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Service Specification and Service Compliance: How to Consider the Responsibility Dimension?

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ABSTRACT

Service engineering is a huge research topic that addresses the specification, the compliance and the sharing of business and IT services across companies, institutions or governmental organizations. Despite many advantages of working with the services, the guarantee of service compliance and management of the service overlaps by the stakeholders remains challenging. The objective of this document is to present a methodological approach in order to specify the links between the organizational layer and the informational layer of services. Therefore our research has focused on clarifying the responsibility dimension of the stakeholders involved in those services. The proposed approach is illustrated with an example in the context of sensitive data exchange between stakeholders from the healthcare domain.

KEYWORDS

Service, Engineering, Compliance, Business/IT Alignment, Responsibility, Information System, Organizational Context.

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1. INTRODUCTION

Service engineering is an important field of research that contributes to address and reduce the complexity of the Information Systems (IS) on the first hand, and that provides new cooperation facilities for the companies on the second hand. Hence, a service offers a well settled and easy way for sharing data, applications or knowledge in a precise enclosed space of the IS. Notwithstanding the obvious benefits offered, the service science still suffers from engineering difficulties that need to be focused on. In between the glaring challenges to consider, the services compliance analysis and the services overlaps management appear to be two crucial issues. In order to face them, the definition of a specific methodological approach that describes the close interactions between the services specifications and the context compliance is required.

In our previous research we launched works about the analysis of the service compliance and about the definition of integrated IS architectures in order to support these services (Khadraoui et al. 2011, Feltus et al. 2011, Feltus et al. 2012). In this document, we present an innovative methodological approach that aims to emphasize and formally specify the links between the organizational layer and the informational layer of a service. Therefore, we have considered and clarified the responsibility of the stakeholders (Prendergast 1995) involved in those services. As presented in (Feltus et al. 2010a), the concept of responsibility allows the gathering in a single semantic domain the obligations and the accountabilities of the stakeholders towards the business activities that realize the services and the rights and capabilities that are necessary accordingly.

The service compliance aims to enhance the quality of services to be offered to the stakeholders. We consider that the verification of compliance is based on three criterias: (i) how to build a stable services from the organizational context?; (ii) how to support evolution of services?; (iii) how the interoperability of services is managed?

The proposed approach permits to establish a strong link between the organizational layer and the informational layer, and to clarify the responsibility dimension in order to guarantee the criteria mentioned above. The sequel of this document is structured as follow: the next section introduces the research method that we have used in order to elaborate our methodological approach. The third section describes the methodological approach including the

different elements composing each part of the compliance. Section four illustrates through a practical example the proposed approach and the last section concludes the document and provides future perspectives.

2. RESEARCH APPROACH

The main objective of the document is to define a methodology allowing specifying services and service compliance considering the responsibility dimension of the stakeholders. Enhancing the service compliance aims at facilitating the exchange and the use of services between actors, organizations or others boundaries. The service compliance contributes to help the stakeholders[1] (Service Architects or Method Engineers) to define the services that support the activities of the company. As a result, one may rightly consider that the objective of the research contributes to serve humans and may, hence, naturally, be included in the scope of design science. In (Hevner et al. 2004). The authors explain that the design science paradigm seeks to extend the boundaries of human and organization capability by creating new and innovative artifacts. In this document we define two innovative artifacts: *the product model* and *the process model*. Those artifacts have been elaborated by using a model design approach, that means that we have systematically reviewed all of the concepts that composed the service by a deep analysis of the literature and that we have associated those concepts in a model of service that we call the product model.

In order to prevent a discrepancy between the research objectives and the research outcomes, the validation of the product and the process model has been realized in order to substantiate their applicability and their usability. Therefore, Palvia et al. (2003) have proposed a set of twelve research and validation methodologies. The case study is one of them that we have retained along our work. The case study methodology is defined as the study of a single phenomenon (eg.: an application, a technology, a decision) in an organization over a logical time frame. We have extended and overridden that definition to the study of the service compliance in the context of the information sharing between many

[1] The main categories of stakeholders are: business practitioners from the different departments/entities, ISs architects, programmers, DBAs.

organizations from the same domain which is the healthcare industry.

3. METHODOLOGICAL APPROACH FOR SERVICE SPECIFICATION

Our methodological approach for service specification is composed of the sum of two artifacts: a *product model* and a *process model*. The product model aims at modeling the main concepts that allow formalizing the service. We use the existential binary model (Khadraoui 2007) for analyse the product model (see Figure 1).

Figure 1. Existential Binary Model/Legend

The process model intends to support the work of the service architects or method engineers which are leading the service engineering. We use BPMN to describe the process model.

3.1 Product Model

In this section, we expose the product model through three parts which represent the model layers. The first part concerns the informational layer: the context, the service, the information and the hyperconcepts. The second part describes the organizational elements (including the business rules, the business activities, the business process and the business roles) and the third part represents the responsibility dimension.

