

Laws-Based Ontology for e-Government Services Construction

Case Study: The Specification of Services in Relationship with the Venture Creation in Switzerland

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Abstract. In this paper, we present our approach in the field of e-Government services construction. In this work, the ontological level extracted from legal sources is used as means to define and to construct e-Government services. Building Information System (IS) and e-Government services based on legal sources presents many advantages: (i) the services and IS conforms to the legal framework that organize the activities supporting the IS and (ii) the proposed approach allows clarifying the links between legal sources, e-Government services and IS, in particular, the alignment between the amendment of laws and the evolution of e-Government services.

Keywords: Information System, e-Government, service, legal sources, activity.

1 Introduction

The institutional activities are governed by legal sources represented by a set of laws which regulates their execution. The contents of laws are mandatory for the institutional domain and represent a reference for the professionals (managers) as well as for the e-Government designers.

However, the legal sources are not properly considered in most existing approaches for e-Government architectures. These approaches lack a systematic framework for the compliance of e-Government services with legal sources. This compliance between legal aspects and e-Government services¹ is a crucial issue for administrations. This

¹ We adopt the following definitions of service: From [9]: "In business science, service is defined as any business action or business activity that has a added value result for a person or a system, this action or activity is offered by another person, entities or a system that make benefits from providing this action". From [6] a service is defined as: "Any act or performance that one party can offer to another that is essentially intangible and does not result in the ownership of anything. Its production may or may not be tied to a physical product".

issue becomes more difficult with the fast-evolving dynamics of laws (i.e. the amendment of a law, the abrogation of a law and the introduction of a new law). This paper illustrates two specific problems:

- How to take into account the legal sources in e-Government architecture?
- How to build the e-Government services based on legal sources?

Our goal in this paper is to present our approach to describe and establish the link between e-Government services and legal sources. This link is established by an ontology which is called “Laws based ontology”. In other words, this ontology is used to define and construct the e-Government services. The paper is structured as follows. Section 2 introduces our proposed framework for the construction of e-Government services. Section 2.1 describes the method for extracting ontology from legal sources. Section 2.2 presents the conceptual basis for discovering and constructing e-Government services. Section 3 discusses difficulties related to the deployment of the proposed approach in public administration.

2 Framework for the Construction of e-Government Services

Our goal in this paper is to use the ontological level extracted from legal sources as means to define and to construct e-Government services.

We present a method to describe the ontological level for e-Government services construction. This is composed of two steps:

- Step 1: Ontology construction from legal sources.
- Step 2: e-Government services identification.

