurance, faces a great challenge concerning the analysis of the meaning that the university experience has for students. This is required for actively designing memorable and deep experiences according to each university's mission.

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Intersecting Technical Knowledge, Marketing Experience and Customer Activities to Innovate

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Abstract. Firms are constantly looking for more effective ways to improve their products and services. Recent studies have outlined the benefits of opening the innovation process to external knowledge sources. The creative and innovation locus can lie also outside the firm, in places where technical knowledge, marketing experience and customer activities intersect. The Web 2.0 and the online communities, favoring the communication and the collaboration among firms and their customers, become an important way to support the creativity and the development of innovative ideas through social interactions. We have selected a case study of a multinational firm that exploits an online community and other social platforms to improve its practice of innovation.

Keywords: open innovation, online community, absorptive capacity, communities of customers/users.

1 Introduction and Research Aims

Firms are increasingly searching for knowledge and innovative ideas also from outside the corporate boundaries. Innovative knowledge and ideas are sometimes not (readily) available within the organizational boundaries and external sources can be exploited to enlarge the internal knowledge base, as suggested by the approach known as ‘open innovation’ [1]. In this paper we highlight the role of Web 2.0 and, in particular, of so called ‘online communities (OC) of creation’. We argue the open innovation approach, from one side, and the OCs, from the other side, can foster the exploration and exploitation of knowledge and innovative ideas, contributing to improve the firm’s innovation practices.

The exploration and exploitation of external knowledge is linked to the concept of ‘absorptive capacity’, seen as the ability of a firm to recognize the value of external knowledge, assimilate it and apply it to commercial ends [2].

Our research question arises as follow: How can online communities improve the firm’s innovation practices?

Due to the novelty of this research field, we adopt an inductive approach based on the analysis of a single case-study, Roland DG Mid Europe, whose innovation practices benefit significantly from knowledge and ideas coming from the OC.

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2 Theoretical Framework

The creativity is mostly defined as the production of novel and useful ideas, processes, or products by a person or a group [3, 4] whereas innovation is related to the adoption of ideas and their implementation [5]. Therefore, the creativity can be seen as the starting point for innovations [6, 7]. Both these processes are often described as stage-based [8, 9]. Following this perspective, idea generation is only one stage of a multistage process [10].

Innovativeness includes at its core the degree of being ‘new’ [11]. However restricting the definition of innovation only to those ideas that are utterly new to the world would make this concept almost empty [11]. Most new ideas emerge as novel recombination of old ideas. Consequently, in our work we focus on firm’s innovativeness seen also as the ability to transform ideas and knowledge in upgrades, modifications, extensions, and new applications of existing products/services.

Recent studies [12, 13] have outlined the benefits of opening the innovation process to external knowledge sources, such as users [14], both client firms and final customers. In fact, the innovation locus can lie also outside the firm in places where technical knowledge, marketing experience and customer activities intersect. The concept of ‘open innovation’ has been introduced in an effort to interpret the alternative to the more traditional model of ‘closed innovation’ [15]. A key related concept is known as ‘absorptive capacity’ (ACAP) [2]. Zahra and George [16] suggest that firm’s ACAP is constituted of four organizational capabilities: acquisition, assimilation, transformation and exploitation of knowledge. The acquisition capability refers to the identification and acquisition of externally generated knowledge critical to the firms’ operations. Assimilation refers to the analysis, the interpretation, and the understanding of the that knowledge. Transformation refers to the combination of acquired knowledge with the existing one, leading to adding, deleting knowledge or interpreting the same knowledge differently. Exploitation is the incorporation of the acquired or transformed knowledge in the operations.

With the advent of ‘Web 2.0’ [17] as a social platform – where collaboration, interaction and sharing of knowledge are encouraged – every user is able to communicate creative ideas as well as opinions via simple and widely used publishing tools [18].

We follow the argument that the open innovation, from one side, and the Web 2.0, from the other side, can foster the exploration and exploitation of innovative ideas and knowledge distributed within the OCs [19]. In particular, we focus on communities of creation that is OC “governed by a central firm that acts as the sponsor and defines the ground rules for participation” [20: 25], conceived as an intersection among communities of production and communities of consumption (see tab. 1).

Table 1. Communities of creation at the intersection between communities of production and consumption [20]

Type	Community of production	Community of creation	Community of consumption
Output	Deliver information in their discussion of products or reports on usage	Generate knowledge by linking personal experience with product tests or answering marketing surveys	Innovate new virtual products or services or (for physical products) contribute detailed building instructions online
Firm's participation	Very active	Active	Passive or no involvement
Examples	User innovation communities like: Open source software development Sports enthusiastics	Crowdsourcing Ideation	Consumer communities Brand communities Fan communities
Main literature	Franke & Shah (2003) Hienerth & Letti (2009) von Hippel (2005)	Nambisan & Baron (2007) Nambisan & Nambisan (2008) Sawhney & Prandelli (2000)	Algesheimer et al. (2005) Bagozzi & Dholakia (2006) Kozinets (2007) McAlexander et al. (2002)

Even if the modification of firms' innovation processes to systematically search for and further develop innovations thanks to user involvement can provide better performances [21], another question arises. How can we measure the innovation performances related to OC – and Web 2.0 environments, in general – when traditional measures of innovativeness (i.e. number of patents) are not applicable?