3.1.1 Informational Layer

The informational layer contains the kernel of the informational level of a service and it's elaborated directly from the basis of the ontology model. The service architect has to make choices and decide for each concept and each link between concepts if it is mapped into a class, a transaction or an attribute, and so on. The informational layer permits to describe the

information needed for the service.

A service is defined as a result of a process of acquiring knowledge in the context of the information system engineering (see Figure 2). It can correspond to an action or series of actions to characterize the relationships between the stakeholders (Khadraoui et al. 2011). It can have one or more goals. A goal may be assigned to one or more services (Entity "Goal-Service"). A service can be specified upon one or multiple existing IS and an IS can support one or more services (Entity "Service-IS").

The Organisational Context describes the business rules, the legal constraints and the capability of the organization to enforce laws and policies (Khadraoui et al. 2011). The entity "Service-OC" expresses a many-to-many relationship between the Entity "Service" and the Entity "Organizational Context." A service can be defined on one or several organizational context(s). An Organisational Context can be concerned by one or more services.

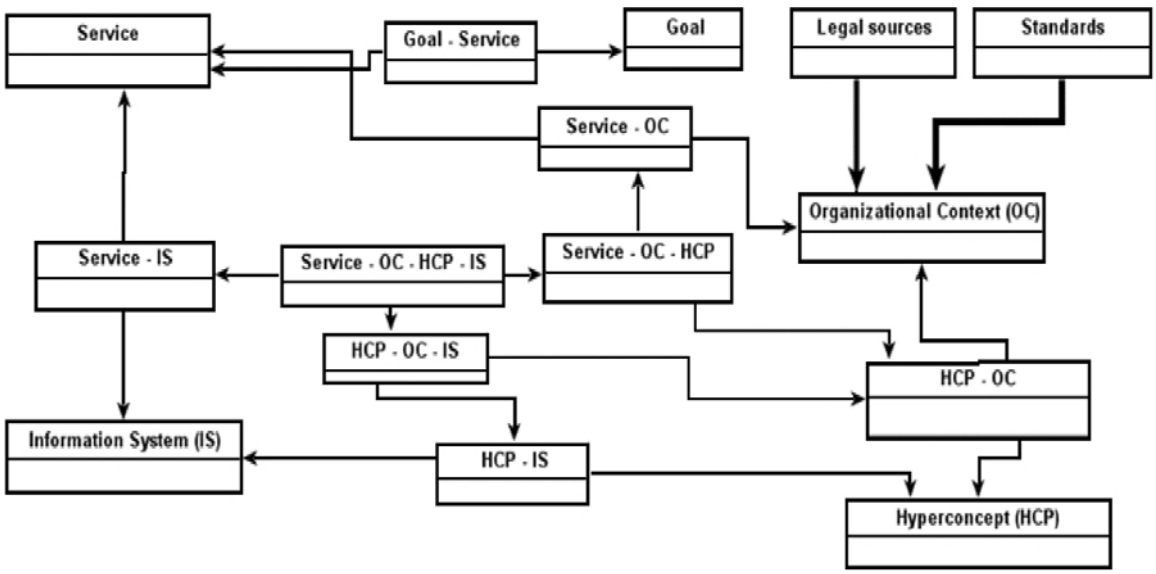

Figure 2. Informational Layer (by Using the Existential Binary Model)

A hyperconcept is constructed on a subset of concepts extracted from organizational contexts, forming a unity with a precise semantic. It is represented by a conceptual graph where nodes are concepts, and edges are links between concepts (Khadraoui et al. 2006), (Khadraoui 2007). A Hyperconcept is expressed in the context of one or more ISs. An IS can

be concerned by one or more Hyperconcepts. We express this semantic relationship by the introduction of the entity "HCP-IS." The entity "HCPC-OC" expresses the direct link between the hyperconcepts and the organizational context.

3.1.2 Organizational layer

The organizational layer presents a set of business rules in the frame of an organizational context and is used to consolidate and enrich the informational elements. It addresses the components of the information system that structure the realization of the service and is represented with the concepts of role, business rule, business activity, business process and services.

A Role represents a set of necessary responsibilities, expressed organizational contexts, to perform the execution of the activities of the development process or to watch the execution of activities performed by the other roles (Khadraoui et al. 2011) (see Figure 3).

The business rules[2] are used to help the organization to better achieve goals, communicate between principals and agents, between the organization and interested third parties, demonstrate fulfillment of legal obligations, operate more efficiently, perform analysis on current practices. Business rules are constraints on the business activities. One business rule can be associated to one or more business activities, and, inversely, one business activity may be associated to one or more business rules. These "business rules" entities are the conditions that the IS must satisfy. They are very significant because they guarantee the coherence of the data and the coordination of the processes of the IS (Khadraoui 2007).