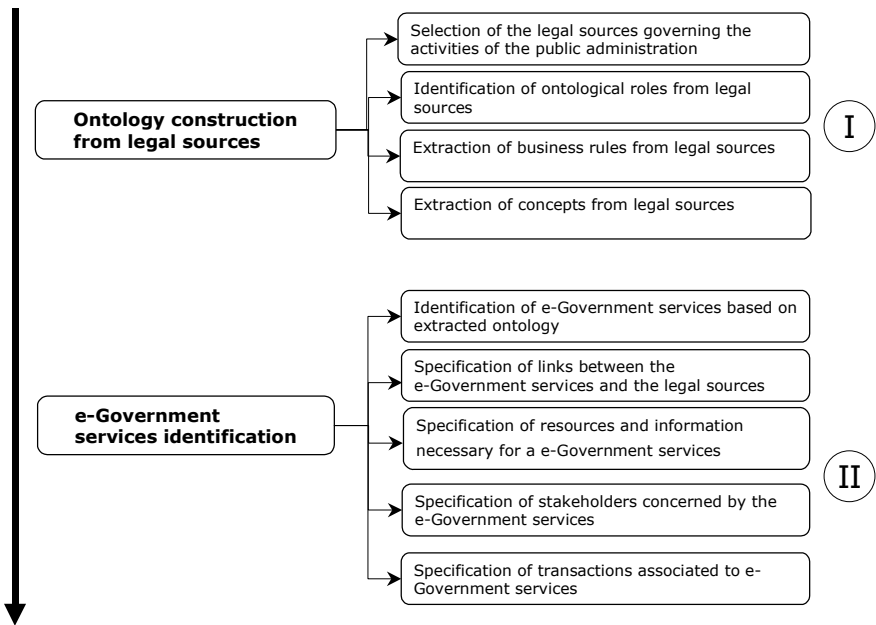


Fig. 1. e-Government services based on legal sources

2.1 Ontology Construction from Legal Sources

In the context of Information System (IS) engineering, we define an ontology as a conceptual information model that describes some specific domain in term of concepts, facts and business rules. An ontology is a reference model which supports information interoperability and shares information: (1) it supports human understanding of the domain under consideration and communication, (2) it facilitates the interoperability across different parts of IS.

The meaning of ontology considerably evolved from its origins in philosophy to its current usage in IS for e-Government. While ontology in the philosophical sense roughly means a categorization of all the entities that exist in the world and the relationships between them, ontology in the IS sense is only considered as a limited universe of discourse [10]. In our research work, laws are considered as a universe of discourse for IS engineering. The concepts and business rules extracted from the appropriate laws are used to build the ontological aspects of the corresponding domain.

Legal texts describe concepts, business rules and roles governing the given institutional domain. The exploitation of these sources of knowledge permits to enhance IS adequacy and compatibility with institution activities and to find stable common information for IS engineering for e-Government in the perspective of sustainable development.

“Laws based ontology” is a new approach for IS engineering that allows establishing and clarifying the links between laws and IS, in particular the alignment between the amendment of laws and the evolution of IS. In other words, we use laws as a source of knowledge to analyze and construct the ontological level of an institutional domain. The exploitation of these sources of knowledge permits to find stable concepts. For us, an ontology contains the stable common information of the IS domain.

In our approach, the “Laws based ontology” is built from one or several hyperconcepts (*Hcp*) [5]. A Hyperconcept is constructed on a subset of concepts extracted from laws, forming a unity with a precise semantic. It is represented by an oriented graph where nodes are concepts and edges are links between concepts. There are only three types of links: (i) instantiations, (ii) existential dependencies and (iii) generalization-specialization links [5]. Our knowledge representation model to describe the “Laws based ontology” is then an oriented graph.

Several structured languages may be used to describe this ontology. For example, we can employ OWL (Web Ontology Language), OIL (Ontology Inference Layer or Ontology Interchange Language), TELOS language as mean to specify the “Laws based ontology”.

The particularity of our knowledge representation model in the context of IS engineering is the ability to establish the link between legal sources and IS specification. More precisely, our aim with this model is to specify the business rules, the organizational roles and the fundamental concepts dedicated to develop an IS and to specify e-Government services.

The hyperconcept schema must satisfy a set of conformity rules including connectivity and concept completeness. The connectivity guarantees that each concept of a hyperconcept is related to at least one other concept from the same hyperconcept. In this case, the hyperconcept represents a homogeneous zone and not a discontinuous unit. If the concept C_1 belongs to the hyperconcept *Hcp* and is linked to the concept C_2 , then C_2 also belongs to *Hcp*.

The process model of the construction of an ontology from laws is expressed as a map (i.e. strategic guideline) [8]. The nodes represent the intentions and the links

between the nodes represent the strategies. An intention indicates the goal to reach and a strategy specifies the manner with which the intention can be carried out.

Figure 2 specifies the processes of the proposed method for extracting an ontology from laws. This map comprises five intentions called:

- Select the laws governing the IS domain and e-Government services.
- Define the ontological roles.
- Define a hyperconcept.
- Build a hyperconcept.
- Validate a hyperconcept.

In [5], we proposed guidelines and method components for the extraction of the laws based ontology. Each guideline can be composed of a set of more detailed sub-guidelines or on the contrary be a part of some more complex guideline.