The innovative performance of firms has been studied quite extensively: both generally available measures such as R&D inputs, patent counts and patent citations, and more specific survey-based measurements have been used. However, the results of many studies have not yet led to a generally accepted indicator or a common set of indicators [22]. Moreover, the firm's innovativeness can be conceived also as the ability to transform ideas and knowledge in upgrades, modifications, extensions, and new applications of existing products/services not captured by new patents.

In the next paragraphs we will try to give some insights and reflections also on this issue, although deeper answers can only be the result of further research.

3 Context of Analysis and Methodology

Roland DG Corporation is a multinational leading firm that operates in the world of digital printing and visual communication. Printers, cutting plotters and 3D products are the most important categories (table 2).

Table 2. Consolidated Sales by Category

	Printers (euro in million)	Cutting plotters (euro in million)	3D products (euro in million)	Supplies (euro in million)	Other (euro in million)
2011/3 (forecast)	123.06	10.60	18.57	89.51	31.62
2010/3	104.99	10.94	17.49	89.75	25.58
2009/3	167.05	14.87	23.03	106.21	30.82
2008/3	215.00	19.95	27.94	100.76	29.61
2007/3	173.09	19.46	24.21	78.61	20.84
2006/3	136.54	16.69	25.59	61.26	12.73

Roland has more than 800 employees, distributed in 8 subsidiaries worldwide. Production includes colour printers, scanners, cutters, engraving machines, prototyping/modelling machines. The competitive advantage of Roland DG Corporation is mainly related to the outstanding and well recognized quality of its products which can be used for many different applications (fig. 1).

Fig. 1. Roland's products and some possible applications

Product innovation and technical improvements follow a 'closed innovation' approach within the R&D department in the Japanese headquarter. The subsidiaries are responsible only for sales, promotions, distributions and customer services.

Roland DG Mid Europe ('Roland Italy') is the Italian subsidiary, a medium firm with 30 employees, revenues for about 30 million Euros (in 2010) and a leadership position with a market share of about 50% in the Italian, French and Balkan area.

Roland Italy has developed a wide OC in Italy, a locus where technical knowledge, marketing experience and customer activities intersect.

The OC was born in 2004 through the development of the forum, conceived as a virtual place to exchange working experiences and suggestions among client/users, brokers/dealers and suppliers. Firstly, the OC works as a community of practice for technical support, thus improving the Roland's customer service. Secondly, the OC is conceived as an important source of ideas and knowledge for new and original applications of existing Roland products (see the examples in tab. 3), allowing new business opportunities. For example, this happened for the innovative use of engraving machines for jewellers, or printers for interior design (decoration on vinyl, drapery, etc.).

Table 3. Examples of messages of innovative ideas spread in the OC

Message	Typology of information
"It would be a good suggestion to give to Roland designers, so in addition to 'intelligent control' would pass even the 'intelligent cut'"	Suggestion for improving Roland products
"I believe that in many cases the accuracy achieved with the known empirical methods is not sufficient, and that (…) 'reverse perforated marks' that the plotter can read (…) may be valuable for our plotters"	New idea
Food: "This is the first chocolate made with the engraver Roland"	New business opportunity
Undertaker: "Clear marble and fresh PS for the decoration of a memorial tablet"	
"I'm testing the 600 (*a machine type*) with some jobs on wood, such as license plates .."	Product's testing

The OC benefits from a great number of members and their heterogeneity: customers (64%), competitors (2%), dealers (3%), partners (2%), and other interested members (29%). Members differ in terms of roles, professions, experiences, knowledge, thus increasing the variety of knowledge that can be shared within the community and the potential for creativity and innovation. Although internally sponsored and regulated (all moderators are Roland's employees), the OC can be considered mainly outside the firm's boundaries, as suggested by its members' composition.

At present, Roland Italy exploits many other different Web tools and applications (such as blogs, wikis, social networks, etc.). Anyway, as emerged by interviews, the forum remains the most important source to innovate. Therefore we have focused on it to develop our case study.

Data collection (made in February 2011) is based on 11 semi-structured interviews (of about 1.5 hrs, via Skype) to the Community and the Communication Managers and the analysis of contents retrieved in two core areas of the forum ('Uses' and 'Technological craftsmen's workshop'), analyzed through the collection of 54,541 messages left in the last three years.

Due to the fact OC members have not suggested the development of utterly new products until now, we have developed our analysis around new applications and new uses or improvements of existing Roland products/services. In particular, we have selected the forum messages – that suggest innovative applications of Roland's products – using two criteria:

- The materials adopted. According to our interviews, traditional materials are often related to traditional uses in visual communication (such as banners, posters, stickers, and so forth). On the contrary, new materials allow a higher degree of innovative uses in new fields (such as decoration of parquets, the

creation of mosaics and frescoes, chocolates with the corporate brand and so forth) (tab. 4).
- At least a forum member explicitly recognizes the real practicability of an innovative use suggested within the forum.