A business activity is defined as a unit of work that produces, transforms and consumes information.

A business process is defined in (Davenport 1993) as "a structured, measured set of activities designed to produce a specified output for a particular customer or market. It implies a strong emphasis on how work is done within an organization." It can be part of a larger, encompassing process and can include other business processes.

[2] http://decisionautomation.com/glossary/38.php.

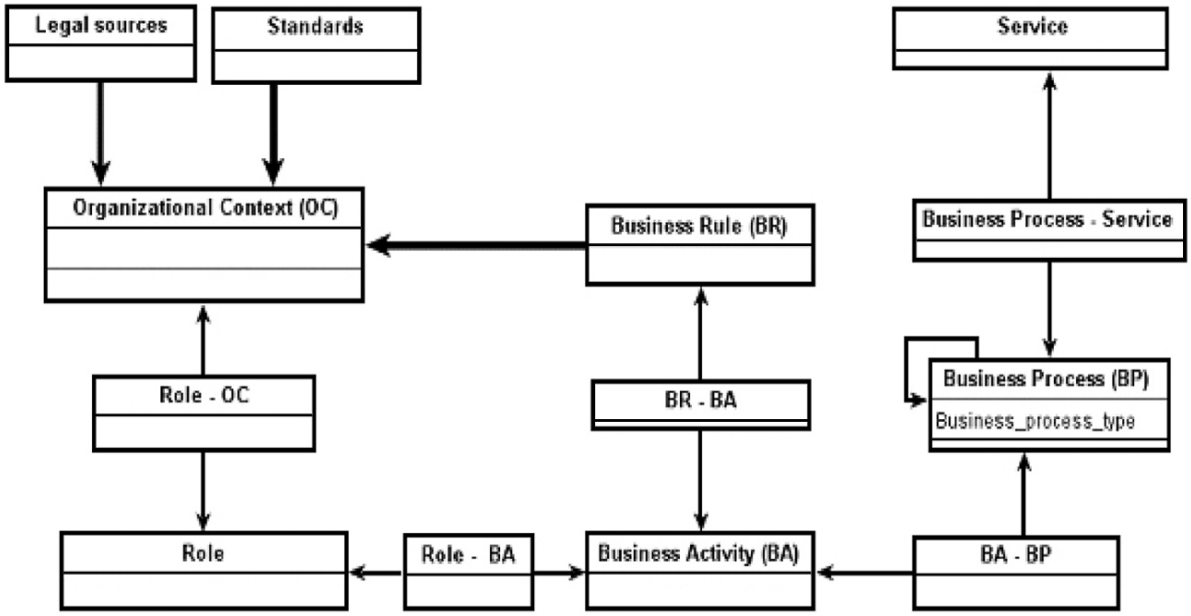

Figure 3. Organizational Layer (by Using Existential Binary Model)

3.1.3 Responsibility Dimension

The review of the governance standards and norms (ISO38500 2008, Sarbanes-Oxley 2002, Basel 2004) (Cobit 4.1) argues for having the responsibilities of the actors involved in business process suitably defined along the enterprises' structures. The definition and the modeling of the entity "responsibility" as for a long time remained lacunars and incomplete in the field of information technology. In order to enhance the compliance of the services and the service overlap management using the responsibility dimension, that dimension has been included in our meta-model (product model). Therefore, we have defined the responsibility as a charge assigned to an employee to signify his accountabilities concerning a business task, and the right and capacity required to perform those accountabilities (Feltus et al. 2011). We have modeled this responsibility using the meta-concepts of employee (or actor), account-tability, right, capability, goal, commitment, motivation, business role and sanction (see Figure 4).

As afterwards illustrated in the example, the responsibilities may be induced and deduced by business rules.