For a given domain, we propose firstly to identify the set of legal texts such as laws, application regulation which formalize the IS domain (figure 2). The study of each of these texts should be made only in the perspective of IS engineering. The laws contain information and knowledge of purely legal nature, which cannot be considered in the IS. Only the key concepts of the domain and business rules are identified and retained. The analysis and interpretation of certain laws is a complex process. An important effort is required to carry out this process. Collaboration with an expert in legislation is necessary.

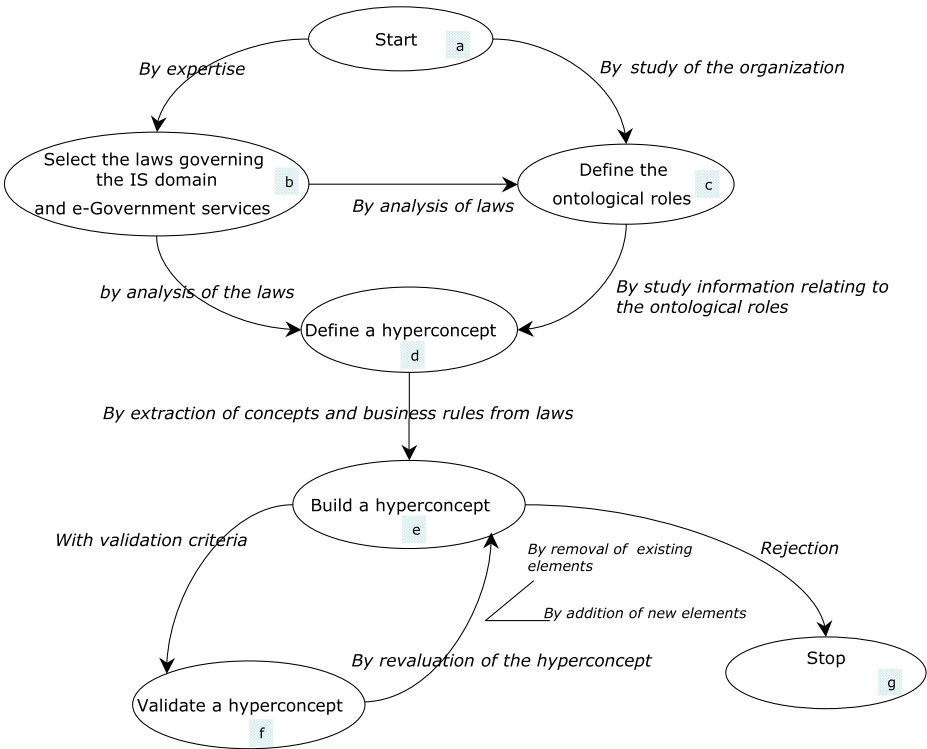


Fig. 2. The process of construction of an ontology from laws

Table 1. Example extracted from the Swiss federal law “Ordonnance sur le Registre du Commercial”.

4. Associations**Art. 97**

The registration of an association indicates:

- a. the statutes date;
- b. the name;
- c. the head office;
- d. the objective;
- e. the resources;
- f. the organisation, the representation and the signature mode.

Art. 98

The registration query is signed by the association's manager. It comes together with:

- a. a legal abstract of the General Assembly minutes which adopted the statutes and designed the bodies, as well as the indication of the authorised people to sign and the signature mode (if necessary).
- b. a copy of the statutes (art. 28, al 4¹¹⁰).

10. Examination by the commercial register office**Art 111a**

- a. ... the associations registered at the commercial register receives an identification number.
-

Figure 2 illustrates two strategies for the definition of the ontological roles. The first strategy is based on the analysis of the domain of the corresponding IS and the second is based on the analysis of the laws which formalize the IS domain.

The map (figure 2) proposes two strategies to define a hyperconcept. The first strategy is based on the analysis of the texts of laws and the second is based on the study of the information related to ontological roles.