We have also selected messages that suggest new service or service improvements recognized as good ideas from at least another community member.

Table 4. Traditional materials versus new materials in the field of digital print and visual communication

New materials adopted in the digital print and visual communication	Traditional materials adopted in the digital print and visual communication
stone: marble – tuff; wood; plaster; drapery: leather - cotton - faux leather – jute; nylon – polyester; glass; vinyl; wax; ceramics – porcelain; chocolate; precious stones: diamond – amber; metals and alloys: steel - aluminum - silver - copper - brass – gold	plexiglass; PVC; paper – cardboard; dibond – etalbond; forex – polystyrene; plasterboard

We have found 231 messages out of 54,541 about Roland's products that satisfy these two criteria as innovative idea proposed the first time within the forum[1]. 193 messages of them were about new applications of Roland's products through the use of new materials; 38 messages of them were about original and different uses of traditional materials.

We have found only 8 messages related to customer services. Thus we have focused on products.

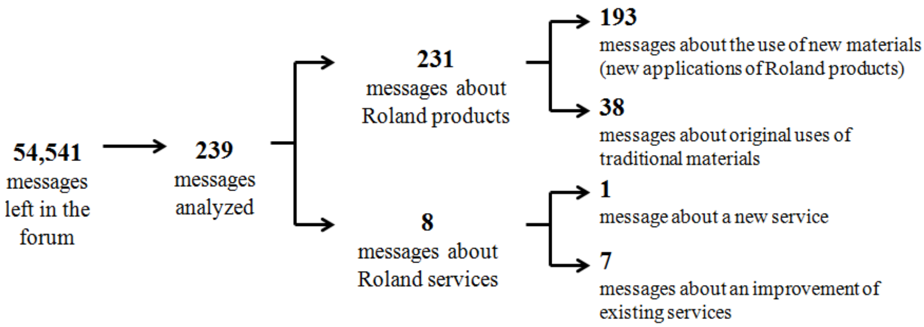

Fig. 2. Our dataset

[1] The forum (in February 2011) counted a total of 89,689 messages. 54,541 messages of them were in the two core area analyzed. Other forum areas, non related to new applications of Roland products, are: 'In rilief', 'Software & computer', 'RolandANDyou', 'I was there!', 'Conversation drawing room'. These areas are mainly dedicated to institutional communication or socialization purposes among users, to strengthen the OC identity and cohesion.

4 Findings and Discussion

The degree of innovativeness nourished by Roland Italy is connected to the specific organizational role of subsidiaries. In fact, as previously said, R&D, production and radical innovations are 'centralized' in Japan. Nevertheless, thanks to the development of the OC, the role of Roland Italy is changing from a mere commercial support toward an active contribution in terms of innovation, though focused on new applications of existing products (fig. 3).

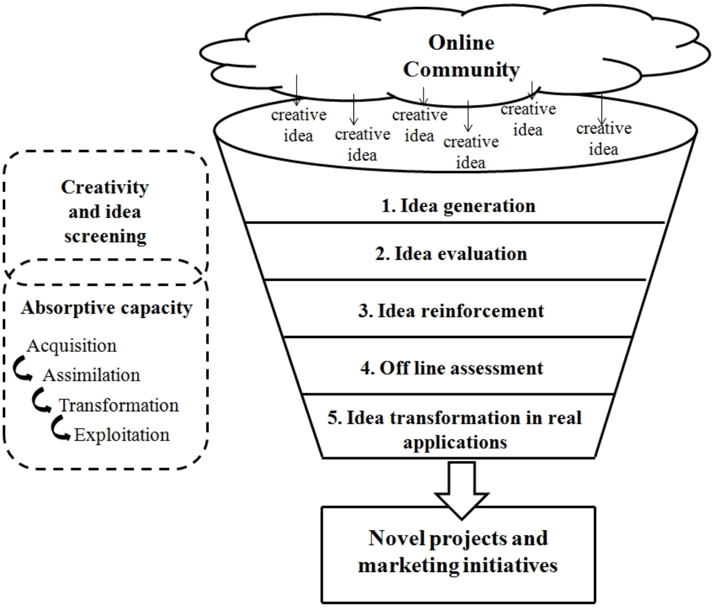

Fig. 3. The innovation process in Roland DG Mid Europe

The OC developed by Roland Italy is a 'community of creation'. The forum, in particular, is explicitly conceived as a community to foster the innovation practices through idea generation and idea screening, feedbacks on product and services, product evaluations and testing, feedbacks on practicability about new uses and new applications of existing products in different fields and markets.

Phases 1 and 2 are focused on creativity aims and benefit from social interactions and knowledge sharing within the OC.

In phase 3 the assimilation and internalization of knowledge begins: Roland Italy tries to reinforce the 'network' around an original idea (i.e. by moderating discussions and organizing topics) and to collects feedbacks about its practicability directly from users/customers. The OC members voluntarily share their knowledge, probably for improving their social status within the OC, for intrinsic motivations and to reciprocally exploit the suggestions to solve working issues, though these considerations need to be deepened and tested with further research. Roland Italy tries to stimulate the flow of innovative ideas in a non invasive way even if the role of the forum moderator is fundamental. As the Community manager has said: "*a moderator needs to listen to, to be well-disposed for dialogue, to have a deep knowledge of topics and a deep understanding of the business. The authority and the ability to decide firmly are very important. Besides, it is very important to create valuable and interesting contents because credibility on the Web arises only when contents are relevant for users. These competencies are very important for the growth of the community*".

