



Digital Business Ecosystem

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WP32 : DBE Regulatory Framework

D32.5: Knowledge base model of regulatory issues



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Short Description:

The deliverable D32.5 defines the “Knowledge Base Model” for the DBE Regulatory Framework as part of a more general “Regulatory Framework Architecture” that we have defined for the DBE.

In order to achieve this goal, we have considered all the entities and actors involved in the Regulatory Framework, as well as the external entities and actors related to it.

The central element of the work is represented by the Model of the Knowledge Base of Regulatory Issues, described through its requirements and its logical structure.

Finally, a mechanism is detailed more specifically to enable the capture of the knowledge related to legal and regulatory issues and the capability to modify and extend such knowledge over time.

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Executive Summary

The main aim of this deliverable is to define and design the Knowledge Base Model for the DBE Regulatory Framework. The Knowledge Base Model we have modelled and designed is intended to be part of a more general architecture that we have defined for the DBE Regulatory Framework. In order to achieve this goal, we first considered all the actors external to the Knowledge Base Model within the Regulatory Framework but still involved with it. We focused also on the opportunity for Legal SMEs to take part in the DBE, providing a business and a sustainability model for the entire framework. We present a Legal Architecture for the DBE Regulatory Framework that can be logically split in two areas, respectively focused on (1) legal and regulatory knowledge and (2) contracts and agreements. The first area is the object of the current deliverable; it includes all the entities that are involved in the definition of the Knowledge Base Model of Regulatory Issues.

The modelling process of the Knowledge Base Model of Regulatory Issues started with technical requirements definition and aimed at outlining the future design and implementation. This part of the work took advantage of the studies and analysis presented by milestone report M32.1, in which we proposed a three-layered infrastructure composed by a distributed knowledge repository of the legal and regulatory issues, a set of representation models of the Knowledge Base, and a set of tools for extracting and managing the knowledge held within the DBE Regulatory Framework. Finally, in order to ensure the effectiveness to the entire Legal Architecture presented, we modelled more specifically a mechanism enabling the capture of the knowledge related to legal and regulatory issues and to allow the capability to modify and extend such knowledge over time. We presented also the design of three tools that implement the mentioned processes: a Semantic Indexer tool, for uploading legal resources and adding semantic content to them; a semantic and syntactic Navigator tool, for browsing the content of the Knowledge Base with the help of its models and representations; and a CA Validator tool, for providing contracts and contract models with a link to the knowledge base content.

1 Introduction

In this work we approach the problem of the lack of competence and certainty in reciprocal trading and awareness of regulatory issues for Small and Medium Enterprises that cooperate to dynamically exchange resources, applications, services and knowledge in an e-business context. In order to address these issues, it is necessary to promote and boost trust relations [D32.1, D32.2], supporting the creation of services and transactions that will respect local and sectoral regulatory requirements. However, though those requirements aim to guarantee certainty in reciprocal trading, often the lack of competence and awareness about regulatory issues creates reluctance and uncertainty between SMEs with respect to e-business. As an obvious consequence, there is the necessity of a regulatory environment, capable of helping SMEs to solve legal and regulatory issues and increasing the benefits for SMEs that will join a digital ecosystem.

In the following sections, we will show how we address the above requirements to design a legal architecture for digital ecosystems, model the knowledge related to contracts, agreement and regulatory issues, and guarantee the effectiveness of the general model by designing and implementing a process for the capture, modification and extension of this knowledge.

This document is structured as follows: in section 2, we describe the Regulatory Framework context, representing a scenario for actors and entities involved. Then a business model for the SMEs, that will sustain the Regulatory Framework, is presented. In section 3, we present the general DBE Legal Architecture, in which actors and entities previously defined concur to provide a solution to the legal and regulatory issues within the DBE. Such architecture will be also the reference point for future software design and implementation within the DBE WP32. The requirements for the Knowledge Base Model of Regulatory Issues, as a part of the DBE Legal architecture, are formalised in section 4 and then the Knowledge Base Model is defined and designed in section 5 according to those requirements. In section 6, some possible scenarios for managing the knowledge within the framework are defined. Finally, in section 7, we focused on tools and processes that will realise the capture and management of the knowledge related to the Regulatory Framework Knowledge Base. More specifically, we focus on the process of contracts validation, on semantic indexing, and on the navigation process of the resources in the Knowledge Base. For the tools implementing these processes, we provide a design through use cases, sequence and activity diagrams.

Related documents, produced within the DBE project, are:

D32.1 Literature Review (LSE – London School of Economics)

D32.2 Generic Layer Knowledge Base (LSE – London School of Economics)

D32.3 An analysis of “Legal ICTs” (WIT – Waterford Institute of Technology)

D14.2 1st prototype implementation of the DBE Knowledge Base (TUC – Technical University of Crete)

D15.1 Business Modelling Language 1.0 (ISUFI – University of Lecce)

2 Regulatory Framework Context

The Knowledge Base Model object of the current analysis is a core part of the wider Regulatory Framework context. In order to define an effective model, a preliminary analysis about general scenarios and actors involved is proposed. Moreover, to strengthen the results of the following modelling process, the current study will be provided with a sustainability model.

2.1 Scenarios and Actors

The main objective of the DBE project is to create an integrated and distributed network of local digital ecosystems for SMEs that cooperate to dynamically exchange resources, applications, services and knowledge. In order to achieve that, it is necessary to promote and boost trust relations between the DBE adopters and the potential ones, supporting the creation of services and transactions that will occur respecting local and sectoral regulatory requirements.

Taking in consideration a starting scenario, as depicted in Figure 1, DBE-adopter SMEs have the necessity to sign contracts for their business and, on the other hand, to guarantee legal compliance and effectiveness to contracts by using the knowledge base for the legal and regulatory issues.

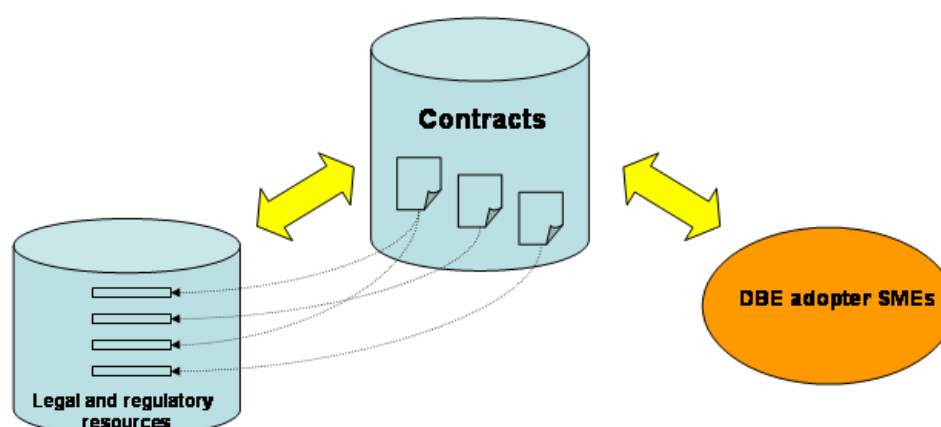


Figure 1. Regulatory Framework starting Scenario

It is possible to add another actor to this scenario, who should be involved in maintaining the Knowledge Base of the Regulatory Framework. This actor could be a centralised institution, such as a government body (Figure 2).

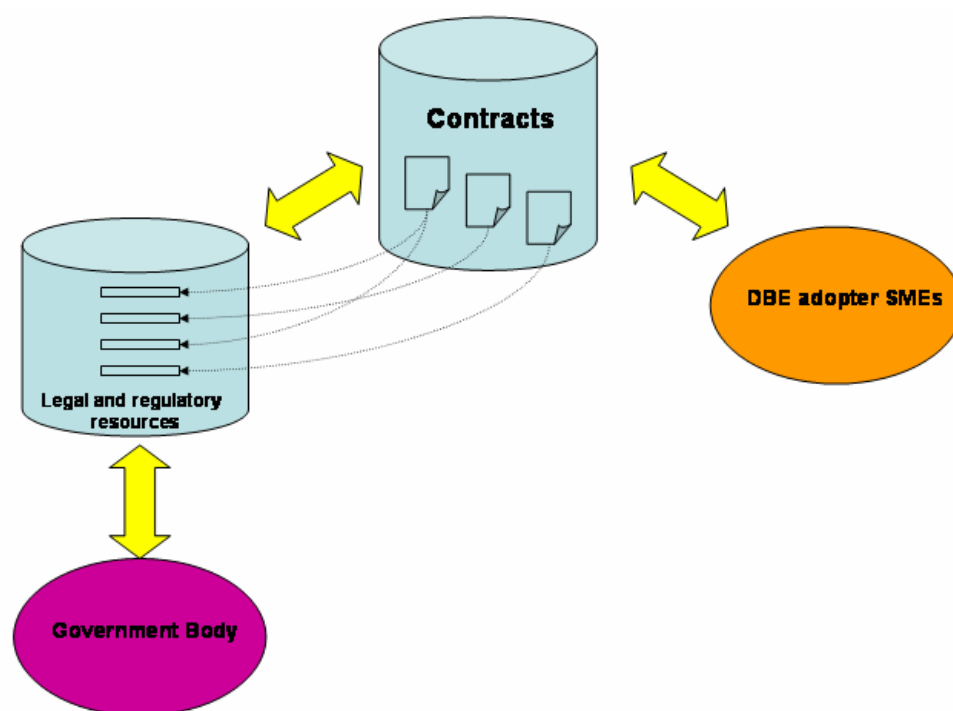


Figure 2. Regulatory Framework supported by a Governmental Body

The Regulatory Framework could also support the creation of a particular SME typology, which can be called “Lawyer SMEs” or “Legal SMEs” and who could perform the KB maintenance and have the responsibility and authority to ensure legal compliance to contracts signed by DBE-adopter SMEs. Another task they can perform is to support the DBE-adopter SMEs in the creation of contracts (if needed). This scenario is represented in the following figure:

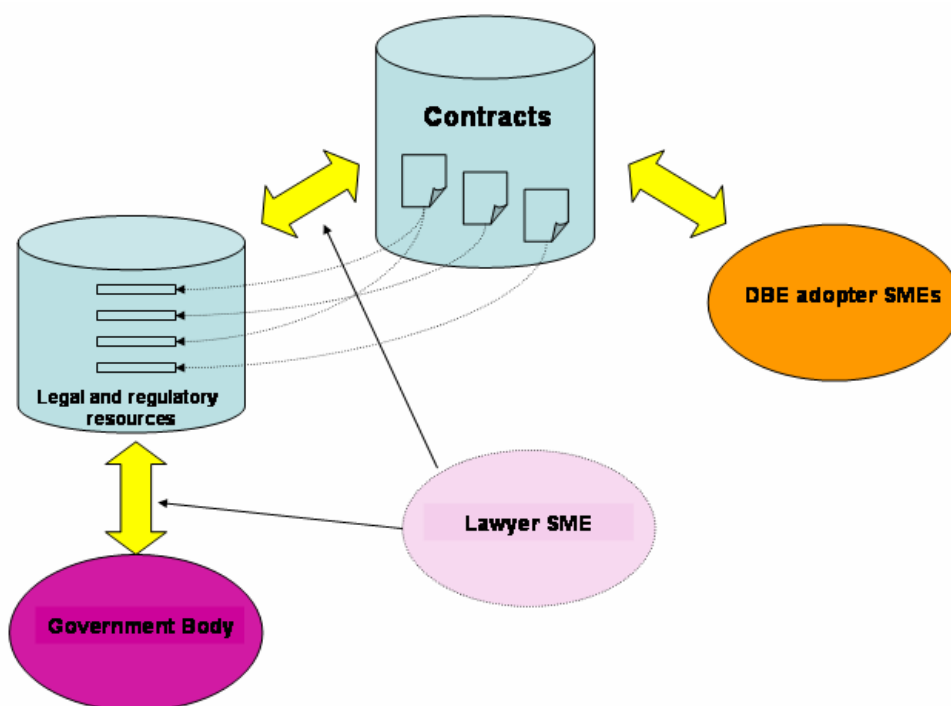


Figure 3. Regulatory Framework final scenario

2.2 Business model of the Regulatory Framework

In this section of the document we want to depict a business model that can be developed starting from the Regulatory Framework scenarios.

We can imagine that the DBE Regulatory Framework can enable the creation of new “Lawyer SMEs”, which can play the role of drivers in the DBE (such as the software SMEs). A Lawyer SME should aim, first of all, at fostering the growth of trust in the DBE and not necessarily should aim at the creation and signature of contracts. The Business Model that allows the creation of Lawyer SMEs is the one adopted by consulting firms.

Lawyer SMEs can help a DBE-adopter SME:

- in the creation of contract templates or contracts, receiving a fee from them;
- to verify and guarantee the legal compliance of the contract (signed by different SMEs) with the law, receiving a fee from the DBE-adopter SMEs.
- to maintain for free the Knowledge Base of the Regulatory Framework, as a premium service that they can offer to the DBE-adopter SMEs.

The introduction of Lawyer SMEs in the DBE Regulatory Framework opens several issues that should be addressed. We talked about the role a Lawyer SME can play in the authorization and the guarantee of a contract signed by two SMEs. Finalising a contract can be done in real-time, but it is still difficult to imagine how it would be possible to validate and authorise a contract in real time. So, we can imagine a business scenario in which if a DBE-adopter SME asks a Lawyer SME to oversee and guarantee the contract validity. That contract validation process may take some hours, one day or more. This time could be a factor in determining the amount of the fee paid by the adopter SME.

Another issue that should be taken into account derives from the opportunity for a lawyer SME to make contracts or models of contract. Lawyer SMEs could provide registries of contracts that DBE-adopter SMEs can access. In this case, it would be necessary to provide some access control mechanism (i.e. Identity Management Systems) to the registry, for example granting access for writing to the lawyer SMEs and for reading to the DBE-adopter SMEs. Finally, a lawyer SME can perform the maintenance of the Knowledge Base and of the Knowledge Base representation models as a premium service for its DBE-adopters SMEs. The open issue, in this case, is in the approach to adopt, in order to sustain the development in time of the knowledge base itself. The approach suggested could be:

- a bottom-up one, such as Wikipedia;
- a centralised one, managed by a governmental body in a centralised fashion.

The approaches that could be followed are related to the on-going discussion on DBE Governance, outlined in the next section.

2.3 Relevance to DBE Governance

Whilst the legal system is, in theory, available for anyone to use, the case-based nature of law and the professional requirements necessary to practice law create thresholds that cannot be crossed by the ‘average citizen’. The historical cases upon which law is based are held in legal libraries or their equivalent and the understanding required to interpret those cases to contemporary situations can only be accessed via firms of legal associates. Physical, social and financial barriers exist that prevent those who need to make use of the legal system from accessing relevant information and professional networks.

In a social sense, the concept of a knowledge base of regulatory issues is therefore highly significant because, in theory, such a repository disembods knowledge of legal issues from historical networks of relationships and closed information spaces through which this knowledge has traditionally been stored and maintained. This implies greater access to regulatory information for those who have been historically excluded from engagement with legal systems. Increased access to regulatory information implies greater participation in the

use of that information, which in turn implies greater involvement in the iterative construction of legal principles. When cast in these terms, the consequences of historical exclusion from access to legal information and services is significant not only to individuals but to the evolution of legal principles and practice. Conceived of in its broadest sense, increasing access to legal information and services therefore has the potential to expand the 'social knowledge base of regulatory issues' and realign it towards the interests of the less powerful and therefore historically excluded members of society.