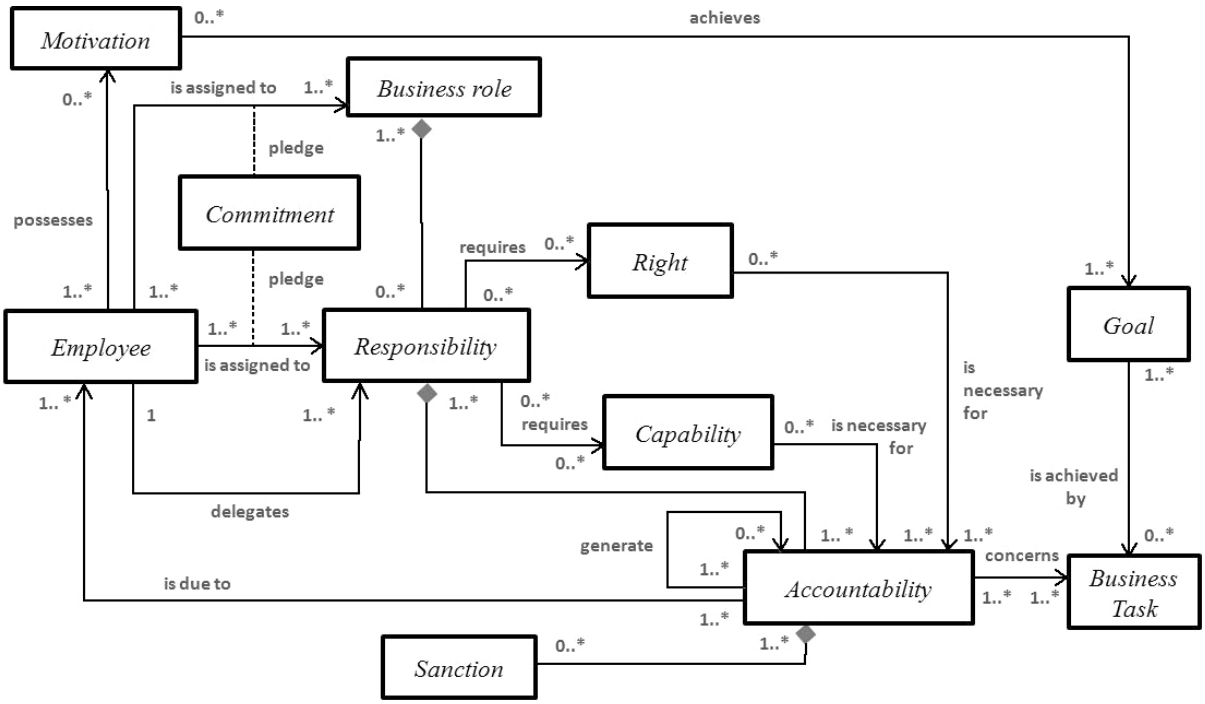

Figure 4. Responsibility meta-model UML diagram

The four following meta-concepts have been kept to be included in our product model:

- An actor is an active entity that interacts with the business and that takes part in the execution of a business activity. The actor may be a human, a group of humans or a software component such as a software agent.
- The entity accountability (Fox 2007, Sinclair 1995) represents the obligation concerning a business activity and the justification that this obligation is achieved to someone else, under threat of sanction.
- The right represents the resources provided by the company to the employee and which is required in order to perform the accountability.
- Access right is a type of right that addresses the type of actions that may be performed by an actor on data object. This is, for example, the right to read, write, create, delete, modify, and so forth, a data or the right to use an application.
- The capability (Vernadat 1995) represents the qualities, the skills or the resources intrinsic to the actor and required in order to perform an accountability that concerns a business activity

- The assignment is the action of linking an agent to a responsibility. Delegation process is the transfer of an agent's responsibility assignment to another agent (Feltus et al. 2010b),