Phases 4 and 5 reflect the firm's specific ability to exploit the innovative ideas and knowledge shared in the OC. These phases are mainly performed inside the firm. In fact, the phase 4 includes a deeper 'offline' assessment of the innovative idea for commercial aims. The latter includes the transformation of the idea into commercial outputs. This phase includes the allocation of resources for novel projects and marketing initiatives (such as the involvement of dealers and retailers in training, commercial campaigns, and so forth).

Actually, the whole process is quite unstructured: thanks to the small size of Roland Italy, the coordinating and confrontation mechanisms among units and people (including the CEO) are quite simple and informal. However, though no formal and structured systems of evaluation have been implemented yet, Roland Italy is deeply convinced the OC contributes to effectively improve the innovation practices. In fact, Roland DG Corporation (the Japanese headquarter) plans to replicate the Italian experience in other Europeans countries.

Nevertheless, another question has arisen developing the case study. How can be measured the innovative performances when traditional measures of innovativeness (i.e. the number of patents) are not applicable, as in Roland Italy case? In spite of the limitations of our case study, we have tried to answer to this question as follows, though further research on this topic is clearly needed.

The 'efficacy' of innovation practices has increased clearly from the OC. We have found that 141 of our '231 forum-messages' (about the 60%) containing new and original ideas have been actually promoted in the Web site by Roland Italy and then 'marketed'. Moreover, we have found an increasing degree of 'innovativeness' of ideas extrapolated from the forum messages in time. In fact, a shift from 'traditional material' to 'new material' (see table 4) has occurred in time, as shown in figure 4[2].

Also the 'efficiency' – in terms of resource exploitation and allocation – of innovation practices has increased. In fact, the number of Roland's employees allocated to the OC have remained unvaried from the beginning in spite of the increasing number of innovative ideas (fig. 4) and the growing dimension of the OC, from 2,204 forum users in 2009 to more than 4,661 users in 2011. Though some economies of learning and the need for further and deeper analyses, in our opinion these data can be conceived as rough proxies of improved innovative performances.

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[2] As explained before, traditional materials are often related to traditional uses in visual communication (such as banners, posters, stickers, and so forth). On the contrary, new materials allow a higher degree of innovative uses in new fields (such as decoration of parquets, the creation of mosaics and frescoes, chocolates with the corporate brand and so forth).

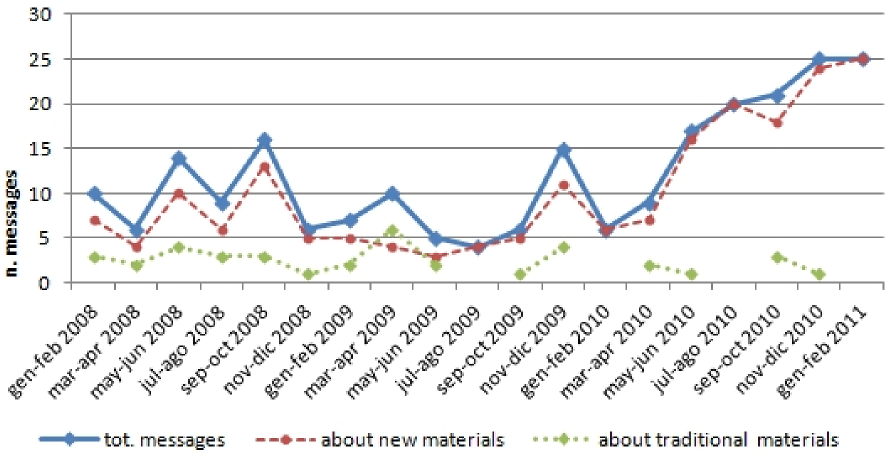

Fig. 4. Distribution of 231 innovative ideas in time

5 Conclusions

This paper aimed at contributing to the effort of depicting the phenomenon of OCs exploited for innovation purposes. In particular, we have focused on the way OCs can improve the firm's innovation practices.

Because of the novelty of this research field, we have adopted an inductive approach based on the analysis of the Roland Italy's forum, as a core virtual place of the Italian OC. In particular, we have analyzed the distribution in time of the 'innovative ideas' arising from the forum and the number of ideas effectively marketed thanks to these suggestions. Though our content analysis can be deepened, we have found Roland Italy has improved its innovative practices thanks to the forum, linking the places where technical knowledge, marketing experience and user's activities really intersect. A related question has arisen. How can be measured the innovative performances when traditional measures of innovativeness (i.e. the number of patents) are not applicable? In fact, as suggested also in literature, the firm's innovativeness can be conceived not only as radical innovation but also as the ability to transform ideas and knowledge in upgrades, modifications, extensions, and new applications of existing products/services. And these are not always captured by new patents, as in Roland Italy case, even if new business opportunities emerge clearly.