Whilst the technological architecture of the DBE knowledge base of regulatory issues makes the possibility of a distributed knowledge base functionally possible, the issues that are defined in this deliverable as concerning legal architecture and knowledge management pose some challenging questions. Whilst divorcing regulatory issues from traditionally closed social networks and information repositories is in some sense desirable from a knowledge management point of view, if the integrity and relevance of a body of professional knowledge is to be retained it cannot simply be divorced from the practices through which that knowledge is produced. Therefore, one of the challenges facing the knowledge base for regulatory issues is how to engage legal practitioners in the use and update of the knowledge base. However, if the knowledge base is not to simply reify the problems of exclusion that it sought to overcome, a boundary has to be maintained between those who have control over the knowledge base itself and those who are contributing to it. A level of mediation is required to ensure that the balance between regulatory need and relevant contribution is maintained. Otherwise, the knowledge base could become dominated by the interests of a few actors such as large corporations, cartels of selected users, or totalitarian governments.

Historically, the interests of powerful actors have been biased toward the tendency to dominate the development of legal frameworks. By increasing participation among small businesses, whose regulatory needs have been traditionally overlooked, contributions to the knowledge base can be elicited from legal practitioners in response to the distinct needs of that group, generating opportunities for interaction for both the legal profession and SMEs.

The problem remains of how to achieve a balance of interests within the knowledge base. It is clear that some form of mediation will be required. ISUFI suggest both a centralised and a locally-centralised model for knowledge management. Within these models local government actors and regional authorities act as mediators. Understanding the full implications of what this mediatory role would entail and developing a code of practice for those mediators providing guidelines on how knowledge management and the engagement of legal professionals can be achieved and detailing how the legal architecture and technological infrastructure should be maintained to achieve a balance of interests should constitute a significant aspect of digital ecosystem governance.

3 *Regulatory Framework Architecture*

As announced through the general scenarios depicted in the previous sections, the main motivation behind the realization of the Regulatory Framework is the necessity to support DBE users in creating and managing the contract life-cycle. In other words, through such a framework, the users will be able to access the regulatory knowledge relevant to their needs and to make their contracts legally effective by linking them with the proper legal resources. As a consequence, the general Regulatory Framework can be thought as logically split into two main areas, focused on:

- Legal and regulatory knowledge;
- Contracts and agreements.

The first area represents the core element within the framework. It aims at collecting the legal resources and providing the suitable mechanisms to represent, manage and exploit such resources in an effective way. This means that it is oriented towards actors interested in maintaining the knowledge base (i.e. government bodies and/or lawyer SMEs) as well as other actors that need to access the content of the knowledge base (i.e. DBE adopter SMEs and/or lawyer SMEs).

All the elements encompassed in such an area contribute to define the Knowledge Base Model of Regulatory issues, the subject of the present document. Even though the needs addressed by the Knowledge Base Model, as well as its characteristics and components, will be analysed in depth in the following sections, it is possible to figure out the general structure of the area just by focusing on its main components directly derived from the requirements previously defined.

As shown in the layered model depicted in Figure 4, the actors involved use specific supporting tools in order to deal with legal resources to reach their specific goals. The interaction between such tools and the content of the knowledge base is not a direct interaction. An intermediate layer is in fact needed to represent the legal resources and enable their effective management and exploitation.

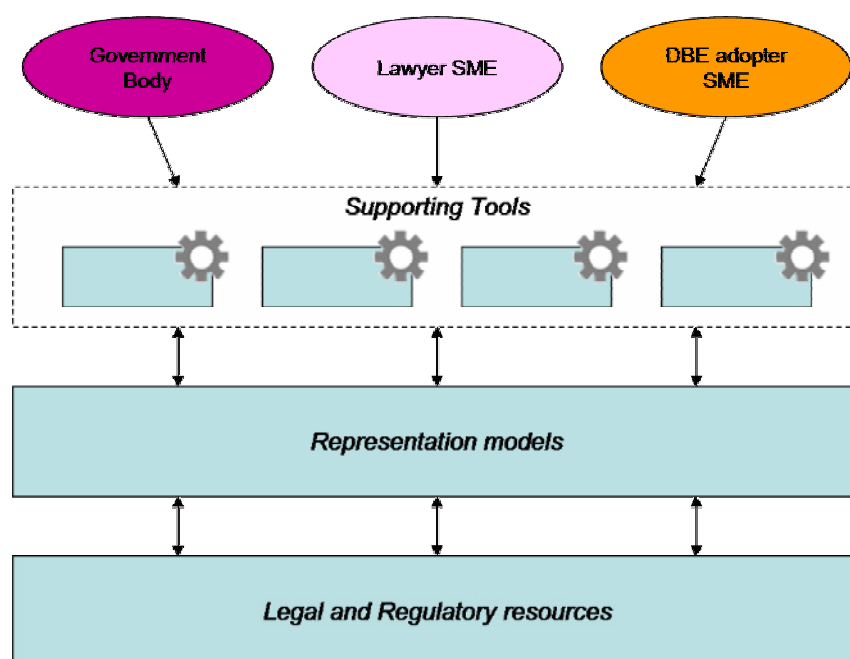


Figure 4. Actors and entities for the Legal and Regulatory Knowledge area

As previously stated, the second area of the Regulatory Framework is mostly focused on contracts and agreements. It aims at enabling lawyer and DBE adopter SMEs to prepare, negotiate and finalise contracts for e-business transactions, providing them with specific

supporting tools (e.g. contract creation tools). The general structure of such area, in terms of the actors and entities involved, is shown in Figure 5.

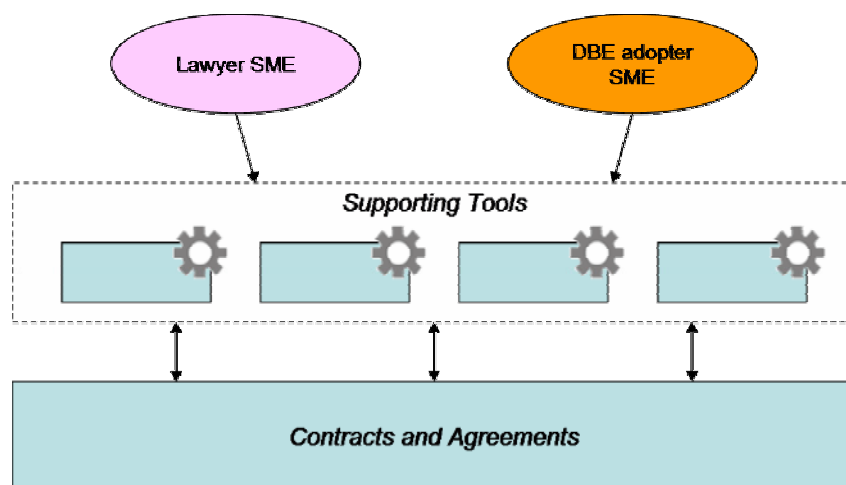


Figure 5. Actors and entities for the Contract and Agreement area

It is interesting to notice how such an area outlines the boundary between the Regulatory Framework architecture and the external DBE environment. In particular, a contract can have a model, represented through an instance of the BML meta-model (see the *BusinessProcess* package). It is planned that these contract templates will be stored in the DBE knowledge base and can be accessed by a filter within the DBE execution environment when DBE services are executed. This means that a relationship exists between the Regulatory Framework and BML, as well as with the DBE Knowledge Base.

Figure 6 shows the general architecture of the Regulatory Framework and the collaboration with some external parts of the DBE environment, as described above.

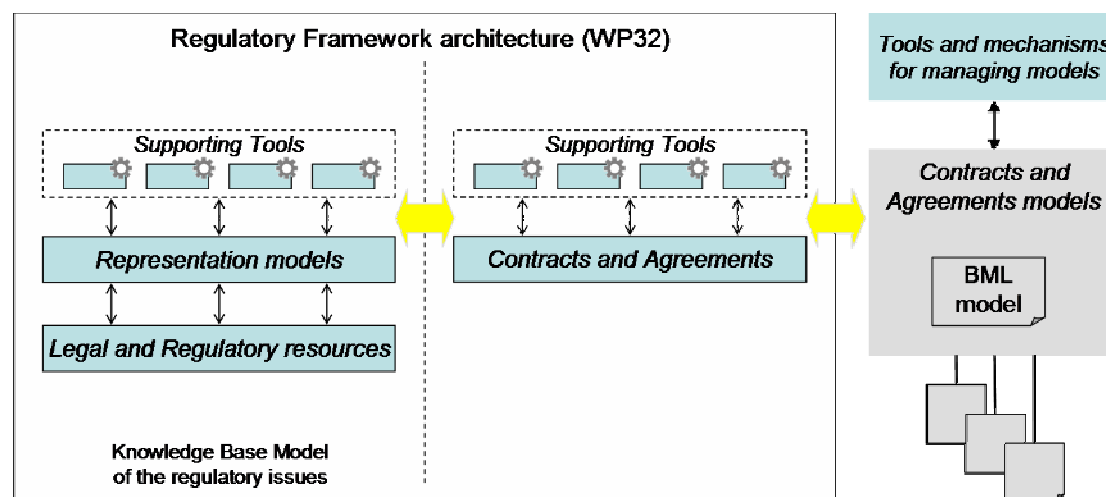


Figure 6. Regulatory Framework Architecture

Starting from the general architecture defined here, the next section focuses on the Knowledge Base Model of Regulatory Issues, in order to analyse more in depth its components and implementation details.

4 Requirements for the Knowledge Base Model of Regulatory Issues

The Knowledge Base of the DBE Regulatory Framework aims at providing the legal basic support to enable partnerships, trading activities and network dynamics between DBE adopters. This goal will be reached through the creation of a trusted environment in which all the relevant regulatory knowledge will be available for trading SMEs and every other actor involved in legal issues. In order to ensure the effectiveness of the model proposed for such knowledge base, it is essential to take into account the constraints coming from the DBE environment as well as some key aspects related to users' characteristics and needs.

The DBE long-term strategy is based on the emergence of regional nodes that interact virtually with other regions and, at the same time, on the emergence of virtual companies that use the DBE infrastructure to create business interactions between different territories and communities [D15.1]. In other words, the evolutionary perspective of the DBE project allows us to envision a close net of relationships among widespread actors, with a particular involvement of SMEs located in different European countries. This means that each economic transaction performed in the DBE context will potentially involve legal issues coming from several national and regional regulations. For example, if the interaction is represented by a B2C transaction, during the definition of the contract it is necessary that the involved SMEs, or the actors responsible for the transaction, are aware of the constraints coming from the regulatory system of the consumer's country. In fact, in B2C cases the jurisdiction of the contract is defined based on the country of consumer residence [D32.1]. As a consequence, it is essential to define a knowledge base model capable of providing this kind of support without restrictions related to the location of the adopters or to the specific community they belong to.

Another important remark related to the evolutionary perspective of the project is represented by the growing size of the DBE user communities. In a long-term perspective, the DBE aims in fact at involving more and more adopters, in order to make the framework fully operative and effective. As a consequence, the model we design should be able to support virtually any number of DBE users.

Starting from such considerations, it is possible to define the following requirements for the Knowledge Base model of Regulatory issues:

- Req. 1: the Regulatory Framework KB should globally enable the sharing of its content.
- Req. 2: the Regulatory Framework KB should be based on a scalable design.

Concerning the characteristics of the infrastructure, from a more technical point of view, it is necessary to maintain a strong alignment between the Regulatory Framework Knowledge Base model and the general vision of the overall project. The DBE project aims in fact at providing an open-source distributed environment that can support the spontaneous evolution and composition of software services, components, and applications [DBE]. This basic constraint implies the necessity to model a knowledge base satisfying the following requirements:

- Req. 3: the Regulatory Framework KB should be based on an open source infrastructure.
- Req. 4: the Regulatory Framework KB should be modelled as a distributed system.

Another fundamental point is related to the semantics underpinning the content of the knowledge base. The DBE Regulatory Framework aims at building trust and ensuring compliance in networked commerce identifying and formalising aspects of the regulatory environment relevant to DBE implementations. In particular, a specific taxonomy, focused on the most significant regulatory issues for the adoption of e-business services among European SMEs, has been developed in order to facilitate the knowledge transfer within the DBE environment [D32.2]. Such taxonomy represents the key element to be used as basis for

the design of the Knowledge Base Model of Regulatory issues. This consideration leads to the definition of the following requirement:

- Req. 5: the Regulatory Framework KB should be based on an analytical framework for classifying and analysing regulatory issues.

Finally, in order to fully reach the envisioned benefits of the Regulatory Framework Knowledge Base, it is necessary to enable the effective management and exploitation of its legal content. This means that the Regulatory Framework Knowledge Base should be modelled in order to provide specific services aimed at enabling the interactions between a Regulatory Framework users and the Knowledge Base. In particular, the mechanisms to capture and maintain the regulatory knowledge will be realised through the functionalities offered by several software tools, designed in compliance with the following general requirements:

- Req. 6: the Regulatory Framework KB should provide functionalities to add semantic meaning to legal and regulatory issues.
- Req. 7: the Regulatory Framework KB should provide functionalities to search and retrieve legal and regulatory issues through syntactic and semantic search.
- Req. 8: the Regulatory Framework KB should provide functionalities to bind contracts and contract models to the knowledge base content. In this way, it is ensured that the Knowledge Base Model of Regulatory issues will be used as a resource for the creation of contracts [D1.2].

The definition of the Knowledge Base Model of Regulatory issues will be realised starting from the requirements above described.

4.1 Relation to DBE Governance

Requirements 1 to 8 described above will contribute to the fulfilment of the envisioned benefits of the Regulatory Framework Knowledge Base only if the DBE vision embraces a knowledge management model in which the development of this base is in compliance of a balance between DBE actors' aims within this DBE vision.

In accordance with the above discussion, the Regulatory Framework Knowledge Base has the potential to meet all the requirements described only if power and control issues regarding the deployment, maintenance and future evolution of the Knowledge Base are officially and (ideally) consensually solved with the contribution of as many DBE actors as possible. However, the sensitive issue of power and control over the KB and the likely involvement of conflicting interests between various types of actors is something which must be further elaborated and preferably solved before the deployment of the KB. Hence, this issue has to be reflected and more extensively addressed both in ongoing and future work carried out in WP32 in relation to DBE Governance.

5 **Knowledge Base Model of Regulatory Issues**

This section aims at defining the Knowledge Base Model of Regulatory Issues, through the description of the structure of its components and their interrelationships, as well as of principles and guidelines governing their design and evolution over time. The model defined will be the reference point to develop a capture mechanism for the knowledge related to legal and regulatory issues. Starting from the general architecture described in the previous sections, a deeper analysis of the model will be proposed. Finally, some design and implementation details will be proposed in order to clearly define the characteristics of the Regulatory Framework Knowledge Base in terms of its adoption within the DBE environment.

5.1 **Logical layers of the Knowledge Base Model**

In compliance with the requirements previously defined and with the general architecture proposed in section 2, the Knowledge Base Model of Regulatory Issues is organised in three main layers:

- the Regulatory Framework Distributed Repository;
- a set of models for the legal and regulatory issues;
- a set of tools and mechanisms for managing and extracting the knowledge.

Such conceptual architecture will be analysed in depth in order to show how other system components or DBE users will perceive and exploit the Knowledge Base of the Regulatory Framework.