The construction of a hyperconcept is carried out by the extraction of concepts and business rules from laws. The validation of a hyperconcept is carried out by the application of validation criteria. A hyperconcept can be rejected, which causes its reevaluation. This reevaluation is expressed by the addition of new elements to the hyperconcept or by the removal of existing elements belonging to the hyperconcept.

The proposed method is illustrated with one case study: the specification of services in relationship with the venture creation in Switzerland and in the State of Geneva. We have selected the Commercial Register area which mainly encompasses the registration of a new company and the modification of its registration. This case study includes services about company registration, raising finance, taxes payment, employees hiring, social insurances and business premises.

With this case, our main goal is to exemplify our methodology, that is, to define and to build e-Government services by the extraction of key concepts from laws. We consider legal sources as prominent, as an absolute referential.

In order to select the most appropriate legal sources at the federal level regarding the Commercial Register and the related services which may be offered, we have used a Swiss doctrinal source² which is considered as a reference by legal experts.

² Fiches juridiques suisses. <http://www.fjs.ch>

The main law regarding the Commercial Register is the “Ordonnance sur le Registre du Commerce”³. We have thus begun to analyse this legal source.

We have then extracted the most significant concepts from the select laws. Here is an example of hyperconcept "Examination of the registration of an association" based on the articles 97-98-111a regarding the registration of an association to the Commercial Register. An association is one out of the fifteen legal forms of organisation concerned by the Swiss Commercial Register.

The following ontological business rules can be extracted from this law fragments:

- the registration of an association to the Commercial Register must indicate the statutes date, the association name, the head office, the objective, the resources, the organisation, the representation and the signature mode.
- the registration query must be signed by the association’s manager.
- the registration query must come together with a legal abstract of the General Assembly minutes, the indication of the authorised people to sign, the signature mode, and a copy of the statutes.

The figure 3 illustrates the hyperconcept schema.

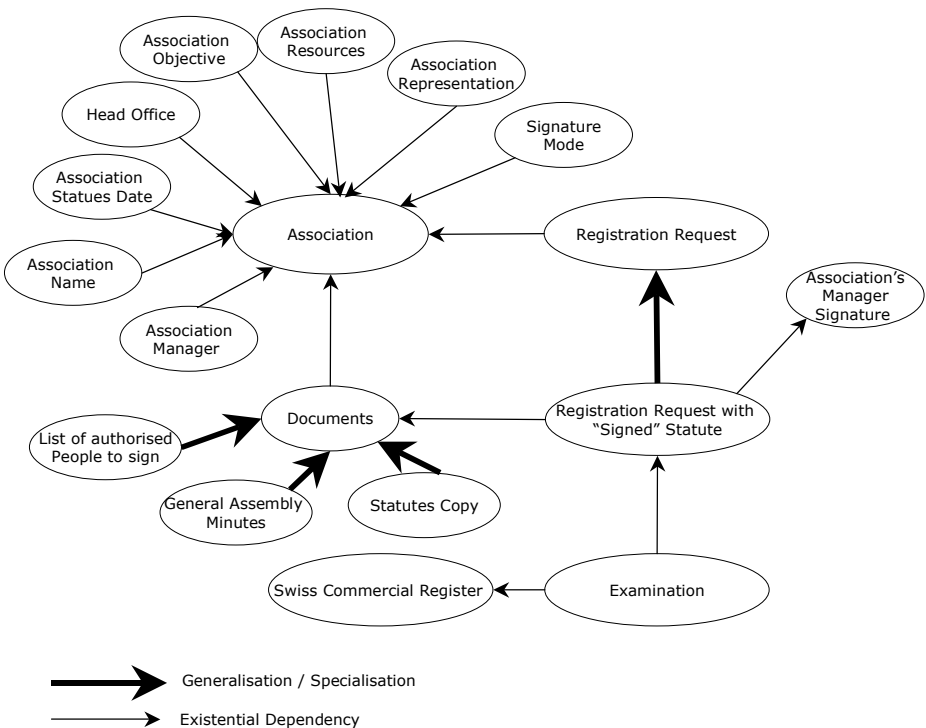


Fig. 3. Hyperconcept “Examination of the registration of an association”

³ Ordonnance du 7 juin 1937 sur le registre du commerce (ORC), RS 221.411. http://www.admin.ch/ch/f/rs/c221_411.html

The following ontological roles can be extracted from this law fragments:

- Association.
- Association's manager.
- Commercial Register Office (cantonal administration).