Therefore, we have tried to rough out some proxies of improved innovative performances related to the specific context of OCs. The 'efficacy', measured as the number and degree of innovative ideas, which has increased in time in the Roland Italy case. In a similar way the 'efficiency' has increased in time: we have assessed it comparing the number of innovative ideas effectively marketed by Roland Italy to the number of Roland's employees allocated to govern the OC.

We are aware of the limitations of this study. First of all, the major emphasis in an incremental rather than radical degree of innovation is a first limitation because it stresses the concept of knowledge exploitation rather than exploration. A second important limitation arises in terms of generalization of Roland experience, especially within large firms. Being a medium firm, Roland's coordinating mechanisms are quite simple and informal. It would be interesting to move towards larger firms with set of processes and practices more likely structured to study more complex organizational settings to improve the innovation practices nurtured by the OCs (and the Web 2.0).

Therefore, we plan to extend further our panel of case studies trying to answer key questions such as: how can we evaluate the development in time of firm's ACAP within open innovation contexts? Which indicators can effectively measure the ability of OCs to nourish the innovation practices? Which organizational settings (i.e. in terms of structure, culture, systems, processes and so forth) can favor the development of adequate ACAP for exploiting knowledge shared within an OC? How to organize for a deeper integration and coordination among key functions directly or indirectly involved in the innovation process exploiting the OC and the related Web technologies?

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Towards Security Assurance Metrics for Service Systems Security

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Abstract. A major shift of paradigm is currently taking place in the business world. The old business model, once focused on the efficiency of manufacturing and galvanised by standardisation, is steadily making place to a service-based business model underpinned by customisation.

Although such a shift is being embraced throughout the developed as well as the emerging world, academia is still lagging behind as the potential of service as a discipline has yet to be fully explored. In a service business, ensuring customer confidence on the security of the service is key to a successful service launch or for retaining customers' loyalty. However as research on service science is still at its infancy, metrics for the specification and valuation of such confidence are still to emerge.

To encourage more work in this direction, this paper explores the motivation behind the ongoing adoption of a service paradigm and provides a set of metrics that could be beneficially investigated by academia to help businesses address more effectively the need for both service provider and consumer to have Security Assurance.

Keywords: Security Assurance, metrics, service.

1 Service Systems: A Natural Change of Paradigm

For centuries economies around the world have been based on manufacturing and the production of goods. What was then relevant for businesses was to ensure efficiency of production i.e. fast and at a low cost through such technique as standardisation. In contrast today, agriculture for instance is said to represent less than 5 % in the developed countries. Despite this low percentage of people involved in that sector, starvation remains a very distant memory in the developed world. For Chesbrough and Spohrer [1], the productivity of agriculture increase was mainly due to the shift of people out of agriculture into knowledge-intensive, specialised industries that support agricultural productivity, including manufacturing of farm equipment, fertilizers, pesticides, superior seeds, land management practices, improved commodity markets, transportation services, fuel supply services, government and institutional support services, and more. Thus, the massive shift into knowledge-intense activities has

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helped to tremendously increase the production activity of a sector driven by few actors. A similar trend is currently taking place, this time driven by the advances in Information and Communication Technology (ICT). In fact virtually any business can, at a relatively affordable price, acquire the technology needed for producing high quality goods. Moreover, ICT now allow businesses to understand more about customers' needs through online survey or information on their affinities that can be stored in dedicated databases. This wealth of information backed by the advances in the technology gives an opportunity to businesses to demark themselves from their competitors by actively seeking to meet customer demand. Services and products are consequently customised (rather than standardised) to reflect the expectation of individual customers. To this end, service has taken centre stage within companies and is now playing a more prominent role in the economy [2].

Lusch and Vargo [3] define service as the application of competences for the benefit of another, meaning that a service is a kind of action, performance, or promise that is exchanged for value between provider and consumer. Security and privacy are crucial factors for the successful introduction and adoption of a service. Therefore, providers who can offer sufficient and credible evidence of the trustworthiness (security and privacy) of their service to consumers will differentiate themselves from their competitors. However, despite the growing interest in service within businesses, academia who should be leading the investigation on the metrics for security and privacy that could be reported to the consumer, has yet to fully embrace the shift of perspective. Indeed, academia is mainly embarked on research on systems when businesses operate largely on a service basis. Though there is evidence that things are starting to change [2]. This disconnect between the business world and the research community has led to research that fails to improve the trustworthiness of service as the consumer's perspective, amongst other pertinent criteria, are unaccounted for. This paper proposes to fill such a gap through the provision of a comprehensive set of metrics for specifying and evaluating the Security Assurance (SA) of a service for both consumers and providers. This paper is organised as follows: in Section 2 we review related work. In Section 3 the paper discusses the SA metrics parameters. Section 4 concludes the paper.