A knowledge base, in relation to information technology (IT), is usually defined as a machine-readable resource for the dissemination of information, generally online or with the capacity to be put online. It is used to optimise information collection, organisation, and retrieval for an organisation, or for the general public. This layer represents the back-end persistency infrastructure that stores the Regulatory Framework Knowledge over long periods of time. As a consequence, it provides the basic services needed to manage such knowledge.

As previously discussed, the Regulatory Framework Knowledge Base will contain all the legal and regulatory resources enabling the creation of the legal and regulatory parts of a contract between DBE users. Concerning the scope of the knowledge base, it is possible to refer to [D32.1]:

- generic issues: fundamental regulatory issues for the DBE generic layer, supporting modelling activities for the basic e-services portfolio;
- sector specific issues: more complex range of issues drawn from sector-specific implementation of DBE;
- localised issues: more complex range of issues drawn from local implementations of DBE.

Legal Resources should be made available to the system in a standard format. Besides the legal resources, the Regulatory Framework KB will also contain a raw form of knowledge, held by the system, about these resources. This form of knowledge shall be stored in a structured way and be accessible by each actor of the Regulatory Framework.

The intermediate layer is represented by a set of models that enable knowledge extraction and management mechanisms. They include all the structures (semantically enriched) useful to represent the Regulatory Framework KB. In particular, this layer is built upon the taxonomies developed for the knowledge base of the regulatory issues, which were intended to identify, classify, and assess regulatory issues relevant to the DBE vision. The taxonomies will be used as a framework for investigating regulatory issues arising in sector-specific and local implementation cases and are intended to evolve with the research findings from these stages. The taxonomies are comprised of three basic dimensions used for categorising and organising research inquiry into regulatory concerns relevant to the DBE vision. The first dimension is that of trust types (X, Y and Z, further subdivided by the DBE layer facets and types of commercial relationships). The second dimension uses the building blocks of

regulatory trust (privacy and consumer protection, e-signatures and security, jurisdiction and consumer protection). The final dimension of the taxonomy draws on the various operational perspectives from which the regulatory issues may be considered in the DBE context (these include the perspective of DBE relationships, DBE actors and software lifecycles) [D32.2].

The third layer contains software tools, interfaces etc. that will implement specific mechanisms for extracting and managing the knowledge of the DBE Regulatory Framework. More specifically, in order to provide a generic user of the Regulatory Framework with the capabilities specified through the KB requirements of the previous section, this layer will contain:

- a Semantic Indexer tool, for uploading legal resources and adding semantic content to them (see Req. 6);
- a semantic and syntactic navigator tool, for browsing the content of the KB with the help of its models and representations (see Req. 7);
- a CA Validator tool, for providing contracts and contract models with a link to the knowledge base content (see Req. 8).

The specific features of these tools, as well as the details related to their design, will be described in the next section.

The three layers, as defined above, are depicted in Figure 7.

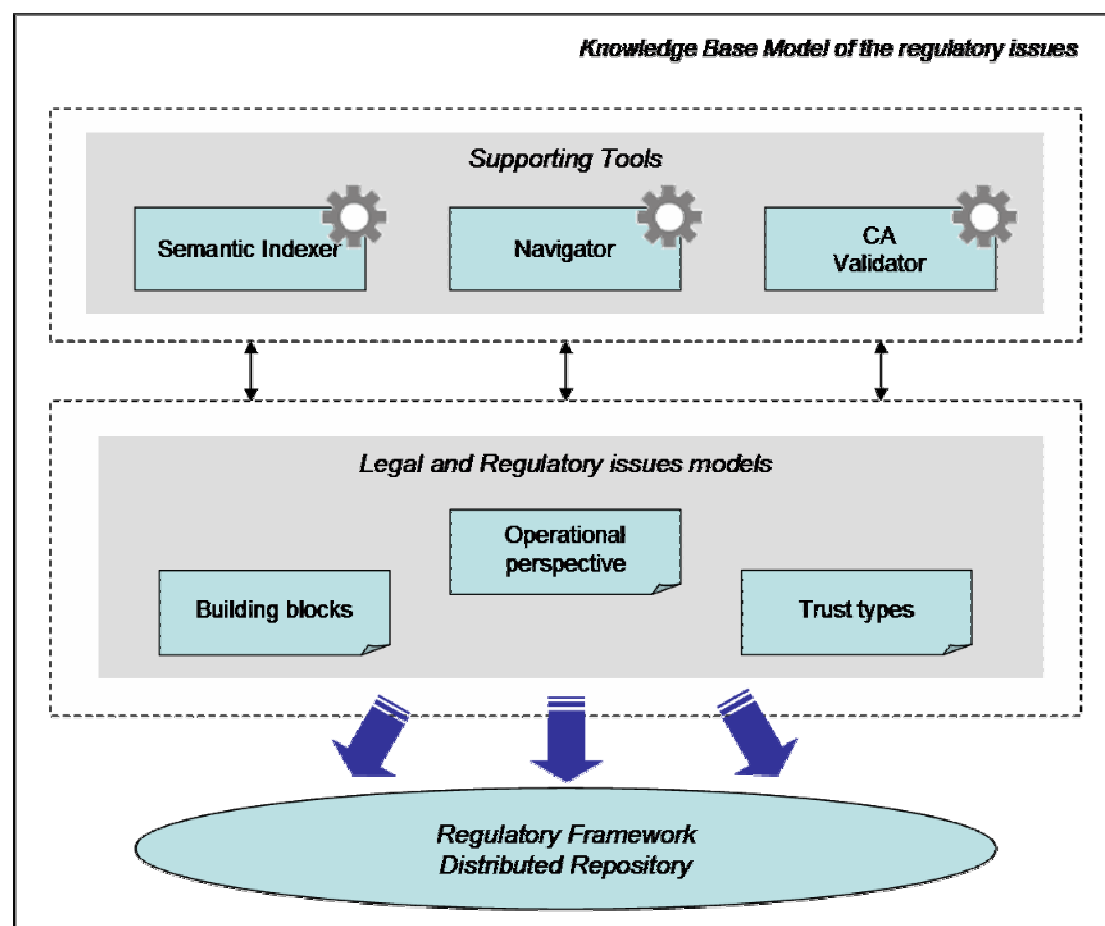


Figure 7. The Knowledge Base Model of Regulatory Issues

5.2 KB Model design and implementation outlines

This section aims at providing a more detailed view about some of the design choices. In particular, it will describe the formats used to deal with the main Regulatory Framework data as well as their representation within the framework. Moreover, a description of the distributed environment, with details about the proposed network structure, will be proposed.

5.2.1 Data representation

Nowadays, laws and regulations are represented in a wide variety of electronic formats and languages; moreover, each of them can have its own reference structure for data representation. As a consequence, to grant effectiveness to the DBE Regulatory Framework it is desirable to represent legal resources with a not-proprietary language that enables interoperability and allows to simply mark-up very different documents.

According with the requirements described above, the format chosen for storing the legal resource is XML. This format, being capable of describing many different kinds of data, is currently used in many initiatives to represent documentary resources in order to allow interoperability and accommodate differences in language, culture, and individual abilities. Considering this trend, we assume that XML will be widely used also to represent the large amounts of documents that typically characterises legal repositories (as an example, see the OASIS' initiative LegalXML, www.legalXML.org).

It is important to notice that the Regulatory Framework KB will use no reference XML schema. This choice will enable schema-independent mechanisms of knowledge creation and management that are flexible and effective enough to address the differences in structure and language mentioned above.

Each XML legal resource will use XPath (XML Path Language) that is a terse (non-XML) syntax for addressing portions of an XML document [<http://www.w3.org/TR/xpath>]. This will enable a more effective creation of additional knowledge about legal resources, since it will be possible to add semantics (in the form of simple assertions) to atomic parts of the resources. With XPath, we aim at addressing assertions in a legal resource of the KB. In a very simplified perspective, assertions can be defined as statements that are true in a given context. For the purposes of this study, the assertions produced represent simple statements able to relate a part of a legal resource to the concepts it refers to. In particular, the Regulatory Framework assertions are created using concepts belonging to the Regulatory Framework taxonomies.

Concerning the taxonomies representation, the proper language has been chosen according to the specific characteristic of the knowledge to be represented. Since the languages commonly used for ontology definition are oversized in the Regulatory Framework context, the choice has been oriented towards a simple tool, in order to avoid a high level of complexity not required for the purposes of this work. Starting from this consideration, the Resource Description Framework Schema (RDFS) has been chosen as taxonomy representation language [<http://www.w3.org/TR/rdf-schema/>].

5.2.2 Distributed environment

The technological solution chosen to deploy the Knowledge Base is represented by a distributed model. This choice allows to maintain compliance with the general philosophy of the DBE project related to the realization of a distributed environment able to offer an effective way to discover, describe, share, analyse, and integrate the information.

Another important remark, that sustains this kind of choice, is related to the possibility to have an open model that enables the realization of different solutions based on the same technological infrastructure. As announced in section 2.2, it is in fact possible to envision different approaches for managing and maintaining the knowledge base contents. Such approaches range from a bottom-up solution (Wikipedia-like) to a centralised one, with the possibility to have hybrid solutions. The most suitable approach should be chosen in a natural way, according to the specific characteristics of each ecosystem.

For example, let us consider an ecosystem organised as an *agora*¹, where mutual trust between (usually unknown) participants is very low: in this case a centralised approach should be the best solution in order to have a party able to guarantee trust in the ecosystem. This role should be played, for example, by a governmental body.

Conversely, in an ecosystem organised as a *value chain*², the existence of a stronger actor enables the possibility to adopt a bottom-up approach. In fact, the partnership to the value chain is a condition sufficient to guarantee a trustable relationship, without the necessity to control the partners' behaviours.

As a consequence, it is necessary to design a network model with a sufficient degree of generality, in order not to force the ecosystem to adopt a specific governance approach. From this point of view, a distributed infrastructure represents the best choice, since it allows to address several possibilities. Defining proper tools and mechanisms for the distributed model allows to simulate a centralised model, enabling a rapid shift towards this kind of solution. A similar degree of freedom should not be allowed by a centralised network model.

The distributed model chosen for deploying the Knowledge Base is Peer to Peer (P2P), compatibly with the project assumptions about the DBE distributed knowledge base. Several models of P2P network actually exist. Three major types of P2P network are:

- Pure P2P:
 - Peers act as clients and servers
 - There is no central server managing the network
 - There is no central router
- Hybrid P2P:
 - Has a central server that keeps information on peers and responds to requests for that information.
 - Peers are responsible for hosting the information (as the central server does not store files), for letting the central server know what files they want to share, and for downloading its shareable resources to peers that request it.
 - Route terminals are used addresses, which are referenced by a set of indices to obtain an absolute address.
- Mixed P2P that has both pure and hybrid characteristics (super-peers model).

According to the analysis made for the DBE Knowledge Base [D14.2], also the DBE Regulatory Framework KB architecture will follow the super-peer network model. The main reason for this kind of choice lies in the efficiency benefits that this model grants and in its capability of taking advantage of the heterogeneity of the peers by assigning greater technological responsibility to those peers that are more capable to handle it [SPN]. However the choice of the super-peer model does not solve all the problems that the DBE Regulatory Framework KB will face, since the design should consider several challenging issues like: dynamic self-organisation of peers and super-peers, performance trade-offs, load-balancing among equivalent peers and among simple peers and super-peers, avoidance of single-point of failure in the super-peers, search performance using super-peers, data placement and indexing across super-peers and other research issues [D14.2].

These considerations lead to the necessity of introducing a specific module within each peer of the Regulatory Framework KB infrastructure, capable of managing the cooperation across peers and between peers and super peers. As a consequence, it will be able to manage different kinds of indexing and routing tables. In this way, each ecosystem may have its own repository (or repositories) and the Regulatory Framework KB can be seen by the user as a single global resource.

Each actor of the Regulatory Framework within the ecosystem represents a peer of the infrastructure. Each peer can access some services and contribute, if authorised, to upgrading the distributed knowledge repository. In other words, a generic user accesses the

¹ An *agora* is a market where buyers and sellers meet to freely negotiate and assign value to goods (e.g. eBay); it is characterised by a high self-organisation and a low value integration [DC].

² A *value chain* is a market where the context provider structures and directs a b-web network to produce a highly integrated value proposition [DC].

entire "logical" KB to browse and retrieve legal resources and information about them. At the same time, a peer can upload a legal resource and/or generate assertions in order to add semantics to such legal resources. The way in which this process should be organised is analysed in the following section.

Moreover, some of the actors involved in the Regulatory Framework can play the role of super-peers within the network. It is important to highlight that the centrality of the role played in the P2P network does not necessarily imply a central role in managing the legal knowledge. Acting as a super-peer simply means that an actor places his technological infrastructure at disposal of the network, in order to provide a link with the other super-peers. This situation has no implications on the ownership of the knowledge, on the centralisation of the model proposed or on the control policies.

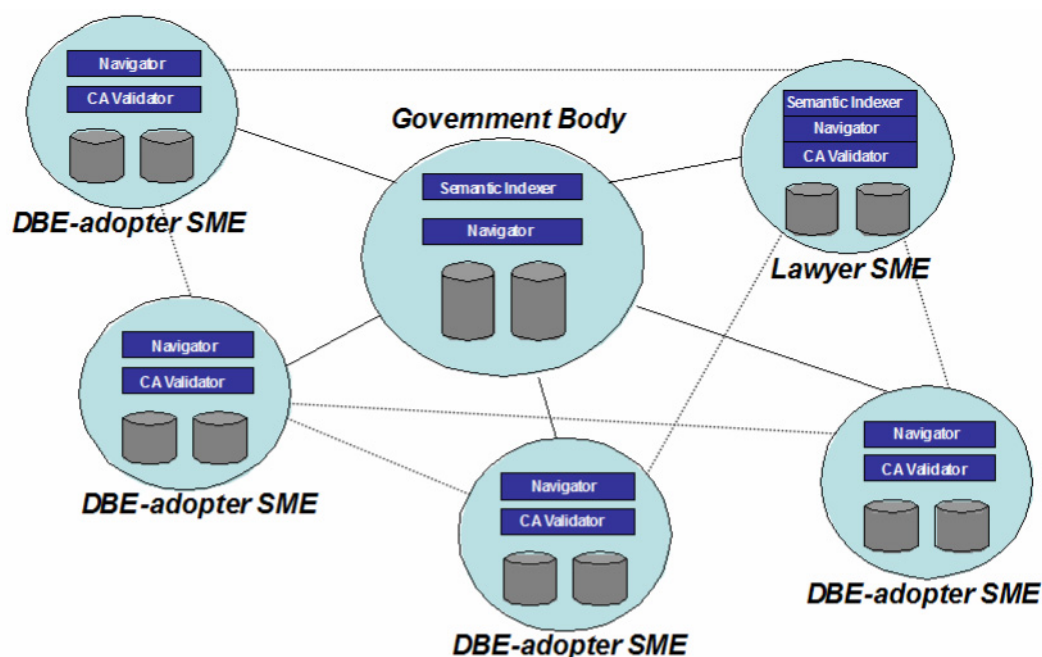


Figure 8. Peer relationships within an ecosystem

In the above figure, an example is presented in order to describe how peers can be distributed and organised within a single ecosystem. Considering the characteristics of the Regulatory Framework and the specific kind of knowledge it manages, it is possible to envision a scenario in which a Government Body, as well as a Lawyer SME, acts as super peer within the network. Conversely, the DBE-adopter SMEs and other Lawyer SMEs simply act as peers, even if these actors generally have no technical barriers to play a more central role. The reason that makes this scenario quite reasonable is that in each ecosystem the actors mostly involved in creating and maintaining a legal knowledge base are institutional bodies or (legal) SMEs that aims at making profits exploiting the benefits of the legal framework. As a consequence, these actors will be willing and interested to play a more direct role within the network. Obviously, this scenario is just one among the possibilities enabled by the model proposed for the networked environment.