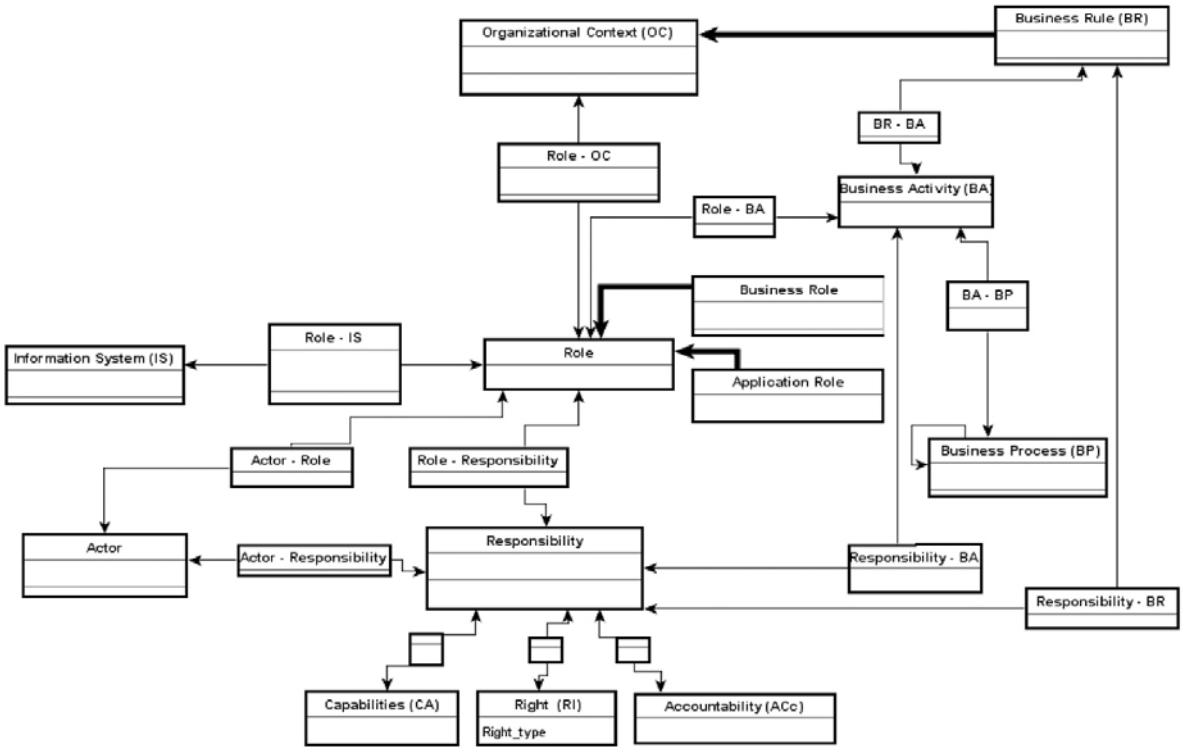

Figure 5. Responsibility Dimension (by Using Existential Binary Model)

3.2 Process Model

According of the context of the project, service architects which are leading the service engineering and the compliance analysis needs to identify the appropriate strategy to carry out the intention of the service. Therefore, we propose a methodological process (see Figure 6) that mainly intends to support the tasks of these service architects.

This process model is composed of several tasks: organizational context identification and analysis, business rule definition, business activity definition, role identification, hypercon-cept elaboration, business process elaboration, informational kernel elaboration, informational aspects construction, responsibility dimension elaboration, service specification, compliance analysis. The first step of the process aims at identifying and analyzing the organisational

context. As previously explained, the organizational context may describe the business rules, the legal constraints (legal sources), the available standards to be used by the organization. The organisational context analysis permits to define business rules and business activities, to identify roles and to elaborate the hyperconcepts from consensual documents. The organizational elements (business rules, business activities, roles) are used to specify how the work is done within an organization. In the proposed approach, once the hyperconcepts are elaborated and the informational kernel is built and as soon as the business process is elaborated, it is possible to construct the informational aspects of a service. This step is mandatory before the specification of each service and is illustrated in the case study presented in the next section.

The informational kernel is elaborated directly from the hyperconcepts. The service architect has to make choices and to decide for each concept and each link between concepts if it is mapped into a class, or a transaction or an attribute, and so on. Three types of aspect: static, dynamic and integrity constraints constitute the content of the informational layer as follows:

- **Static aspects** specify the data structure of the service;
- **Dynamic aspects** express the behavior of different elements of the service;
- **Integrity constraints aspects** specify the constraints governing the behavior of the elements of the service. Integrity constraints of a service generally represent the business rules of an organization. An integrity constraint is a logical condition defined over classes, which could be formally described and verified by transactions or methods.

The aim of service specification is to describe how the service operates upon IS. This process is realized by service architect. The responsibility dimension elaboration allows clarifying who is responsible for what data? who can access the data? In this context, the process of responsibility dimension elaboration permits the alignment between the organizational layer and the information layer.

All these steps permit to analyze the compliance of services at different levels.