2.2 Public Administration Services Identification

The model presented below could serve as the conceptual basis for identifying public administration services.

2.2.1 Hyperconcepts and e-Government Services

e-Government services are subject to government regulation. As we said previously, we used the legal framework to define public administration services. More precisely, the constructed hyperconcepts are used as means to define and build e-Government services. The key element of the proposed model is the entity “Service”.

A service is defined by a name, a description, a type, and a goal. A subset of services can be defined and proposed based on the established ontology. This task is carried out by analysing the semantics of the constructed hyperconcepts. This analysis requires the validation of the business actors who are concerned by e-Government.

The Entity “Hyperconcept – Service” in the figure 4 expresses a many-to-many relationship between the Entity “Hyperconcept” and the Entity “Service”. This relationship expresses the fact that one hyperconcept can be used to define one or several services. A service can be defined on one or several hyperconcepts. A service may need the invocation of other services.

In our example, the semantic of the hyperconcept «Examination of the registration of an association» allows us to define two services:

- The first service allows getting information about the registration conditions.
- The second service permits the validation and the examination of the registration request by the Swiss commercial register.

These two services are clearly identifiable in the hyperconcept.

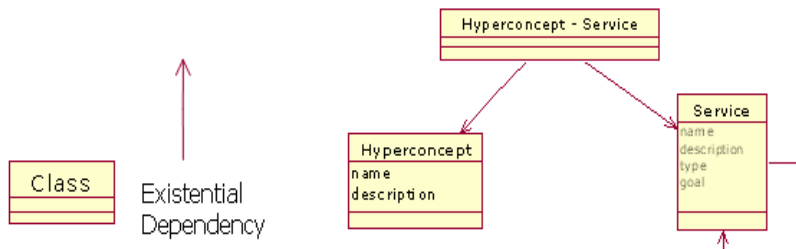


Fig. 4. Link between hyperconcepts and services

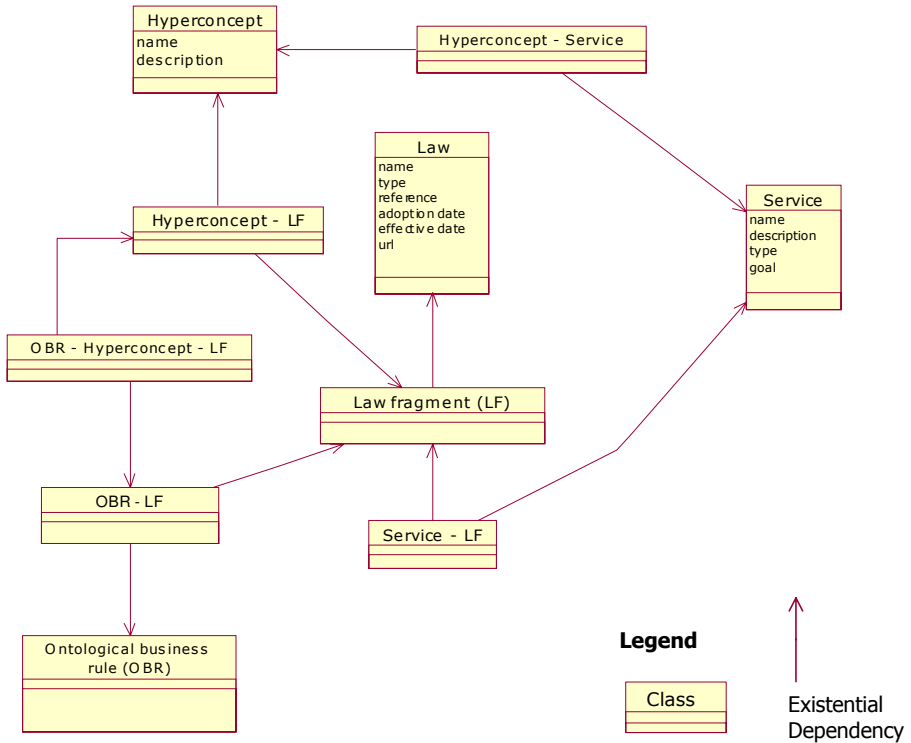


Fig. 5. Link between services, hyperconcepts, laws fragment and ontological business rules