In a wider perspective, the relations between super-peers, as shown in the following figure, should permit to create a logically seamless knowledge base. This will enable the user to perceive the distributed repositories as a single global resource, in a way completely transparent for him.

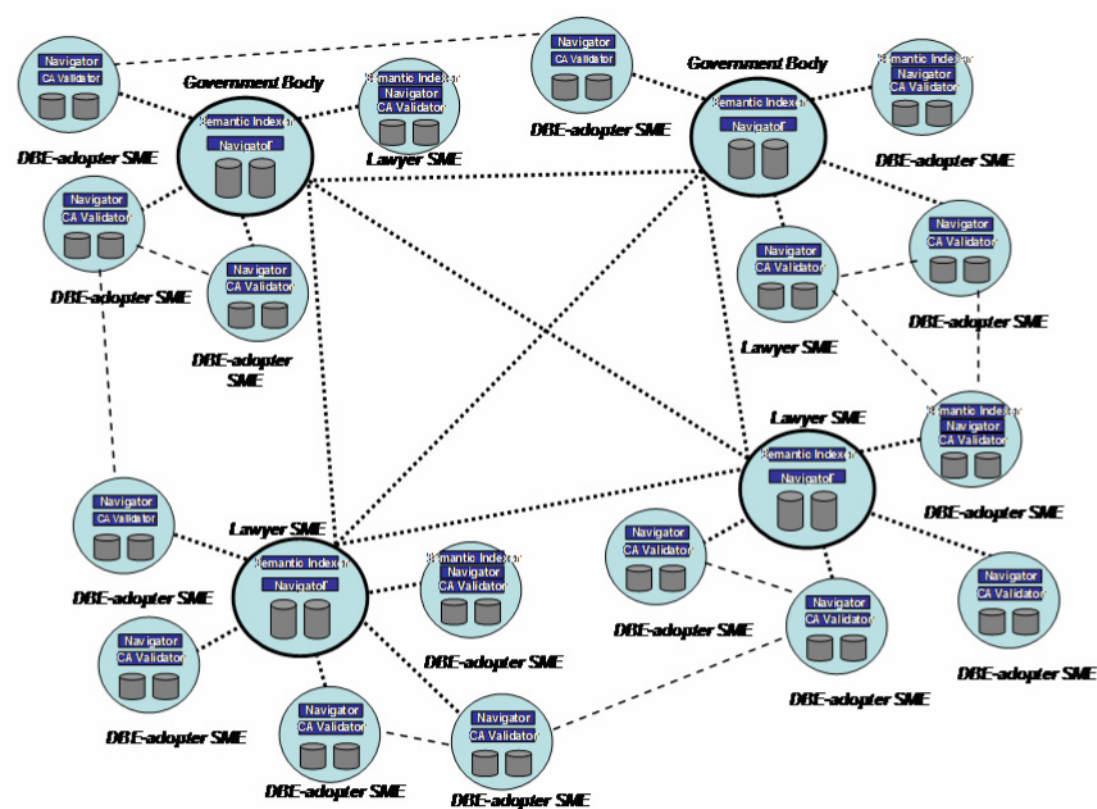


Figure 9. Super peers relationships in the DBE Regulatory Framework

6 Knowledge management processes

The complexity of the network, as well as the increasing number of widespread actors, generates some important issues related to the management of the knowledge within the Regulatory Framework Knowledge Base. This section aims at exploring possible scenarios that could be adopted in managing the legal knowledge within the framework.

As announced in section 2.2, there are several possible approaches for the KB evolution over time, ranging from a bottom-up solution to the centralised fashion.

The approach chosen, jointly to the distributed architecture of the knowledge base, could imply some issues closely related to redundancy and inconsistency of data and, as a consequence, strongly affecting the effectiveness of the framework.

In order to clearly address these rising issues, it is important to analyse such maintaining activities distinguishing among different typologies of knowledge resources that are stored within the knowledge base.

6.1 Legal resources

It is possible to envision different possibilities for uploading and maintaining the knowledge related with legal resources; in particular, we will refer to:

- locally centralised approach;
- decentralised approach.

In the first approach, governmental bodies are the sole entities authorised to upload and manage legal resources in an ecosystem. For such bodies, it is possible to delegate the uploading activity, charging a legal SME with the task of introducing the legal knowledge within the knowledge base. It is important to highlight that the actor performing this role (either a governmental body or an authorised legal SME) is not the owner of the legal knowledge (that is always publicly available). It just provides it to the other actors, ensuring them that the knowledge base content is correct.

The main justification behind this solution is closely related to the adoption process of the DBE. In fact, the DBE long term strategy stands on the capability of the DBE Project Partners to mobilise regions, territories and communities on its innovative vision. Regions, territories and distributed communities will adopt DBE vision and frameworks creating in the first stage isolated communities that simply move from territory based relations to virtual one. The following step, when the number of regions, territories and communities is large enough and a critical mass is reached, it is based on the emergence of regional nodes interacting in virtual mode with other territories and at the same time on the emergence of virtual companies using the DBE infrastructure to create business interaction among different territories and communities. The last step is the creation of a complex network of business relations that virtually connect every DBE territories, communities and companies. Such approach needs, as propulsive energy source the regions and communities capability of innovation which should be enabled and supported by correct policies [D15.1]. Starting from this scenario, the strong role given to a central governmental body is widely justified.

The main advantage coming from the centralised approach is that the central authority acts as a guarantor of the trust within the ecosystem. Accuracy and correctness of legal resources are in fact guaranteed by a well identifiable subject, which is in some way responsible for that. The main shortcomings of this approach are related to the degree of involvement of governmental bodies in a digital ecosystem. Even if the adoption process of DBE is structured to have a high level of involvement of local authorities and bodies, the presence of such actors is not mandatory in developing a digital ecosystem. This means that the approach proposed is not viable in every context.

Concerning the second approach, in the envisioned scenario all the actors of the regulatory framework (i.e. governmental bodies, legal SMEs, legal experts of business adopters) are

authorised to upload and manage legal resources. This approach should ensure a higher and more rapid alignment between the content of the knowledge base and business' needs, as guaranteed by the bottom-up nature of the process. Anyway, the high number of contributors could generate some problems of redundancy and inconsistency of data. In order to address these problems, the ecosystem should define and adopt a mechanism to check/validate contributions. The introduction of such control mechanism should be necessary in order to avoid redundancy and, at same time, to overcome the main shortcoming of the decentralised approach, that is a not identifiable guarantor of trust.

A more restricted version of the same approach is represented by a situation where more than one governmental body is involved in the ecosystem and charged with the uploading activities. Even if, the number and the variety of the actors involved in this activity is lower, also in this case some control process should be implemented.

6.2 Assertions

As in the previous case, it is possible to define different approaches for uploading and maintaining the additional knowledge about legal resources (i.e. assertions), distinguishing between a locally centralised approach and a decentralised one.

These approaches can be combined with those proposed for legal resources in several ways, in order to obtain the most suitable solution accordingly with the characteristics of a specific digital ecosystem. Obviously, some combinations can be considered as not reasonable. For example, probably no ecosystem will adopt a solution with a decentralised management of legal resources and a centralised management of assertions.

Considerations and comments proposed in section 6.1 are valid in this case too. Anyway, there is a great difference between this kind of activities and those related to uploading legal resources.

In fact, creating and uploading assertions aim at providing legal resources with additional knowledge in order to help users in retrieving and using them correctly. As a consequence, while in the first case a wrong classification could imply a lower effectiveness of the framework, an error in uploading a legal resource could imply more serious consequences, with possible legal liabilities.

As an example, let us consider a lawyer SME that is creating a contract and is searching for a legal resource referred to food transportation in Italy. If the assertions are not accurate, it probably will retrieve a law that is not actually related with this application field or it will not be able to retrieve the needed law. Anyway, the lawyer SME will be able to detect the error or to note the inefficiency immediately. Conversely, if the assertions are correct but the content of the referenced legal resources is not precise, the contract realised on the basis of that law risks to be invalid, with serious consequences for both the lawyer SME and the contract parties.

This means that the approaches used to manage the uploading activities for the assertions are less critical for the actors of the framework.

Despite this lower criticality, it is anyway important to define some control mechanisms to solve problems arising in a decentralised approach. This will allow to overcome problems related to redundancy and to ensure correctness of the assertions within the knowledge base.

6.3 Control mechanisms

Previous sections describe the possible need for the implementation of a control mechanism within the ecosystem that adopts a decentralised approach.

Anyway, even if a centralised approach is adopted at the ecosystem level, some redundancy problems arise if the framework is analysed in a wider perspective. As previously stated, the Regulatory Knowledge Base should be perceived as a single global resource. This means that contents referred to a given ecosystem are available and usable for actors belonging to other ecosystems. Moreover, it is possible that the scope of a given legal resource is

extended to more than one ecosystems (e.g. EU directives), with the possibility that different ecosystems try to upload the same legal resource.

As a consequence, the control process should be applied in uploading legal resources or assertions, from one side, to avoid redundancy and inconsistency and, on the other side, to avoid out-of-date information or improper classification of legal resources in the knowledge base, if necessary.

The first kind of control can be addressed implementing a specific functionality of the legal framework, in order to check the existence of a legal resource or an assertion within the knowledge base when a user asks to upload it.

Concerning the second aspect, a control mechanism aimed at guaranteeing the correctness of the knowledge base content surely needs a more careful analysis.

A very interesting solution to this issue could be represented by the creation of a consortium of legal SMEs and/or governmental bodies that verifies the information uploaded by all the contributors to the knowledge base. This mechanism could represent a very powerful tool in order to ensure trust and effectiveness within the framework, but it should generate problems related, for example, to a high concentration of power to a limited number of actors.

This kind of problems and possible solutions (such as a dynamic membership) should be faced in a more accurate DBE governance discussion.

7 Tools for the DBE Regulatory Framework

The knowledge capture mechanism will be realised by the functionalities offered by several software tools. In this section we will describe these tools giving an insight on the internal process and on their possible GUI. The software tools will outline and enable the interactions between a user of the Regulatory Framework and the Knowledge Base.

Front office services offered within the Regulatory Framework are:

- CA Validation
- Semantic Indexer
- Navigator

Functionalities offered by these tools are:

1. Legal validation of contracts and contract models according to current laws contained in the Knowledge Base
2. Knowledge Base indexing according to the KB model of regulatory issues
3. Search and retrieve of legal and regulatory issues through :
 - a. full text search
 - b. knowledge base model of regulatory issues

This set of functionalities is intended for:

- Business Users of DBE-adopters SMEs;
- Lawyer SMEs
- Government Body

according to the knowledge management processes described in Section 6. Notice that authorisation policies, mechanisms and tools are out of the scope of this document. For the functionalities designed below we assume that users have the necessary authorisation to perform them.

Common to all the tools of the Regulatory Framework is the use case "Choose Taxonomy", where the tool enables User to select the taxonomy through which he/she wants either to index or navigate legal resources, or validate contract.

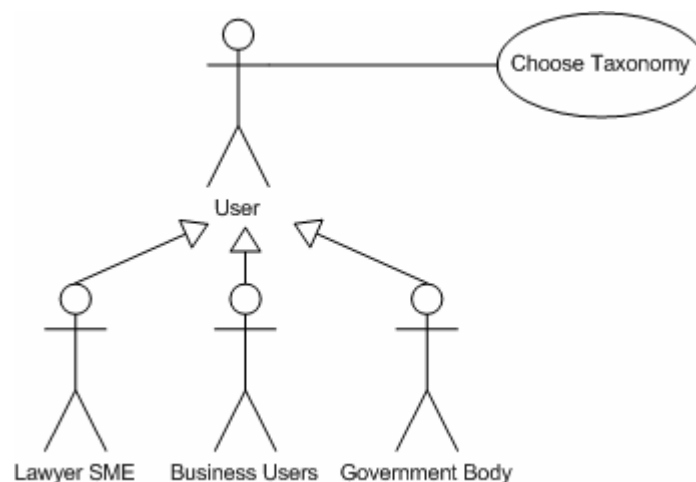


Figure 10. The "Choose Taxonomy" use case

Choose Taxonomy

Subject Area	
Business Event	The system visualises a model (taxonomy) for the KB of the Regulatory Framework with its tree structure
Actor(s)	Lawyer SME, Government Body, Business User
Preconditions	-
Termination Outcome	Condition(s) Affecting Termination Outcome
Visualise Taxonomy	The system loads and visualises the taxonomy, selected by the user, as tree structure
Impossible to visualise Taxonomy	The system can't retrieve the selected taxonomy
Use Case Description	The system allows the user to choose one of the taxonomy from Regulatory Framework KB models. The system will then visualise the taxonomy as a tree structure
Input Summary	Taxonomy List
Output Summary	Selected Taxonomy as tree structure

Finally, a use case that can be considered as independent from specified subsystems (but essential to their well-functioning) is the upload of a legal resource.

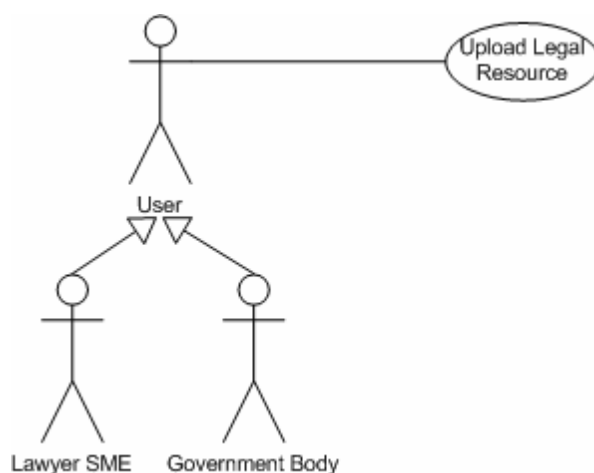


Figure 11. The “Upload a legal resource” use case

Upload a Legal Resource

Subject Area	
Business Event	The user wants build into the KB of DBE the legal resource
Actor(s)	Lawyer SME, Government Body
Preconditions	-
Termination Outcome	Condition(s) Affecting Termination Outcome
Legal Resource uploaded	The system adds the legal resource to the Knowledge Base of the Regulatory Framework

Cannot upload legal resource	System cannot upload the legal resource
Use Case Description	The system allows a user to store a legal resource in the Knowledge Base of DBE
Input Summary	A legal resource
Output Summary	

After the description of use cases common to all the tools from the Regulatory Framework, we analyse each system with its use cases.

7.1 Semantic Indexer

The Semantic Indexer enables the association of semantic content related to the legal and regulatory issue model to the Knowledge Base (taxonomies) of the Regulatory Framework (resources). This task will be performed through the creation of assertions that contain concepts belonging to the taxonomies. The assertions will be linked to each XPath (whose text is automatically created by the Indexer) of a resource in the Knowledge Base. We will make use of semantic assertion in the form of: "XPath *is_about* concept[instance]". In figure 12 the main activities of the semantic indexing process are represented.