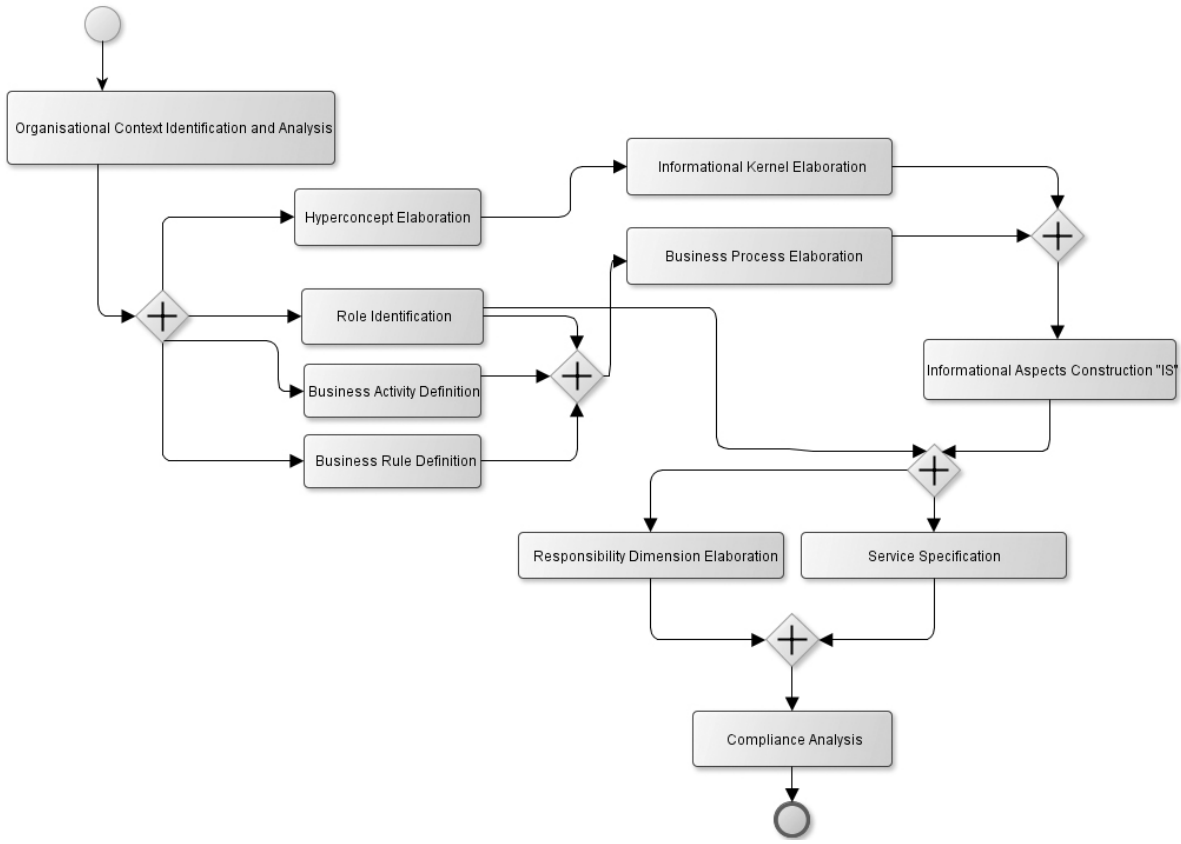

Figure 6. The Methodological Process

The proposed methodological process aims at constructing all the background of a service: the ontological background of a service (hyperconcepts construction), the organizational background and the informational background of the service. The responsibility dimension is constructed by focusing on informational aspects of a service and on the basis of the roles identified within the organization.

4. EXAMPLE IN HEALTHCARE

The management of the access right in the healthcare domain is of major importance since the data manipulated concern personal high sensitive information. At Luxembourg, this personal data protection has been legitimated by the national law of August the 2nd, 2002, and all actors playing in the healthcare area has the legal obligation to conform to it under the threat of sanctions.

This example illustrates how the product model and the process model can be used in practice. The example is structured as follow: firstly, we present the context and the objective, then we engineer a service dedicated to *Give access to the patients' record*, finally, we analyze the compliance offered through the service when it is used by three distinct organization.

4.1 Context and Objective of the Example

The context of the example, as illustrated on Figure 7, is the sharing of medical information between medical institutes from the same region, ie: the *Hospitals*, the *National agency for statistic* and the *Insurance Companies*. At a regional layer, the healthcare institutions need to share information about the inhabitants of the region. Therefore a service is elaborated in order to share the patients' records. In order to define a service overlap (in the sense of a service that may be accessed by the 3 professional institutions in the mean time and considering the business rules), we highlight, firstly, how the *Give access to the patient's record* service can be specified using the meta- model elaborated in the previous section, and, secondly, how it can be used, in compliancy with the business rules, in order to strengthen the compliancy in the usage of the service by the different actors involved.

In this example, the added value of the service stays in the provisioning of the right access to the right institution. Indeed, at the patient's record level, some part of the information is considered public like for instance the *National healthcare ID, the age of the patient*, the *history of the medical acts that he has benefitted from*, etc. and other information is considered private. This is the case for instance of *blood analyses*, *serology report* (eg.: *HIV+*), *lab results*, *resume of the health disease and others illnesses* she suffers, etc. Depending on the private or public character of the information, business rules constraint the access to different types of actors. The medical staff of the hospital institution is allowed to access all the information. This is justified because, on one hand, they need access to the complete history of the medical data related to the patient in order to provide care and perform medical acts, and, on the other hand, they also need access to information required for the invoicing department, including the *National healthcare ID*, the *insurance company, etc.* The insurance company only needs access to the public Patients' record in order to pay

back the patient for medical acts. The National agency for statistics only needs access to the private Patient's record in order to analyze the evolution of the pathology at the regional layer. They may not access the Public Patients' record so they will not be able to retrieve the links between the patients (personally identified) and their private data.

In the example, we focus our attention on the responsibility of the doctors. In a hospital, the doctors are responsible for treating the patients. They, therefore, need the capability to realize medical acts and to have a medical education. They need the right to access the entire patient's record layer and are accountable towards the patients, the medical director of the hospital, the law and themselves (that last accountability is justified by the feeling of guilt if the patient is deceased after the treatment).