2 Related Work

Defining a metric taxonomy for the security of systems and organisations is a topic where extensive work has been presented. The WISSSR, 2001 workshop [4] debated the challenges in developing metrics or measures for systems requiring security or assurance, but failed to reach an agreement on a set of measures to be used or even a consensus in any particular approach. An interesting characterisation of information security metrics was proposed by Bodeau (2001) of the MITRE Corporation (sponsor of that workshop) according to whom metrics might best be viewed as a combination of information related to "what need to be measured", "why you need to measure it", and "who you are measuring for" [4]. Such a characterisation of SA emphasises the need to clearly distinguish metrics that may serve service providers and those more relevant to service consumers. The security metrics guide for Information Technology [5] provides guidance on how an organization, through the use of metrics, can identify the adequacy of in-place security mechanisms, policies, and procedures. It describes the metrics development and implementation process and how it can be used to adequately justify the security mechanisms investments. Seddigh et al. [6] proposed a novel definition for Information Assurance considered as the ability of a network or system to facilitate the timely transfer of information between two or more parties in an accurate and secure fashion. Such a definition is then used to develop a taxonomy of Information Assurance metric groups which can be used for the measurement of IT Information Assurance. Vaughn et al. [7] divided their taxonomy into two distinct categories of metrics. The first category (organisational security) of metrics aims at assessing the 'Information Assurance (IA) posture' (i.e. the actual state) of an organisation while the second category is for assessing the IA capabilities of a product or system (Technical Target of Assessment - TTOA).

The first category of metrics is mainly used to provide feedback to improve the IA posture of the organisation. This category is further classified into four sub-categories:

- IA Program Developmental Metrics measure the organisation's strength in terms of IA security policies and security process.
- Support Metrics help to measure the organisation's resources committed towards security and the quality of personnel working on security.
- Operational Metrics measure operational readiness for security incidents and operational security-related practices.
- Effectiveness Metrics reflect how effective the organisation's practices actually are by counting various security incidents.

The second category of metrics is for the Technical Target Of Assessment (TTOA). This type of metric is intended to measure how much a technical object, system or product is capable of providing security in terms of protection, detection and response. This category is often used in comparing or differentiating between alternative and competing TTOA, e.g. the EAL ratings of the Common Criteria. Vaughn et al. [7] further divide the TTOA metrics into two sub-categories – metrics for measuring TTOA's strengths and metrics for measuring a TTOA's weaknesses. Savola [8] has proposed a high-level information security metrics taxonomy that incorporates metrics for both organisational information security management and product development. The proposed taxonomy is based on evaluating the taxonomies reviewed above and is divided into: business level security metrics; security metrics for information security management in the organisation; and finally security, dependability and trust metrics for products, systems and services. The BUGYO and BUGYO BEYOND project [9, 10, 21] has led to the definition of a methodology and tool dedicated to the evaluation of continuous SA of operational telecommunication services. Inspired by the CC, SA in the context of BUGYO and BUGYO BEYOND is understood as the ground for confidence that an entity meets its security objectives.

The term entity within BUGYO mainly refers to the service or a sub-component of it. Unlike the CC, BUGYO defines five levels of assurance and the methodology consists of five steps that are: modelling, metric specification, assurance evaluation, aggregation and finally display and monitor. Given the complexity of today's services' model, the modelling steps of the methodology advocates to consider only the components of the service that are critical for the secure provision of the service. In another word in BUGYO, the SA of a service is grounded to the SA of the underlining infrastructure that supports it.

As it can be appreciated, all the above reviewed contributions only consider SA from the perspective of the system operator or the service provider. Therefore leaving SA accounted for at the level of service consumers. This paper proposes SA metrics that may be further investigated to address the need for SA for service consumers and providers alike. By making a clear dichotomy between SA metrics for service providers and service consumers, our initiative heeds one of the calls from the WISSRR workshop on security metrics [4].

3 The Proposed Security Assurance Metrics for Service

Security Assurance is commonly defined as the ground for confidence on the security mechanisms to meet their objectives [11]. Service providers as well as service consumers are concerned about the security and privacy of services. Indeed, in the one hand, consumers are unlikely to use a service that does not offer an acceptable level of protection. In the other hand, providers may found themselves at odd with the law and regulation in case a security breach can be traced back to a non-compliance with the law or regulation. With the implication of the latter ranging from financial fine to a prison sentence, Security Assurance, more than security, is particularly important for companies [12]. The metrics proposed by this paper aim at estimating the level of confidence both providers and consumers may hold on a service to meet its required security and privacy obligations. In a previous publication [13], we identified the key concepts pertinent to the appraisal of SA of IT systems. Such metrics includes evidence of deployment of the required security mechanisms, their correctness with respect to a security policy or regulation, the effectiveness of the security mechanisms, the thoroughness of the means of security verification. In the present article we discuss how such metrics can be extended in a service realm to better address the need for SA for both service providers and service consumers. This paper also integrates metrics related to privacy considerations to account for the need for consumers' anonymity. The proposed metrics are depicted in Figure 1 and further analysed in Table 1. As can be seen in Figure 1, each type of metrics is linked to the stakeholders to whom it may be of more relevance. However this does not exclude the fact that a given metric could also be indirectly relevant for the other stakeholder (provider/ consumer). For instance, privacy metrics are primarily relevant to the service consumer though a service provider would also need to provide evidence to the regulator as to how their service meets privacy requirements. The next section expands on the SA metrics relevant to service providers and consumers.