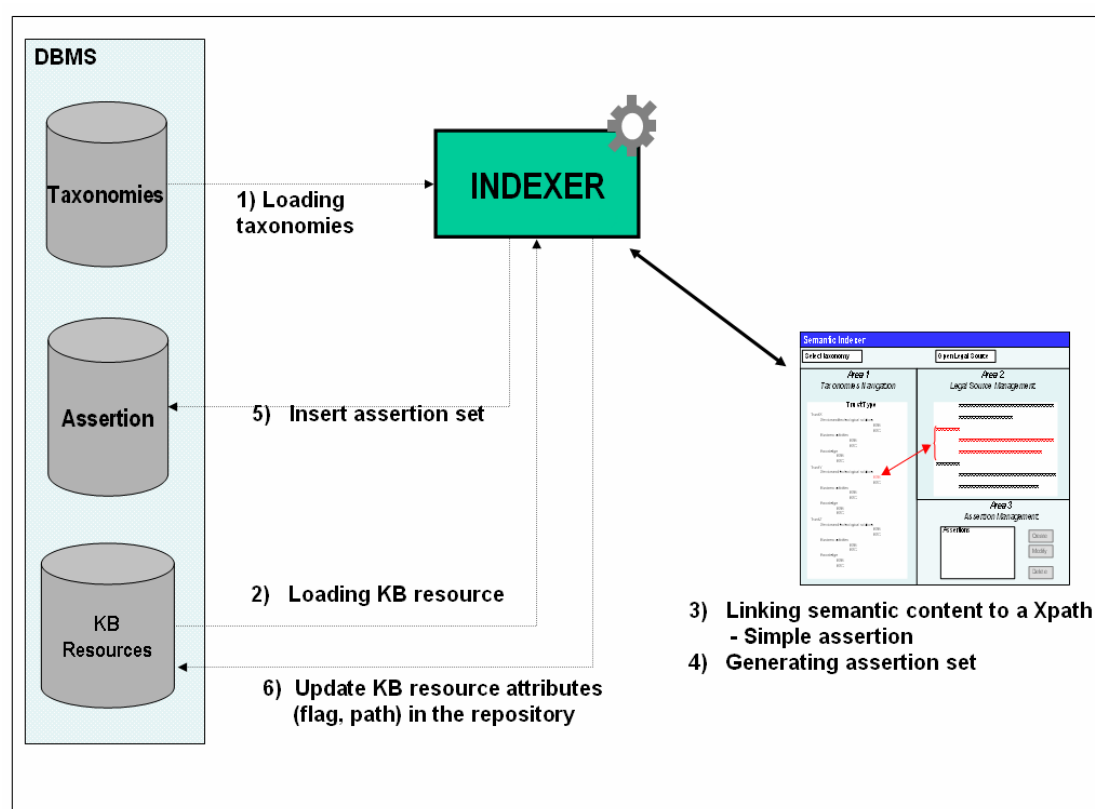


Figure 12. Semantic Index process: internal view

To index a resource in the Knowledge Base, first of all we load the taxonomy (1) with which we want to index, then retrieve all the resources and select the one we want to index (2). It will be possible to index the entire resource or just a part of it. The following step will be the creation of one or more semantic assertions that create the link between the XPath and a concept of the taxonomy (3-4). This process can be executed more times with the same resource in the Knowledge Base, creating several assertions using different taxonomies. The generated assertions will be stored in a database (5) and as a consequence the attributes

(i.e. a flag that indicates if the resource is indexed and where) of the resource will be updated (6). Assertions can be modified, deleted and added to a resource of the Knowledge Base.

7.1.1 Semantic Indexer Use Case

As stated above, the Regulatory Framework Semantic Indexer is a tool that enables the association of semantic content related to the legal and regulatory issues model to the Knowledge Base of the Regulatory Framework. Users that can access to Semantic Indexer functionalities are legal experts who belong to Lawyer SME or Government Body.

With this tool a user can:

- Create new assertions on a legal resource
- Modify and delete existing assertions on a specific legal resource;
- Visualise the existing assertions related to a specific legal resource.

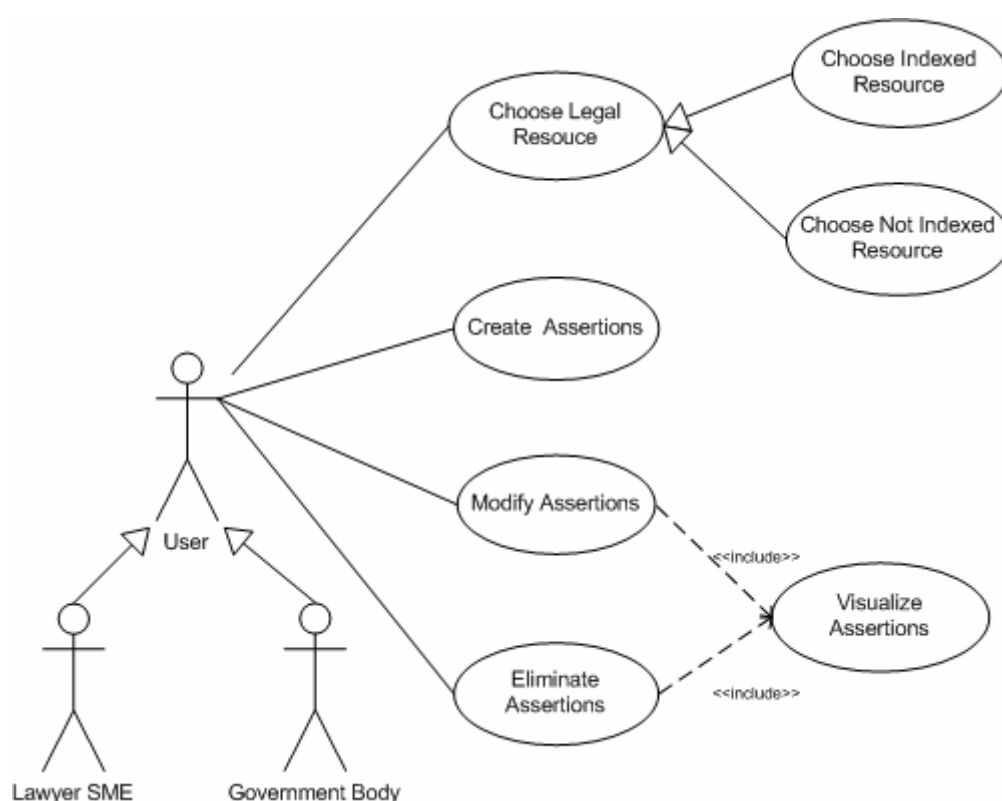


Figure 13. Use Cases of the Semantic Indexer

Choose Indexed Resource

Subject Area	Semantic Indexer
Business Event	The user wants to create new assertions or modify existing ones associated with already indexed legal resource
Actor(s)	Lawyer SME, Government Body
Preconditions	
Termination Outcome	Condition(s) Affecting Termination Outcome

Visualise subject of document and existing assertions	The system verifies the existence of assertions related to that legal resource and it shows them
Visualise only the subject of the document	The system can't retrieve existent assertions and/or visualise them
Visualise only the existing assertions	The system can't retrieve and/or visualise content of the selected legal resource
Use Case Description	The system allows the user to select a resource from the DBE Regulatory Framework Knowledge Base in order to add assertions or to modify them
Input Summary	List of legal resource indexed and not indexed
Output Summary	Content of the legal resource and its assertions

Choose not Indexed Resource

Subject Area	Semantic Indexer
Business Event	The user wants to index a DBE legal resource
Actor(s)	Lawyer SME, Government Body
Preconditions	
Termination Outcome	Condition(s) Affecting Termination Outcome
Visualise the content of the legal resource	The system retrieves and visualises the content of the selected legal resource
Cannot visualise the content of the legal resource	The system does not retrieve and visualise the content of the selected legal resource
Use Case Description	The system allows the user to select a resource with no assertions from the DBE Regulatory Framework Knowledge Base
Input Summary	List of the legal resource indexed and not indexed
Output Summary	Content of the legal resource

Create Assertions

Subject Area	Semantic Indexer
Business Event	The user wants to create new assertions for a legal resource (either indexed or not indexed)
Actor(s)	Lawyer SME, Government Body
Preconditions	UC: "Choose indexed Resource", "Chose not Indexed Resource" and "Choose Taxonomy"
Termination Outcome	Condition(s) Affecting Termination Outcome
Assertion creation	The system links the XPath of a legal resource (or the XPath of a part of it) to one concept of a taxonomy contained in the assertion (e.g., <i>XPath is_about concept [instance]</i>)
Assertion creation failed	The system verifies that the assertion is not well-formed or that assertion already exists
Use Case Description	The system allows the user to add semantic content to that legal resource (or a part of it) through assertions. The assertion is created by associating the document XPath to a concept of the taxonomy
Input Summary	Concepts of taxonomy and a legal resource

Output Summary	A new assertion that links the legal resource to a concept of the taxonomy
-----------------------	--

Visualise Assertions

Subject Area	Semantic Indexer
Business Event	The user wants to visualise assertions (between all the existing)
Actor(s)	Lawyer SME, Government Body
Preconditions	UC "Choose indexed Resource" and "Choose Taxonomy"
Termination Outcome	Condition(s) Affecting Termination Outcome
Visualise assertion details	The system retrieves and visualises assertions selected by the user
Cannot visualise assertion selected	The system can't retrieve and/or visualise details of the selected assertion
Use Case Description	The system allows the user to select an assertion (from the existing ones) whose details will be shown afterwards
Input Summary	The list of assertions related to a legal resource and a specific taxonomy
Output Summary	The selected assertion details (the concept of the taxonomy and the document XPath)

Modify Assertions

Subject Area	Semantic Indexer
Business Event	The user wants to modify assertions
Actor(s)	Lawyer SME, Government Body
Preconditions	UC "Visualise Assertion"
Termination Outcome	Condition(s) Affecting Termination Outcome
Assertion modified	The system modifies the existing assertion by linking the legal resource to a new concept of the taxonomy and without modifying the document XPath
Assertion not modified	The systems checks that another assertion with the same concept and XPath exists, or the assertion is incomplete ("not well-formed")
Use Case Description	It allows user to modify one of the assertions already created for the specific legal resource. After visualising its details, an assertion can be modified by changing the concept or the document XPath from the existing assertion
Input Summary	The assertion that has to be modified
Output Summary	The modified assertion

Delete Assertions

Subject Area	Semantic Indexer
Business Event	The user wants to delete an assertion

Actor(s)	Lawyer SME, Government Body
Preconditions	UC “Visualise Assertion”
Termination Outcome	Condition(s) Affecting Termination Outcome
Delete assertion and store document as “not indexed”	The system will mark the legal resource as “not indexed”, if the deleted assertion was the only one associated with a specific legal resource
Delete assertion	The system deletes the assertion selected by the user
Cannot delete assertion	It is not possible to delete the selected assertion
Use Case Description	The system allows a user to delete the selected assertion for a specific legal resource
Input Summary	Assertion that has to be deleted
Output Summary	

7.1.2 Semantic Indexer Graphical User Interface

The GUI of the Semantic Indexer can be divided in three main areas in order to visualise and manage the process of resource indexing with the concepts of the taxonomy. We can find the Taxonomy Navigation Area (Area 1), on the left, in which a taxonomy can be loaded and navigated. In the upper-right part, the KB Resource Management Area (Area 2) will enable to display the resource to be indexed. In the Assertions Management Area (Area 3), assertions can be displayed, created and deleted. Semantic Indexer GUI is shown in Figure 14.

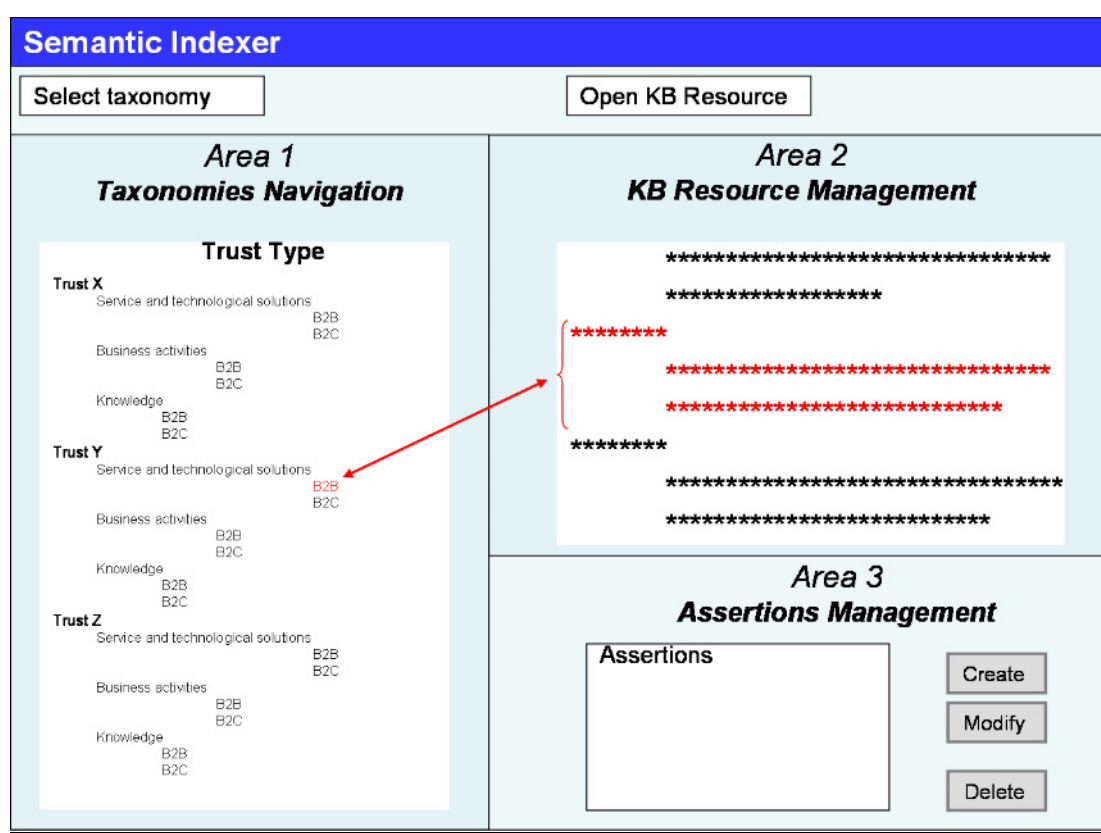


Figure 14. Semantic Indexer GUI

7.2 Navigator

The Navigator is the tool that will search and browse the knowledge base of the Regulatory Framework by:

- Syntactic search
- Semantic search

Thus, the Syntactic Navigator is thought to be a full-text research engine that will retrieve a query string, inserted by the user, searching in all the resources in the Knowledge Base (so in both indexed and not indexed resources). The Semantic Navigation enables a user to browse directly the taxonomy and to retrieve all the resources in the Knowledge Base (for which assertions has been previously created) related to a specific concept. The Navigation process is represented in figure 15.