A hyperconcept is defined on the basis of one or several laws fragments (see figure 5). A law fragment can contribute to the definition and the construction of one or more hyperconcepts. We express this semantic relationship by the introduction of the entity “Hyperconcept - LF”. An ontological business rule is extracted from one or several laws fragments and a law fragment can contain several ontological business rules. We express this relationship by the introduction of the entity “OBR - LF” in the model. We express the link between services and laws fragment by the entity “Service - LF”.

A stakeholder can be concerned by one or more services. A service for its execution can involve one or more stakeholder. There are three categories of stakeholders: Enterprise, Public administration and Person (citizens). The public administration is the entity that provides the service to the enterprise, the citizen or to itself internally. In others words, the enterprise or the citizen interact with the administration to get all relevant information about services. The entity “Public admin.”, in the proposed model, specifies the departments, divisions and branches in which public administration services are performed.

The relationship between the “Stakeholder” entity and the “Ontological role” entity expresses the facts that a part of defined stakeholders can be found in an ontological role described in laws. An ontological role represents a set of necessary responsibilities, authorities and capabilities, expressed in laws, to perform the execution of the

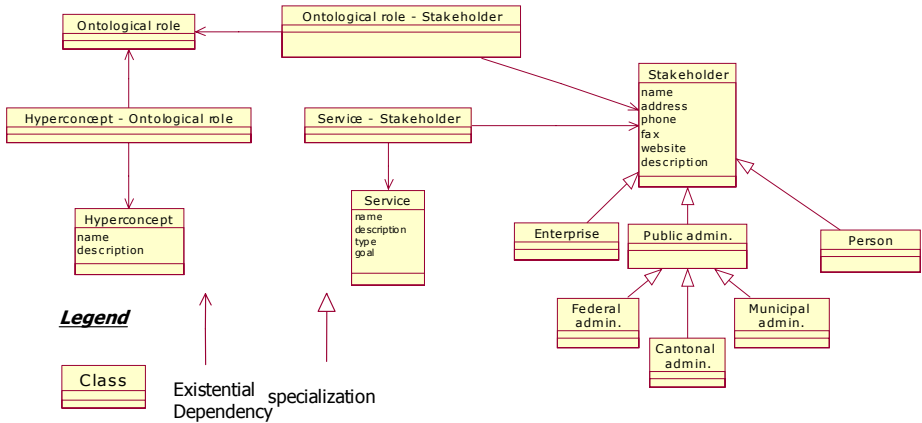


Fig. 6. Link between services, stakeholder and ontological roles

activities of the development process or to watch the execution of activities performed by the other roles.

In our example, the following ontological roles are considered as stakeholders:

- Association.
- Association's manager.
- Commercial Register Office (cantonal administration).

E-Government services are governed by preconditions which are expressed in our model (figure 7) by the entity “Resource and Information” (usually specified as an ontological business rule which is extracted from laws).