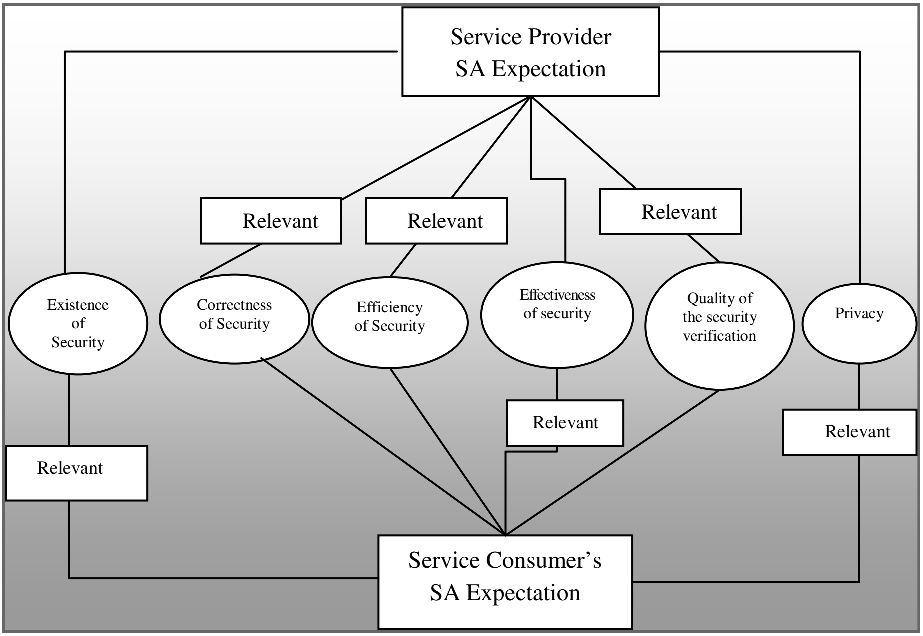

Fig. 1. Proposed SA metrics for service based on their relevance to Service Provider/Consumer

3.1 The SA Metrics Relevant to Service Consumers

This section elaborates on the SA information that may be shared with the service consumers to gain his/ her trust on the reliability of a service. The nature of such information could be clearly stipulated in a Service Level Agreement or SLA between provider and consumer. Generally speaking, service consumers need assurance that their transaction through the use of a given service bears no substantial risks. This implies that the service provider should implement the required set of security mechanisms for ensuring the security of the service as well as the privacy of the consumer. Rather than taking the service provider words for security, consumers will require evidence of that security and privacy. In particular they may want to see evidence of security mechanisms' implementation/ deployment and their effectiveness.

3.1.1 Evidence of Deployment/ Implementation of the Required Security Mechanisms

Evidence of the security mechanisms deployment or implementation is a metric that could be particularly relevant to service consumers. The catalogue of security mechanisms required for a service may emanate from a preliminary risk assessment during which specific type of controls are recommended for mitigating certain types of risks. Thus, consumers would be more inclined to resort to a service whose provider can provide evidence of how security risks are being handled. This would be a step beyond the traditional approach that consists in taking the provider's word for security. As shown in Table 1, the provider should demonstrate, amongst other:

Security related metrics	Existence of security	Presence and availability of mechanisms for: - Access control - Data integrity - Data availability - Physical security
	Correctness of a security mechanism	- Activity correctness - Deployment and implementation correctness
	Effectiveness of a security mechanism	- Evidence of penetration testing results - Log files analysis
	Efficiency of a security mechanism	- ROSI
Security verification related metrics	Verification quality of the security mechanisms	- Coverage of verification - Depth of verification - Rigour of verification - Independence of verification
Privacy related metrics	Privacy	- Data confidentiality - Service consumers anonymity

- how access control is being enforced
- ways in which the integrity of customer's data are preserved
- evidence of existing mechanisms to prevent a denial of service
- evidence of physical security could also be relevant to the customer especially in a context of datacenter where the customer data may be stored and processed in servers or other computer storage devices.

3.1.2 Effectiveness of the Security Mechanisms

Security effectiveness is often considered as the strength of the security mechanisms to thwart security attacks and other security risks, or mitigate their impact on assets in case such risks materialise. Arguably, indicators of the effectiveness of the security mechanisms matters more to customers as it is the most concrete way of appreciating the adequacy of the security of the service they are using. However, the definition of proper metrics to determine the effectiveness of the security is a hard task [14, 15]. McHugh, in the panel workshop on Information Assurance metrics [15], reflects on security metrics that could provide an indication of the resources or effort required to compromise a [service] system i.e. a measure of its security effectiveness. McHugh [15] asserts that: 'For such a measure to be useful, it should be soundly based on demonstrable assurances of the form 'if I do **X** (at cost **Y**) the cost of compromising the system will be raised by **Z**''. Although applicable to security mechanisms such as properly managed crypto-systems, the unknown remain the capability of the adversary. Nonetheless other techniques exist for determining the strength of the deployed security mechanisms. For instance, the analysis of security incident records such as log files during a service system audit is an approach commonly used to identify the strength of the security mechanisms. The assumption being that the number of successful attacks is negatively correlated to the strength of the security mechanisms. Of course a system that has experienced a plethora of successful attacks may be simply not protected up to the adequate level. However the lack or negligible number of successful attacks is not necessarily synonymous with strong security as Payne remarks 'Luck plays a major role' [16]. Nevertheless historical records of events to judge on the effectiveness of the security mechanisms can be useful for reassessing security need.