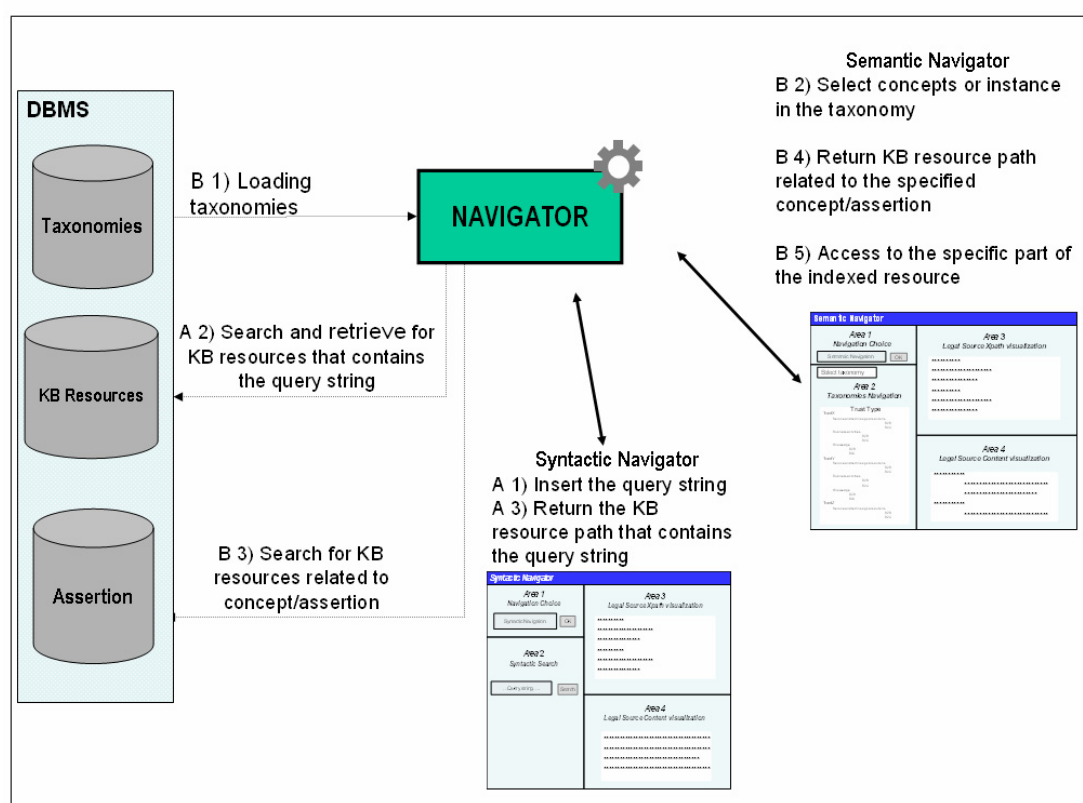


Figure 15. Navigation process: internal view

If the Syntactic Navigation is chosen, a user has to insert his query string (A1) so that the navigator can search and retrieve (A2) the resource in the Knowledge Base that contains the string wanted. Finally, the list of the resources will be displayed (A3).

To perform a Semantic Navigation, it is necessary to load the taxonomy through which we want to navigate (B1), pointing out the concept we are interested in (B2). Doing so, all the resources in the Knowledge Base with semantic assertions that contain that particular concept will be retrieved (B3-B4). More specifically, for a specific resource the XPaths contained will be displayed (B5).

7.2.1 Navigator Use Cases

The Regulatory Framework Navigator is a tool that allows either syntactic search or semantic search within the Knowledge base of the DBE. Users of the Navigator are either Government Body, Business User of DBE Adopter SME or Lawyer SME.

The main functionalities that the Navigator offers are:

- the syntactic navigation of the Knowledge Base (legal resources, either indexed or not indexed, retrieved with a full-text research);
- the semantic navigation, with which a user can browse the taxonomy in order to retrieve all the previously indexed legal resources in the Knowledge Base linked to a specific concept.

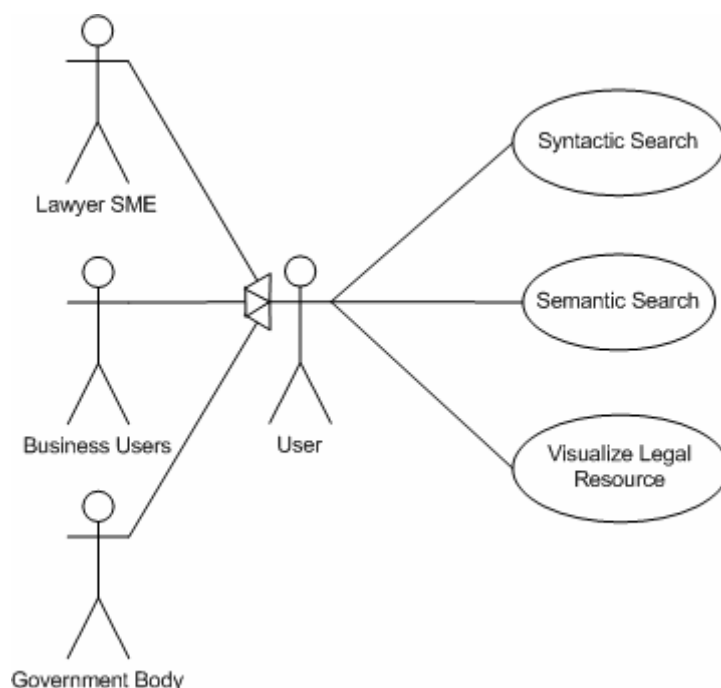


Figure 16. Use Cases of the Navigator

Syntactic Search

Subject Area	Navigator
Business Event	User wants to retrieve all the resources containing a specific string
Actor(s)	Lawyer SME, Business User, Government Body
Preconditions	
Termination Outcome	Condition(s) Affecting Termination Outcome
List of all the legal resource (indexed and not indexed) containing the query string	The system retrieves the set of documents that contain the query string submitted, returning a reference to each legal resource.
No matching found	The system cannot retrieve any legal resources containing the query string inserted by the user
Use Case Description	The system allows the user to insert a string (query string) that the Navigator uses for a full-text search within all documents of the Regulatory Framework Knowledge Base. The system returns the reference to all the resources that contains the query string.

Input Summary	Query string
Output Summary	List of legal resources which contain the string searched

Semantic Search

Subject Area	Navigator
Business Event	User wants to retrieve legal resources indexed by a specific concept of taxonomy
Actor(s)	Lawyer SME, Business User, Government Body
Preconditions	UC "Choose Taxonomy"
Termination Outcome	Condition(s) Affecting Termination Outcome
List of all the legal resources indexed with an assertion containing the concept selected	The system retrieves the legal resources indexed with the assertion containing the concept selected
No matching found	Navigator cannot retrieve any resource indexed with the assertion containing the concept selected.
Use Case Description	The system performs a semantic search of the indexed legal resources in the Regulatory Framework Knowledge Base, by retrieving all the assertions containing the concept selected
Input Summary	A concepts of the taxonomy must be selected
Output Summary	The list of resources indexed linked to the concept selected by the user

Visualise Legal Resource

Subject Area	Navigator
Business Event	User wants to access to the content of a legal resource retrieved by the system
Actor(s)	Lawyer SME, Business User, Government Body
Preconditions	UC "Syntactic Search" or UC "Semantic Search"
Termination Outcome	Condition(s) Affecting Termination Outcome
Visualise the content of the selected resource	The system visualises the content of the selected legal resource
Cannot visualise resource selected	System cannot retrieve or visualise the legal resource selected by the user
Use Case Description	The system allows the user to visualise the content of a legal resource that the system has previously retrieved
Input Summary	List of legal resource
Output Summary	Subject of legal resource selected

7.2.2 Navigator Graphical User Interface

Even if two different GUIs are thought for the Navigator, they have 3 areas in common. They share:

- the Navigation Choice (Area 1), in which it is possible to switch from the syntactic to the semantic navigation;
- KB Resource results list (Area 3), in which a list of the retrieved resources will be displayed
- KB Resource Content Visualisation (Area 4), in which the resource content can be displayed once the resource has been selected in area 3.

As pointed out in the previous section, with a syntactic navigation it will be possible to visualise the entire content of a resource from the KB (Area 4). With a semantic navigation, it is possible to visualise the XPath of the resource in the KB (Area 4). Finally, for the Semantic Navigator, in Area 2 a user can select and navigate through the taxonomy, as shown in Figure 17:

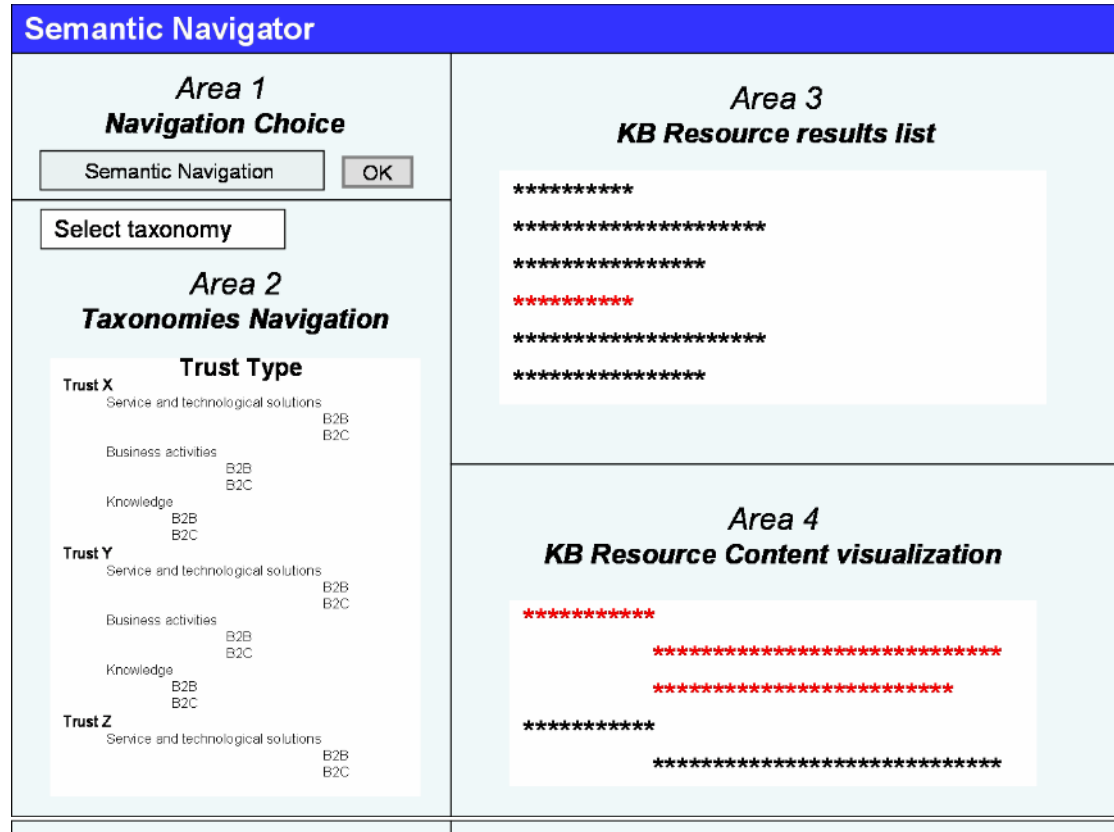


Figure 17. Semantic Navigator GUI

For the Syntactic Navigator, in Area 2 the user can insert a query string to start the searching process throughout the KB (Figure 18).

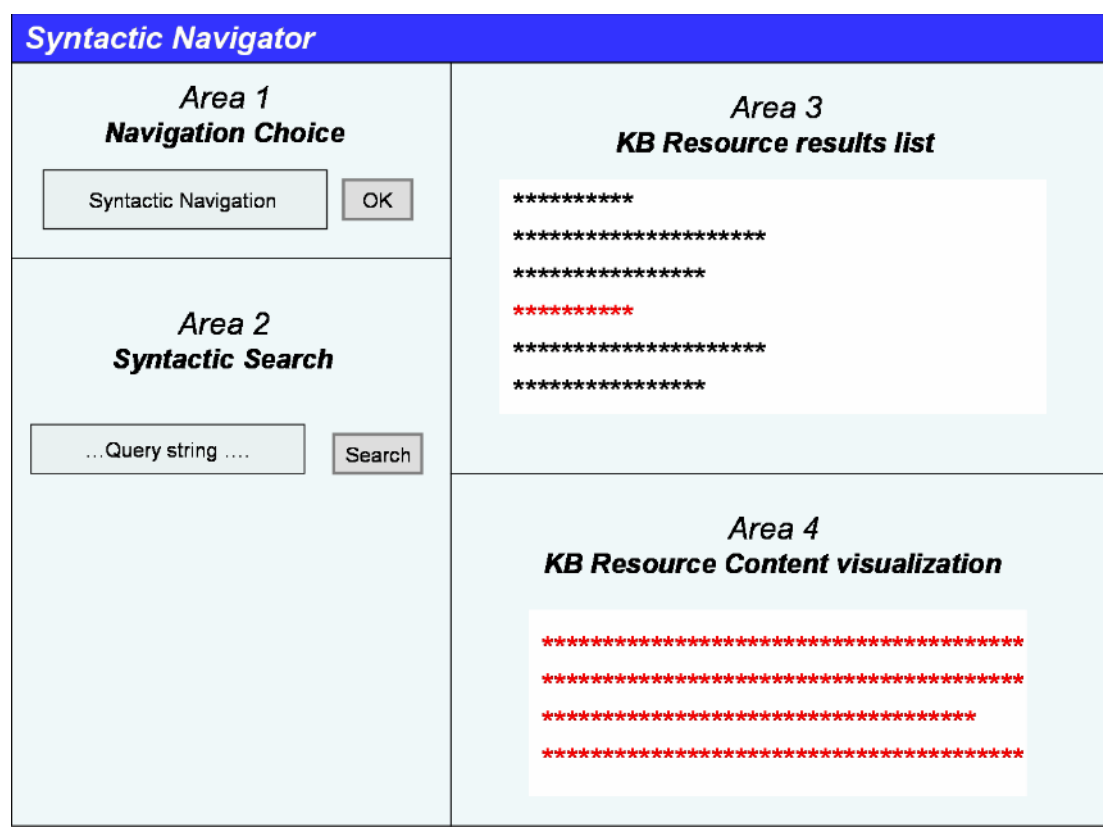


Figure 18. Syntactic Navigator GUI

7.3 CA Validator

The Contract&Agreement Validator is a tool that enables the user to support its operations in verifying legal validity to either an existing contract or an empty contract template. This means that the Validator has to be primarily the tool that should support³ the user who is in charge of giving legal validity to a contract.

On the other hand, a contract validated by a Lawyer SME by using the Validator can be considered, from a DBE-adopter SME's point of view, as a legally valid contract, and it can be visualised using the validator to display the legal resources that the contract has been linked to.

More specifically, the CA Validator is a tool that supports a legal expert of a Lawyer SME, when he/she gives a legal validity to a contract, by linking to the entire contract (or just to part of it) one or more links to a resource in the Regulatory Framework Knowledge Base.

This tool offers three functionalities:

- the Semantic Navigation of the KB through the taxonomy;
- the creation of link to the KB resources in the XPath⁴ of the contract;
- Navigation of Contracts

While the first and second functionalities are intended for Lawyer SMEs (in the real validation process), the last is designed for the legal expert of a DBE adopter SME that wants to know and read all the contracts signed by the SME. Once the contract is linked with one or more resource of the KB, it can be stored as a contract whose legal validity has been verified within the Regulatory Framework KB.

³ Just using the Validator is not enough to give legal validity to a contract.

⁴ Also in this case, we suppose that a contract is available in XML format.