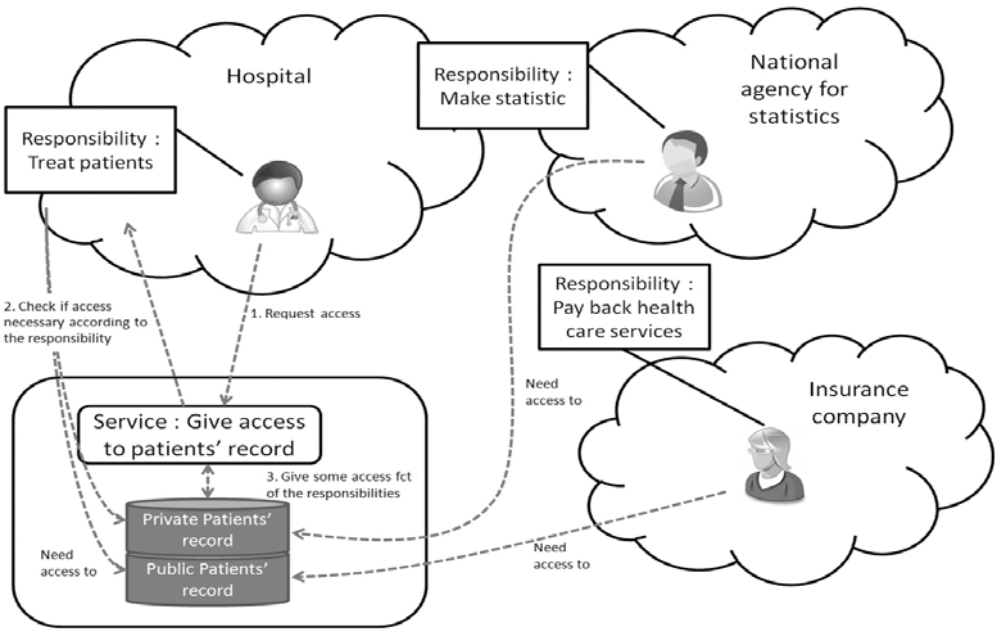

Figure 7. Example in the Healthcare Sector

4.2 Engineering of the Service

The elaboration of the product model in previous section provides the main advantage to gather a unique model including the organizational layer, the information layer and the responsibility dimensions that are significant for the formalization and for the deployment of services.

4.2.1 Informational Kernel Elaboration

In order to engineer and formalize the service *Give access to the patient's record,* we need first to specify the information system that is associated to the service. That information system is specified according to the organizational constraints that apply on the service.

In our example, the organizational constraints are different depending on whether we address confidential data or public data. Therefore, we need to create two new hyperconcepts. The first one, named *Patient's record*, is composed of the concept *Patient* that represents the human for which data exists in the database which is accessed by the service (see Figure 7). The concept *Patient* is associated to the concept of *Record* that is composed of *private* and *public data*. These *private* and *public data* are associated the concept of *Information system.* The second hyperconcept that we create is the hyperconcept of *confidentiality level.* That hyperconcept results of the association of *data* that concerns a *patient*, which is accessed by a *role* assigned with precise *responsibilities*. The concept of *Patient* exists in both new hyperconcepts and is equivalent. The concept of *data* exists in the information system layer, the concept of *role* exists at the organizational layer and the concepts of *actor* and *responsibility* in the responsibility dimension. By defining that hyperconcept, we define the semantic of the confidentiality that vary depending on the type of *data*, type of *actor* and *role* that access it, type of *responsibility* and type of *patient*. For instance, the *data serology analysis* is confidential except for the *doctors* that have the *responsibility* to treat the *patient* named *John* or is partially available for the insurer that a *responsibility* to pay back the medical act of *John*.

4.2.2 Business Process Elaboration

Next, we have to specify the business processes which realizes and which operates the services. That specification is performed at the organizational layer which is concerned by the service and which influences the service specification. In our example, in order to have the service *Give access to the patient's record* operated, we have to specify the business processes that support the service as well as the business activities that complete the business processes. The product model (presented in Section 3.2) permits to represent two types of business process. The business processes that realize the service and the business process that

use the service.

4.2.2.1 The Business Process That Realises the Service

In order to give access to the patient's record, the most significant process that we depict is the process that validates the compliance between the business rules and the requests issued by the different actors and the different roles. That process is composed of four business activities (see Figure 8). The first one is the activity to receive the request, the second activity is the activity to check the compliance, the third activity is the activity to decide whether or not the access is given to the medical record and the last activity is really the provisioning of the access right. Each of those activities is associated to one or more business role(s) that has for objective to realize the activity. In that case of the analysis of that process, we acknowledge the role is mostly played by software agents that use algorithms in order to retrieve the access right query, to analyze the compliancy according to different attributes such as the business rules, to make the decision and to provide the rights.