Penetration testing is often used to obtain evidence of the security effectiveness during the late phases of system development. Penetration testing is especially valuable when it is carried out in the actual operational environment. Thus, this requires the testing environment to be as close as possible to the actual operational situation of the system, whether it is a part of an organisation's Information System or used by a consumer end-user.

3.1.3 Privacy

Privacy is now a major concern for any individual or company engaged in the usage of service. The importance of privacy has reached an extent which has led data privacy protection to become one of the drivers of current and future information security practice as discussed in [17].

It is commonly accepted that the boundaries and content of what is considered private differ among cultures, individuals and companies, but there is a shared basic common themes. In fact more often, privacy would encompass two main concepts: Anonymity of the individual or organisation and the confidentiality of the information being processed or stored. Anonymity relates to the non-disclosure of an individual or organisation's identity in the public realm. For the individual or organisation, some information may be sensitive for its activity or reputation. Therefore limiting their disclosure can be vital to ensure the service competitiveness. In order to address the need for privacy in service, indication on how the anonymity of service consumers and the confidentiality of their data is achieved has to be presented to the consumers along with evidence of their well functioning.

3.2 The SA Metrics Relevant to Service Providers

As can be seen on Figure 1, three main SA metrics are of prime interest to the service provider: (i) metrics relating the correctness of the security mechanisms adopted and (ii) the thoroughness of the verification process adopted for the verification and (iii) the efficiency of the security mechanisms.

3.2.1 Correctness and Quality of Verification of a Security Mechanism

The correctness of a security mechanism is concerned with its conformity with respect to a security policy or regulation. Two types of correctness may be distinguished [13]: *Deployment correctness* relates to the appropriateness of the security mechanisms' configuration while *activity correctness* is concerned with the security mechanisms' compliance to other procedural policies such as the frequency of updating it. Examples of activity correctness include: *antivirus should be updated every morning, users' password to be changed every 90 days, etc.* In both cases, a comparison between the actual deployment/implementation of the security mechanism of interest and a reference (specifications for a recommended deployment/implementation) should be made to determine the adequacy of the security mechanism deployment/ implementation status.

The confidence on the correctness results is highly dependent on the thoroughness of the means of verification. Information relating the thoroughness of the security verification provides to the service consumer a good insight of the extent to which the correctness status can be relied upon. Our philosophy of SA, which is in line with the Common Criteria [11] asserts that greater assurance results from the application of greater verification effort and that the goal is to apply the minimum effort required to provide the necessary level of assurance. The increasing level of effort is based upon:

- Coverage of the verification: the effort is greater because a larger portion of the security mechanism's functionalities is included in the verification;
- Depth: verification efforts deployed to a finer granularity of the security mechanism are more reliable;
- Rigour: the more structured and formal the verification, the more reliable the result obtained;
- Independence of verification: verification performed by a third party evaluator or software tool provides more assurance than a self-assessment

Capabilities levels for each verification characteristics may be defined as in [13, 18]) to help achieve an overall verification quality level.

Two alternatives may be considered while accounting for the information related to the means of security verification. The first one consists in defining correctness values which upper thresholds would be the level associated to quality of verification. In this way, the correctness value would be a mirror of the quality of the security verification. The second approach is about computing separately the value of correctness and the verification level quality. The latter would then represent the level of confidence one could hold on the former.

3.2.2 Efficiency of the Security Mechanisms

The role of efficiency objectives is to set constraints and a resource, time and financial framework for the system and security engineering efforts. At the technical level, some security efficiency objectives can also be interpreted as system performance objectives [19]. Security efficiency is of prime importance to service management as it helps to understand the adequacy of a given security mechanism. A well known indicator of the efficiency of the security is the Return on Security

Investment metric or RoSI. However, there is no consensus on the ways in which RoSI should be estimated, and opinions are diverse as to its pertinence as an indicator of security performance [20].

4 Conclusion

This paper has argued that from a service perspective, the need for Security Assurance metrics for both service providers and consumers is necessary. Much of the current academic research has mainly focused on addressing security from a system operator or service provider perspective. However, since services are created for and used by consumers, the need to investigate SA from the view point of a service consumer would have to be addressed. To stimulate more research in this area, this paper has presented a set of SA metrics and organised them based on their relevance to the service provider or the service consumer.

In future work, we will seek to expand the metrics presented in this paper in view of making them more comprehensive. Besides the specification of the metrics for appraising SA at service level, researchers would need to address issues relating the aggregation of those metrics and their reporting to the stakeholders. Aggregation is particularly important when one is interested in knowing the overall SA level of a service based on information about its constituent components or sub-services. Importantly, such aggregation would depend on how the service's components contribute to the provision of the overall service. The reporting of SA is equally important and must be done in a form that enable a good understanding and a appropriate decision making by both the service provider and service consumer.

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