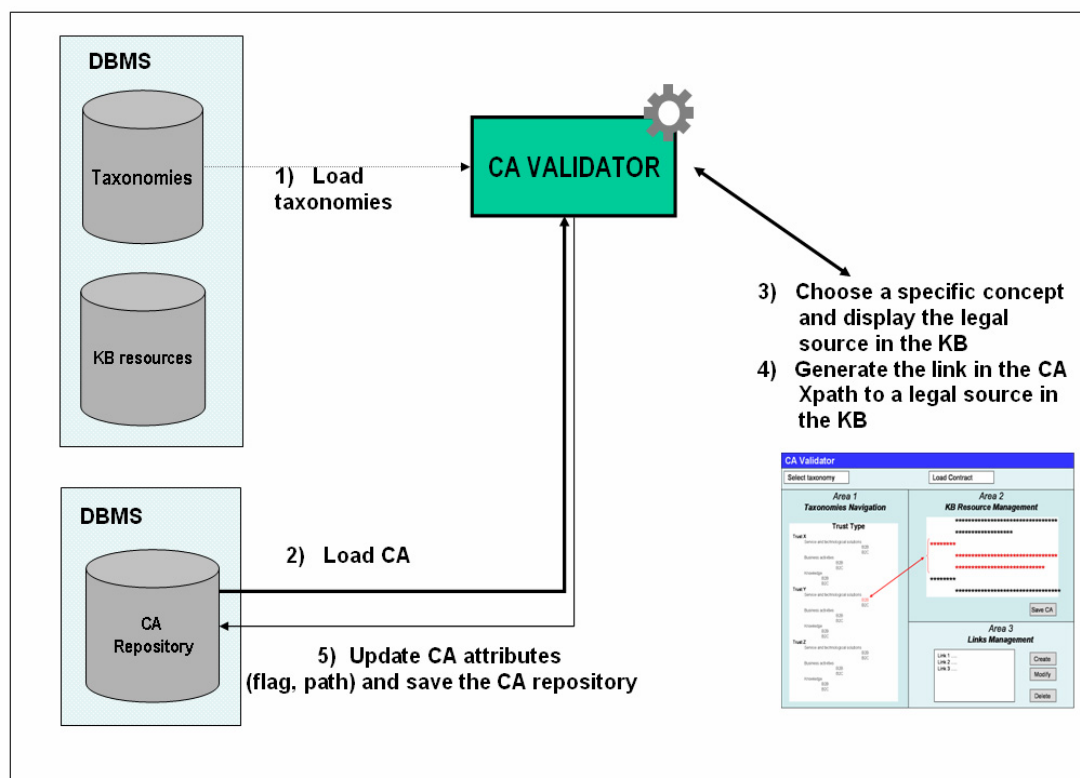


Figure 19. CA Validator: internal view

As shown in Figure 19, the legal validation process starts with the loading of the taxonomy (1) and then of the contract we want to validate (2). Notice that taxonomies and contracts belong to different databases. By the legal validator user interface, it is possible to visualise the resources related to a specific concept in the taxonomy (3). Once a resource is chosen, it is possible to create links between that resource and a specific part of the contract (4). It is also possible to visualise already existing links, modify or delete them. The process ends with the storage of the contract in the CA repository (5).

7.3.1 CA Validator Use Case

The Regulatory Framework Contracts&Agreements Validator is a tool that allows users to link a contract (or a contract template) to one or more Regulatory Framework's legal resources. A link is the reference to the laws by which a contract is disciplined.

The main functionalities the CA Validator offers are:

- CRUD (create, read, update, and delete) of the links
- the semantic navigation within a contract through the taxonomies.

The link management involves the editing of a link to the legal resource in a specific part of the selected contract.

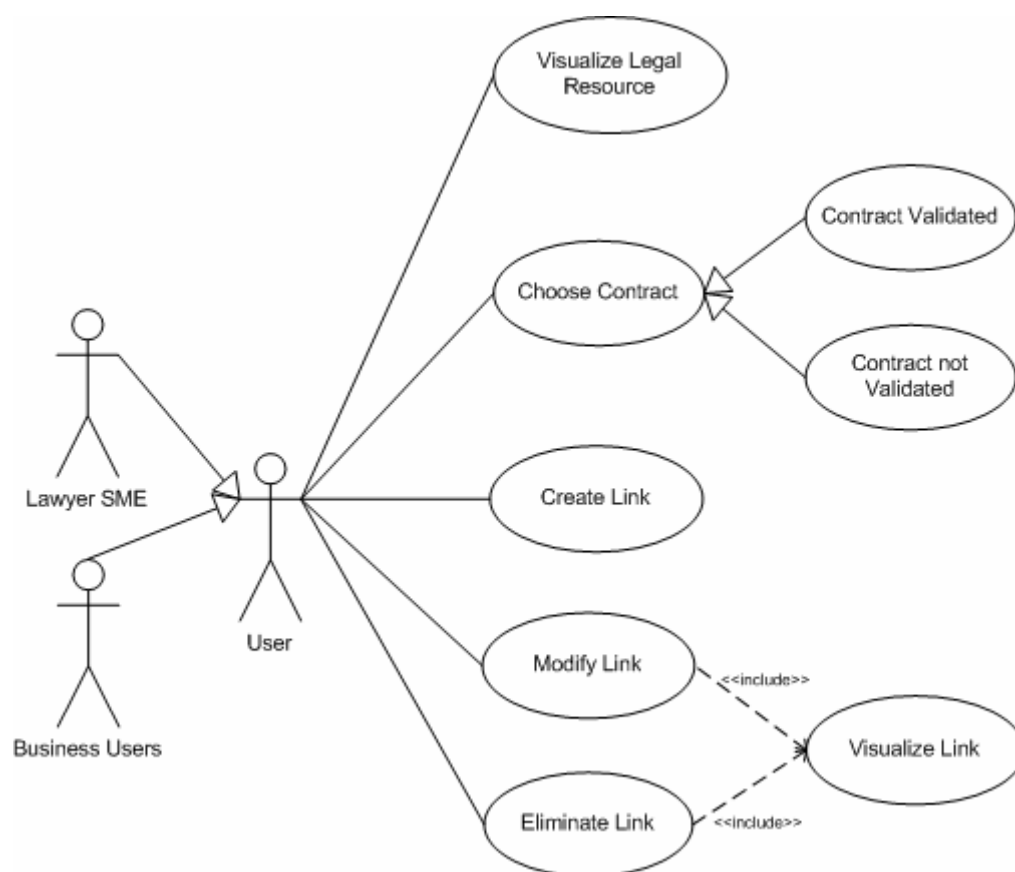


Figure 20. Use Cases of the CA Validator

Visualise Legal Resource

Subject Area	CA Validator
Business Event	User wants to access to the content of a legal resource retrieved by the system
Actor(s)	Lawyer SME, Business User
Preconditions	UC "Choose taxonomy"
Termination Outcome	Condition(s) Affecting Termination Outcome
Visualise the contents of a legal resource	System retrieves and visualise the content of a specific legal resource indexed with a selected concept in the taxonomy
Cannot visualise the contents of a legal resource	System cannot retrieve any the content of a specific legal resource indexed with a selected concept in the taxonomy
Use Case Description	The system allows the user to visualise the content of a legal resource, previously retrieved
Input Summary	List of legal resource
Output Summary	Subject of legal resource selected

Load Validated Contract

Subject Area	CA Validator
Business Event	User wants to visualise a contract already linked to the Regulatory Framework Knowledge Base

Actor(s)	Lawyer SME, Business User
Preconditions	
Termination Outcome	Condition(s) Affecting Termination Outcome
Visualise the content of a contract and its links to the Knowledge Base	The system visualises the content of the selected contract and shows all the links to legal resources in the Regulatory Framework Knowledge Base
Cannot visualise the content of a selected contract	The system can't retrieve and/or visualise c the content of a selected contract
Use Case Description	The system allows the user to load a contract from a list of either validated or not-validated contracts. When the user selects a contract already linked to a specific taxonomy, the system visualises contract's content and its links to the regulatory framework KB
Input Summary	List of contract, either validated or not validated
Output Summary	The content of a contract with its links to legal resources in the Knowledge Base

Load a not Validated Contract

Subject Area	CA Validator
Business Event	The user wants to bind contract to one or more legal resources of the Regulatory Framework Knowledge Base
Actor(s)	Lawyer SME, Business User
Preconditions	
Termination Outcome	Condition(s) Affecting Termination Outcome
Visualise the content of the selected contract	The system retrieves and visualises the content of the selected contract
Cannot visualise the content of the selected contract	The system can't retrieve and/or visualise the content of the selected contract
Use Case Description	The system allows the user to load a contract from a list of either validated or not-validated contracts. When the user selects a contract not linked to any specific taxonomy, the system visualises contract's content.
Input Summary	List of contract, either validated or not validated
Output Summary	The content of the selected contract

Create Link

Subject Area	CA Validator
Business Event	The user wants to create a new link to a legal resource for a selected contract
Actor(s)	Lawyer SME, Business User
Preconditions	UC "Choose Contract" and UC "Choose Taxonomy"
Termination Outcome	Condition(s) Affecting Termination Outcome
New link created	The system binds XPath of the entire contract (or part of it) to an instance of the taxonomy selected by the user

Cannot create a new link	The system verifies that the link is not well-formed or that link already exists
Use Case Description	The system links contract to the KB by linking to XPath an instances of the taxonomy selected
Input Summary	A contract and a concepts of the taxonomy
Output Summary	A new link

Visualise Link

Subject Area	CA Validator
Business Event	The user wants to visualise link details associated to a contract
Actor(s)	Lawyer SME, Business User
Preconditions	UC "Choose Validated Contract" UC "Choose Taxonomy"
Termination Outcome	Condition(s) Affecting Termination Outcome
Visualise details of the selected link	The system retrieves and visualises details of the selected link
Cannot visualise the selected link	System can't retrieve and/or visualise details of the selected link
Use Case Description	The system allows the user to select a link from all the ones associated to a contract. Then it retrieves and visualises link details
Input Summary	All the links associated to a selected contract for a specific taxonomy
Output Summary	Contract XPath and a concept of a specific taxonomy

Modify Link

Subject Area	CA Validator
Business Event	The user wants to modify an existing link
Actor(s)	Lawyer SME, Business User
Preconditions	UC "Visualise Link"
Termination Outcome	Condition(s) Affecting Termination Outcome
Link modified	The system modifies the selected link with a new concept from a specific taxonomy
Link not modified	The systems checks that another link with the same concept and XPath exists
Use Case Description	The system allows the user to edit a selected link associated to a contract. User can browse a specific taxonomy and then replace the concept in the XPath
Input Summary	The link that has to be modified
Output Summary	The link modified

Delete Link

Subject Area	CA Validator
Business Event	The user wants to delete an existing link
Actor(s)	Lawyer SME, Business User
Preconditions	UC "Visualise Link"
Termination Outcome	Condition(s) Affecting Termination Outcome
Delete a link and store the contract as "not validated"	The system will mark the legal resource as "not indexed", if the deleted link was the only one associated with a contract for a specific taxonomy
Delete a link	The system deletes the link selected by the user
Use Case Description	The system allows a user to delete the selected assertion for a specific legal resource
Input Summary	Link that has to be deleted
Output Summary	

7.3.2 CA Validator Graphical User Interface

CA Validator GUI allows full control of the validation process by displaying the taxonomy on the left (Area 1) and the contract to be validated on the right (Area 2). The taxonomy visualisation area is similar to the one presented in the Semantic Navigator GUI and in the Semantic Indexer GUI.

In the Contract Management Area, it is possible to visualise the contract and save it when the validation process is ended. In Area 3 is possible display a list of references of legal resources, instances of concept of taxonomy selected. Moreover is possible visualise the entire content of legal resource in a pop-up.

In Area 4, it is possible to manage the links that a user wants to associate to a contract. By the list box, the user can select an existing link in order to modify or delete it. Pushing the button "create", the user can create a new link.

A CA Validator Graphical User Interface is shown in Figure 21.

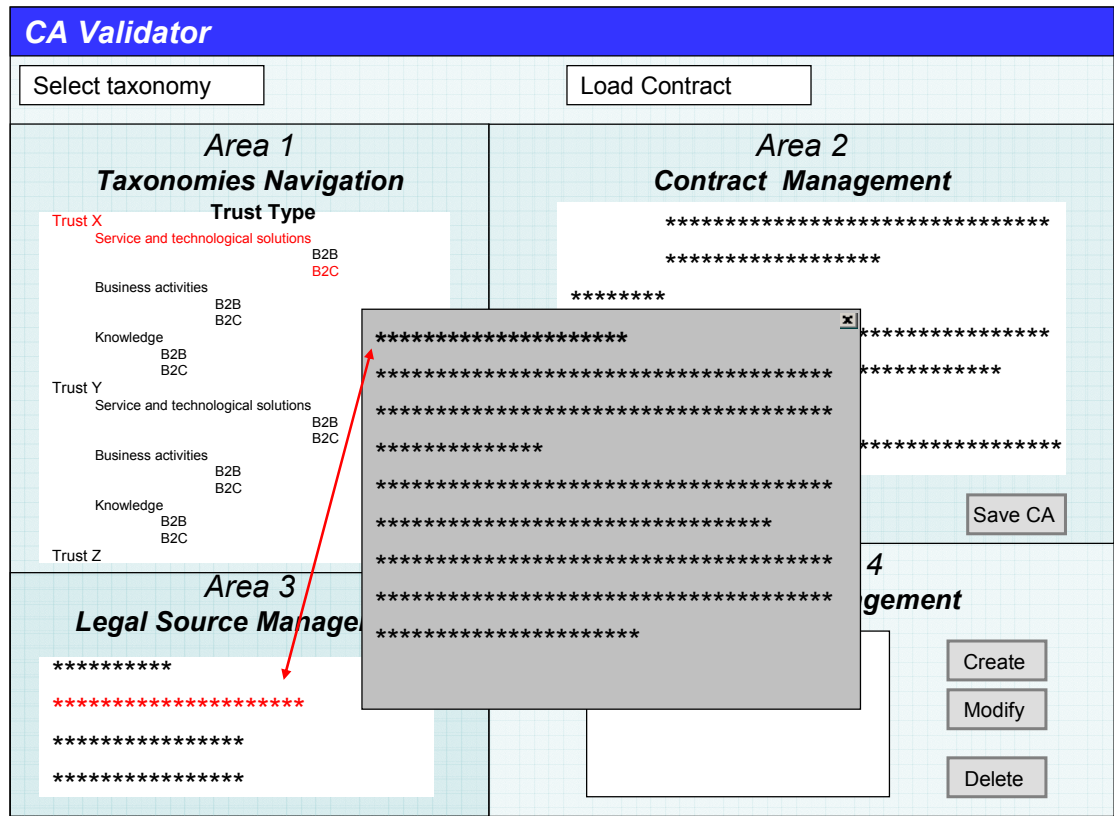


Figure 21. CA Validator GUI

7.4 Technical Design

In this section, we give an insight on the technical design of the tools described in previous sections. The technical design will be another reference point for future implementations of the Regulatory Framework. We choose to model the interactions between a DBE Regulatory Framework user and the system through some activity diagrams and then the interactions between the specific entities of each subsystem through some sequence diagrams.

7.4.1 Activity Diagrams

As previously stated, the activities diagrams give a dynamic view on the system, by describing the interactions between users and the system. Each activity diagram reported has been modelled starting from the use cases described in previous sections.

Choose Taxonomy

According to the taxonomy selected by the user, the system retrieves it and visualises the concepts. When the system cannot retrieve the taxonomy, an error message is displayed to the user.