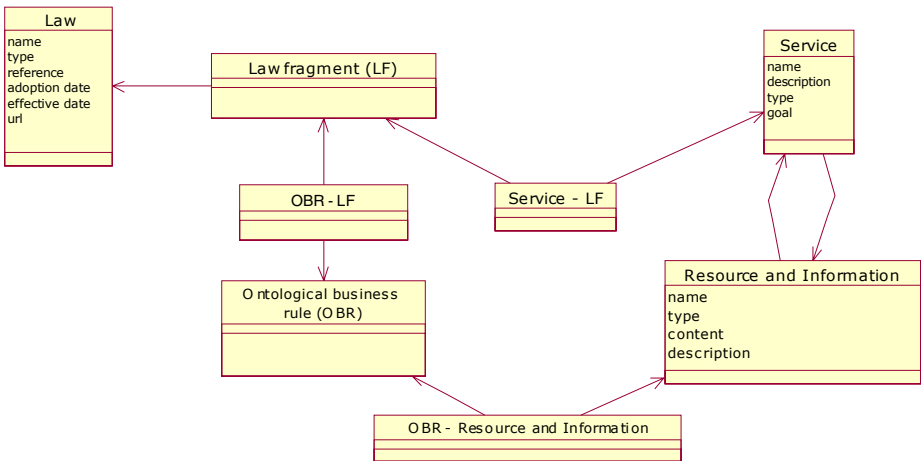


Fig. 7. Link between service, resource and information and ontological business rule

An ontological business rule can specify one or several resource /information. A resource/information is concerned by one or several ontological business rules. This relationship is expressed by the “OBR – Resource and Information” entity. The business rules are used to help the administration to better achieve goals, communicate between principals and agents, between the organization and interested third parties, demonstrate the fulfillment of legal obligations, operate more efficiently, perform analysis on current practices. Consequently, business rules are very significant because they guarantee the conformity of services with the legal framework.

In our example, Resource/Information which governs the “Validation and Examination of the registration request” service are:

- The registration of an association to the Commercial Register must indicate the statutes date, the association name, the head office, the objective, the resources, the organisation, the representation and the signature mode.
- The registration query must be signed by the association's manager.
- The registration query must come together with a legal abstract of the General Assembly minutes, the indication of the authorised people to sign, the signature mode, and a copy of the statutes.

Resource/Information is clearly expressed, at the ontological level, in terms of ontological business rule associated to the hyperconcept «Examination of the registration of an association».

2.2.2 Information System Component (ISC) and e-Government Services

The aim of this paragraph is to specify how the e-Government services are described and expressed in IS. We propose the concept of ISC to enable to work with a part of an IS as a component.

In other words, we consider that it is a need to work with a part of an IS, in particular with a unique and a coherent set of conceptual specifications. Consequently, we adopt the ISC concept as a solution for the implementation and the deployment of IS and e-Government services.

In our proposed approach, once the ontological level is built, we are able to derive a set of ISC from the ontological level. Three types of aspects constitute the contents of the ISC, as follows: (i) the static aspects which specify the data structure of the IS, (ii) the dynamic aspects which express the behaviour of different elements of the IS and (iii) the integrity constraints aspects which specify the rules governing the behaviour of the IS elements. The integrity constraints of an IS generally represent the business rules of an organisation. An integrity constraint is a logical condition defined over classes and verified by transactions or methods.

We are not detailing in this chapter the process of ISC derivation from the ontological level. Below, we propose a model to establish link between services, hyperconcepts, ISC and transactions.

As we see in figure 8, one hyperconcept then corresponds to one or more services, and a service to one or more ISC. The entity “Service – Transaction – ISC” expresses the direct link between service, transaction and ISC.