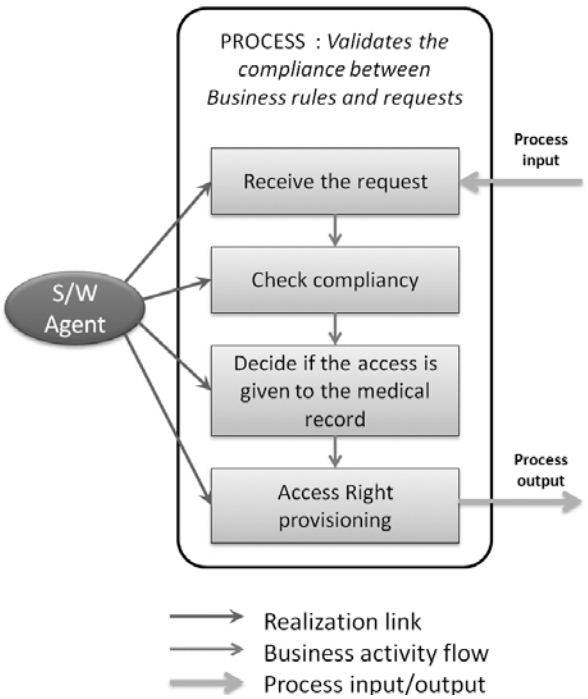

Figure 8. Activities Flow for Business Proves Validates the Compliance Between Business Rules and Requests

4.2.2.2 The Business Process That Operates the Service

The service *Give access to the patient's record* is used by three types of stakeholders: the *Hospital*, the *Statistics institute* and *Insurance Company*. Each stakeholder needs to have access to the patient's record, in order to perform their own business processes and business activities. Let's take the example of the business process related to the treatment of the patients at the *Hospital.* That business process is composed of three business activities: The first one is *Ask access to the patient's record*, the second is *Diagnose the patient's problem* and the third is *Give drugs and perform a medical act*. In our case, all of the three activities are assigned to the business role of the *Doctors*. In the case of the first business activity to *Ask access to the patient's record*, that task is also assigned to the D*octor's assistant* role.

4.2.3 Responsibility Dimension Elaboration

The responsibility dimension is considered, in our product model, as the pivot that permits the alignment between the organizational layer and the information layer. Indeed, as we have previously advocated, the concept of responsibility is composed of the accountabilities to perform obligation on a business activity and it specifies, at the same time, the required rights. Concerning the task to Ask access to the patient's record, two responsibilities exist. The first responsibility is the responsibility of doing the request to the service provider. This responsibility is assigned to the doctor's assistant that requires therefore the ability to use the patient's record management system and the right to read the patient's record. It is composed of an accountability to do the request and is under the responsibility of the doctor that performs the query. The second responsibility is to decide what information from the patient's record is necessary in order to treat the patient and to ask the assistant to retrieve that information. This responsibility requires a medical education and the right to make request to the assistant. The accountability of the doctor is due to four stakeholders as explained previously.

4.3 Compliance Analysis

In order to illustrate the analysis of the compliance, we introduce two scenarios in our healthcare example:

The first scenario: an employee that makes a query concerning the private data related to a patient that he/she personally knows. In this case, the role of the stakeholder at the organizational layer is *Statistics analyst* and his/her responsibility is to make statistics about the birth rate of children with protein deficiency. This business activity is part of the annual health statistic report publication process. At the service execution level, the *Check compliancy business* analysis the responsibility of the requester and he retrieves that according to the business rules, the responsibility to make statistics about nativity does not required those types of access to the private data of the "patient that he knows", he concludes that the information that is requested needs to be kept confidential for that stakeholder.

The second scenario concerns a doctor's assistant that requests access to pulmonary analysis of a patient treated by the doctor that he assists. In this case, the business activity is to check compliancy that composes the service acknowledges that the responsibility to treat a patient really requires the access to that patient's record and that the business rules, in this case consider that for that responsibility, it is no longer confidential.

5. CONCLUSION

In this paper, we propose an innovative methodological approach for service specification in order to engineer services considering the requirements for service compliance and for service overlap management.

The development of this methodological approach has been realized in the frame of the design science theory and by using the model design theory. Our results have been illustrated through an example in the healthcare domain.

The example has highlighted that our methodological approach is applicable and usable in a real world application where, in order to granting access rights to private data, a service may be defined considering the responsibilities of the stakeholders involved.

Our future works focus on the development of further cases, in the frame of a Luxembourgish hospital.

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Christophe Feltus is graduated as an Electromechanics Engineer from the Institut Supérieur Industriel des Art et Métiers Pierrard (Belgium). He worked for several years in private companies as: Production Head at Pfizer SA in Jette, Project Coordinator at Nizet Entreprise in Louvain-la-Neuve, and Assessor for the Civil Belgium Aviation Administration in Brussels, Belgium. He joined the Centre de Recherche Public Henri Tudor in the Grand-Duchy of Luxembourg in 1999 to work in the field of Service Science and Innovation. There he has taken part in a projects related to IT security, IT governance and business IT/alignment and has developed the responsibility modeling theory.