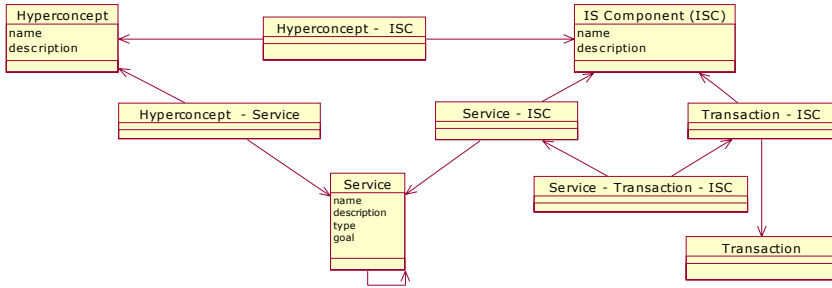


Fig. 8. Link between service, hyperconcept, ISC and transaction

2.2.3 Implementation of the Proposed Model

We have implemented our proposed model to define and construct e-Government services based on legal sources with the Protégé⁴ ontology editor. Each hyperconcept which is identified through laws analysis is stored in the same ontological classes' structure, referenced above as our proposed model. We populate the classes one by one, beginning with the class "concept". Protégé allows us to easily navigate through the interrelated concepts of our hyperconcepts (either through the Protégé Frames instances forms or through graph representations such as the ones offered by the Ontoviz Protégé plug-in). In the near future, we envision to build a core IS model from a Protégé ontology with a link to an Oracle DB instance (through RFD data store).

3 Discussion about Difficulties Related to the Deployment of the Proposed Approach

Implementing this approach in the public administration certainly creates strong reactions and raises several issues. In this context, we suggest to base the creation of institutional IS engineering and online services on the existing laws, because these legal texts are the unquestionable source of information for the public administration.

One of the main advantages of such an approach is to explicitly match the legal framework, which provides the basis of the activities of a public administration, to the provided services, especially online services. Although not written to build IS, laws nonetheless contain relevant and potentially very valuable information to build IS.

The laws studied in our research - Swiss federal laws, but also cantonal laws and their application regulations - supply information, business rules. Moreover, this analysis also reveals the roles and functions that the public administration (in our case the State of Geneva) has to perform. These elements in the laws have to be transposed in the institutional IS of the State of Geneva, either through software applications and databases, or through other specific organisational functions.

The wealth of information contained in the legal framework is therefore processed to build an ontology of the IS.

⁴ <http://protege.stanford.edu>

3.1 What about the Inconsistencies in the Laws?

The complexity of the Swiss legal framework, which encompasses federal, state and local levels, makes reaching a perfect consistency of the laws unlikely. Our approach permits to reveal the inconsistencies included in the legal framework. This raises the broad issue of the means allocated in the public administration in order to solve these inconsistencies. The ideal answer would be to bring this to the attention of the parliament at the political level. However, this ideal way of dealing with the problem is hardly practical. The observed business implementation of the laws and regulations sometimes offers an empirical way of bypassing these formal inconsistencies.

3.2 What Skills Are Required to Implement This Approach?

The hierarchical structure of the laws and the specific legal terms are certainly essential elements to be taken into account when modelling the IS from the laws.

This brings the following questions:

- Should this analysis be performed by the legal experts who write the laws? In this case, should these experts be able to model IS? This analysis could broaden perspectives as far as conceiving and writing the laws, while verifying their consistency. This would raise awareness about consistency issues and offer means of dealing with the problem.
- Should this analysis only be performed by IS designers? In this case, should they take into account the laws as their source for modelling? In order to clarify the legal texts and resolve ambiguities, collaboration with a legal expert is essential.

3.3 The Law Doesn't Correspond to Business Practice

One of the difficulties we have encountered with this approach is in the assessment of the correspondence between legal fragments and the existing practice. Indeed, there are three possible cases where a legal fragment does not correspond to the practice. To begin with, there is the case where the law is incomplete to cover a business practice. Then, there is the case where the law is incoherent with the practice. Finally, there is the case where there is a legal vacuum. These three cases require to be handled by legal expert.

3.4 Is the Legal Framework Sufficient to Describe All the Online Services?

This approach allows the identification of a first set of services. It may not be exhaustive, but it is nonetheless based upon an unquestionable source of information, the laws themselves. This constitutes a strong basis in order to help develop a sound e-Government project.

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