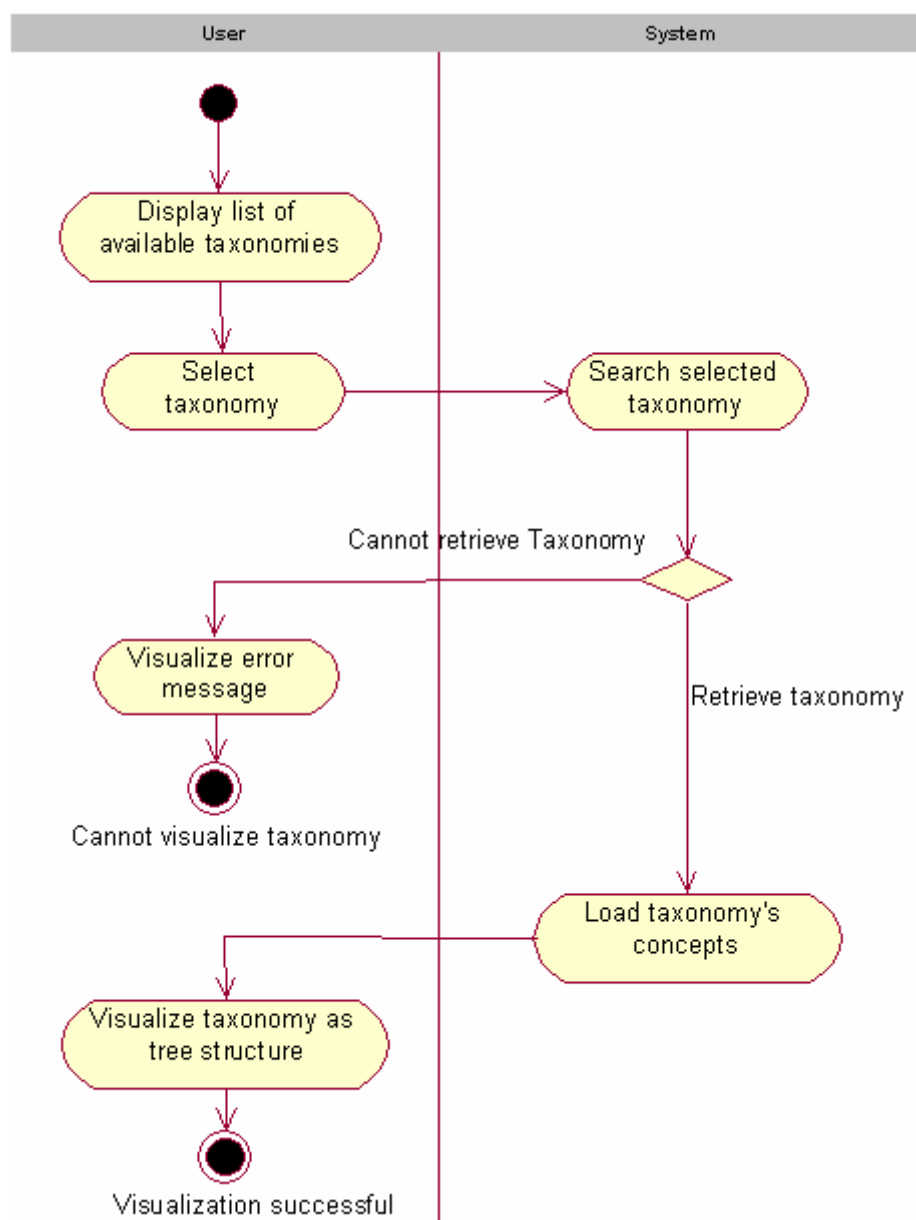


Figure 22. "Choose taxonomy " activity diagram

Upload Legal Resource

In the following diagram, the procedure to upload a legal resource is represented.

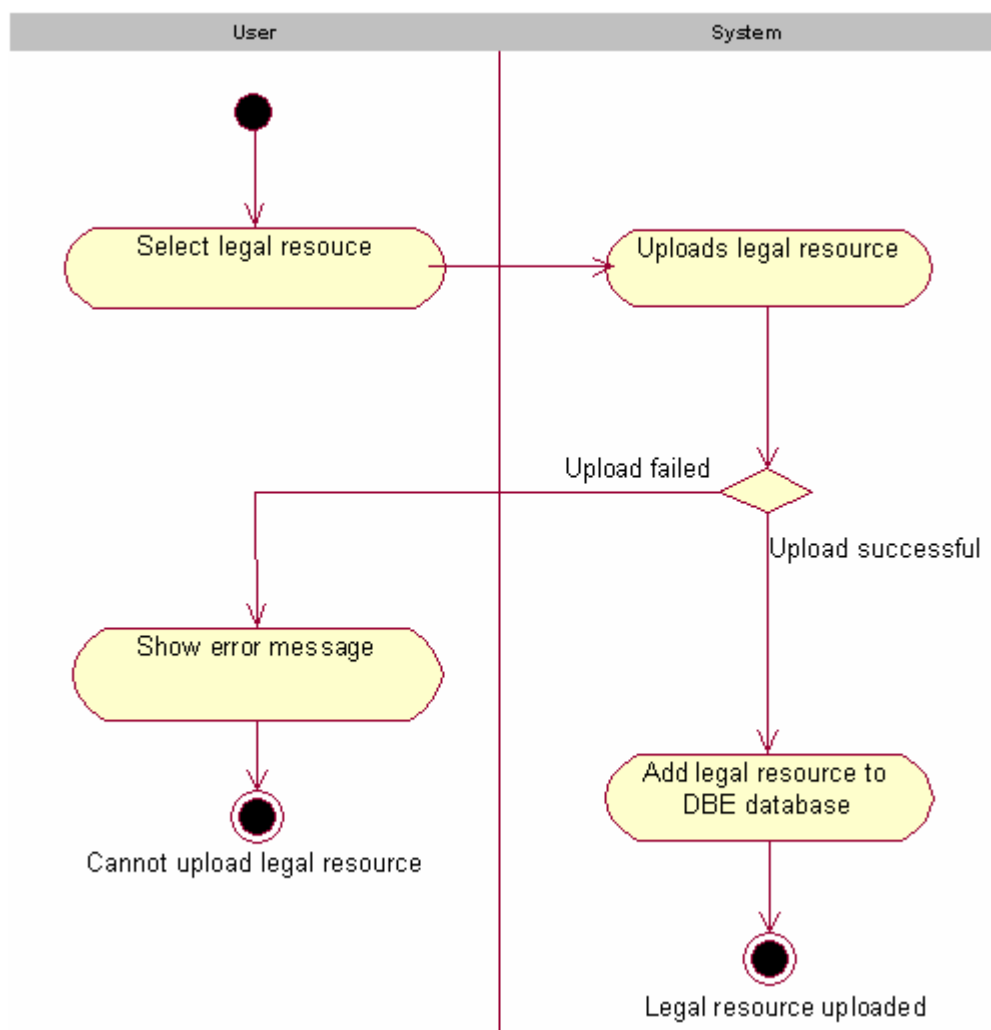


Figure 23. "Upload legal resource" activity diagram

Semantic Indexer

Choose Legal Resource

Before a user can choose a specific legal resource from the KB Repository, the system will display all the available resources. The resource chosen by the user will be retrieved and then visualised according to its structure. The system will check also if the resource chosen by the user has already been indexed or not. If it was already indexed, the system will retrieve and display all the assertions related to the resource. If one of these procedures is not successful, an error message will be displayed to the user.

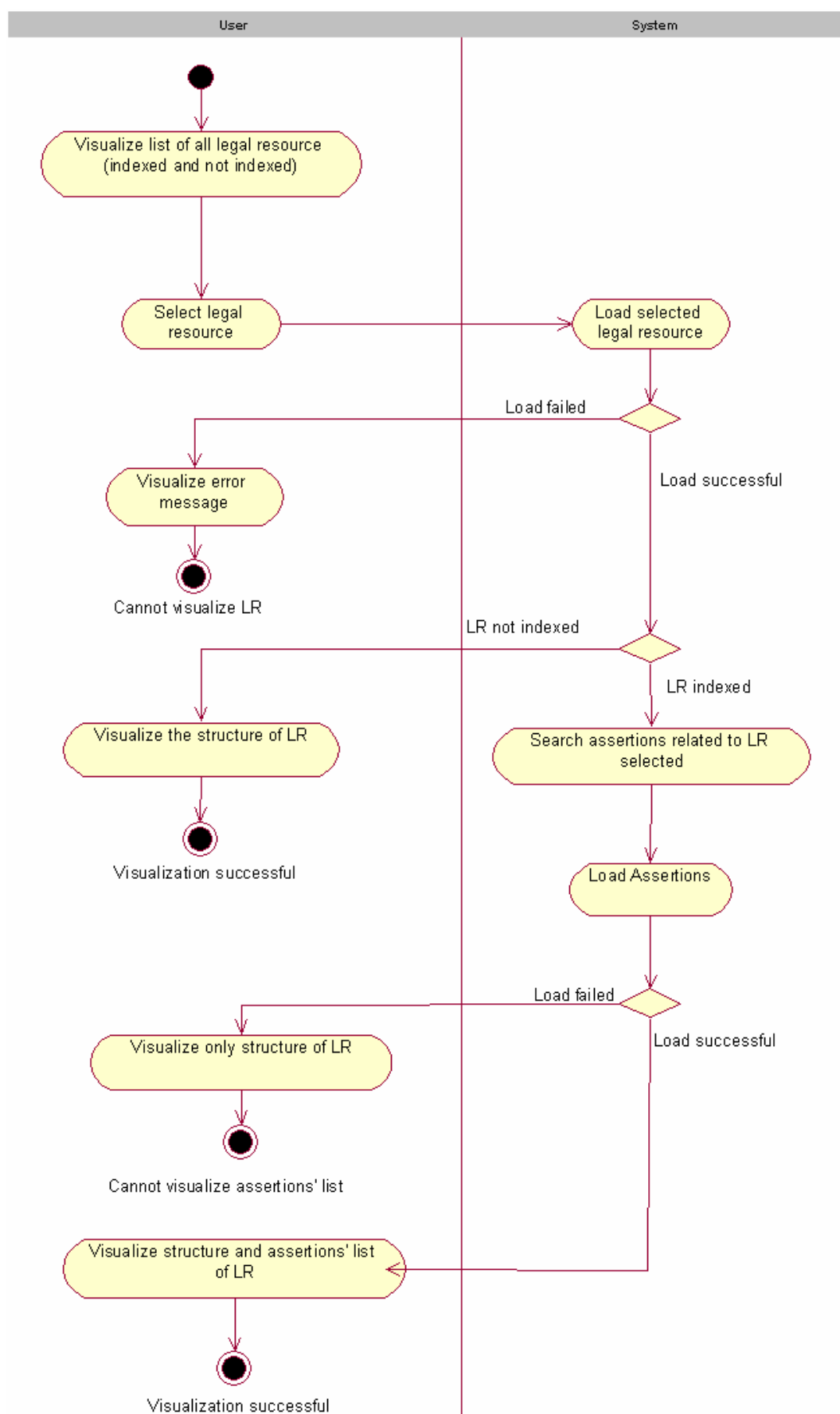


Figure 24. "Choose legal resource" activity diagram

CreateAssertion

When a user wants to create a new assertion to a legal resource, the system has to make several checks. First of all, the system will check if only one legal resource has been selected for this procedure. Then it will check if only one concept from the taxonomies has been selected. After these checks, a wizard will guide the user in the creation of the assertion.

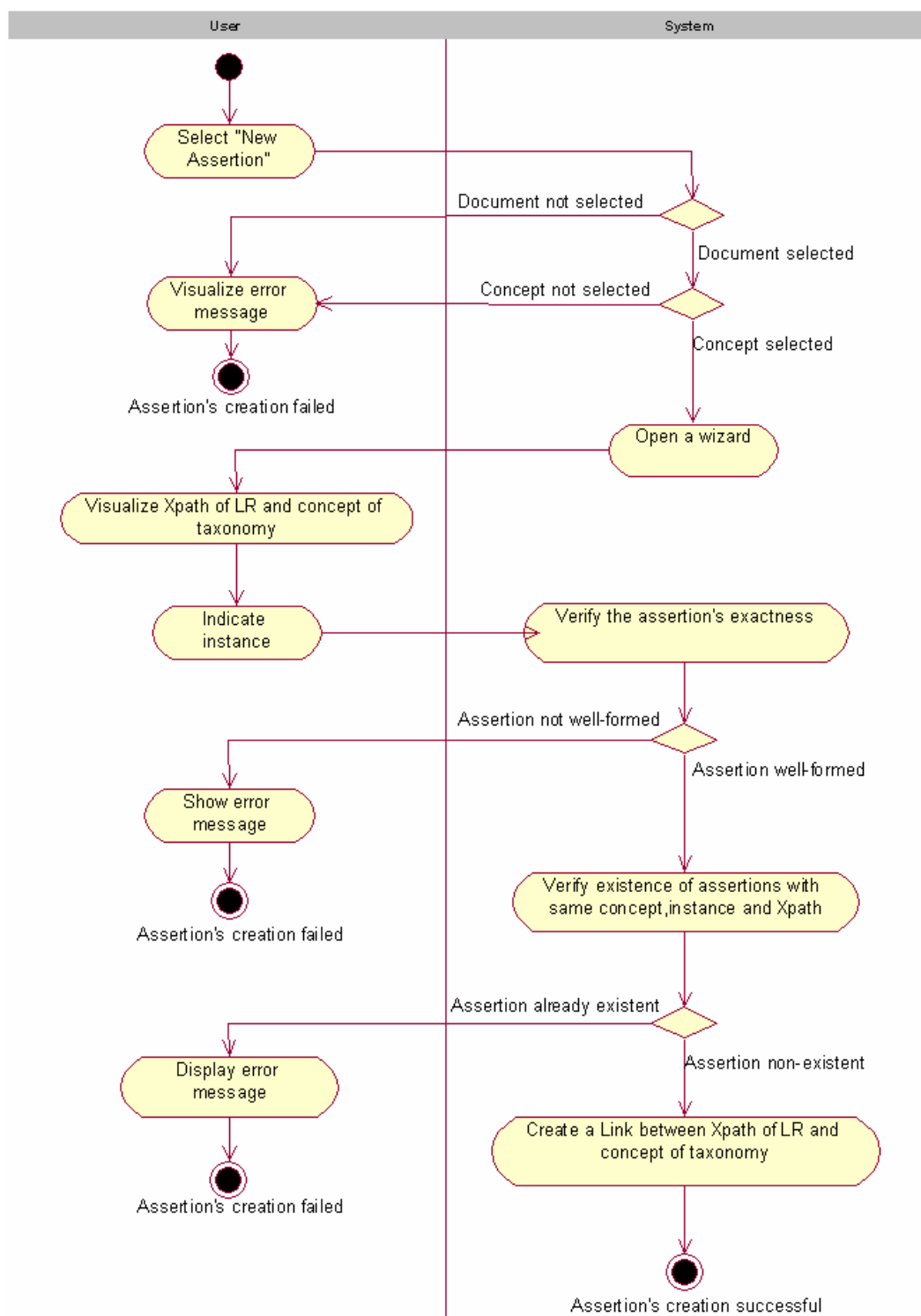


Figure 25. "Create assertion" activity diagram

Choose assertion

This procedure allows a user to choose a specific assertion (among all the existing ones) related to a legal resource. Consequently the system will visualise all the details (XPaths, concepts, instances) linked to that assertion.

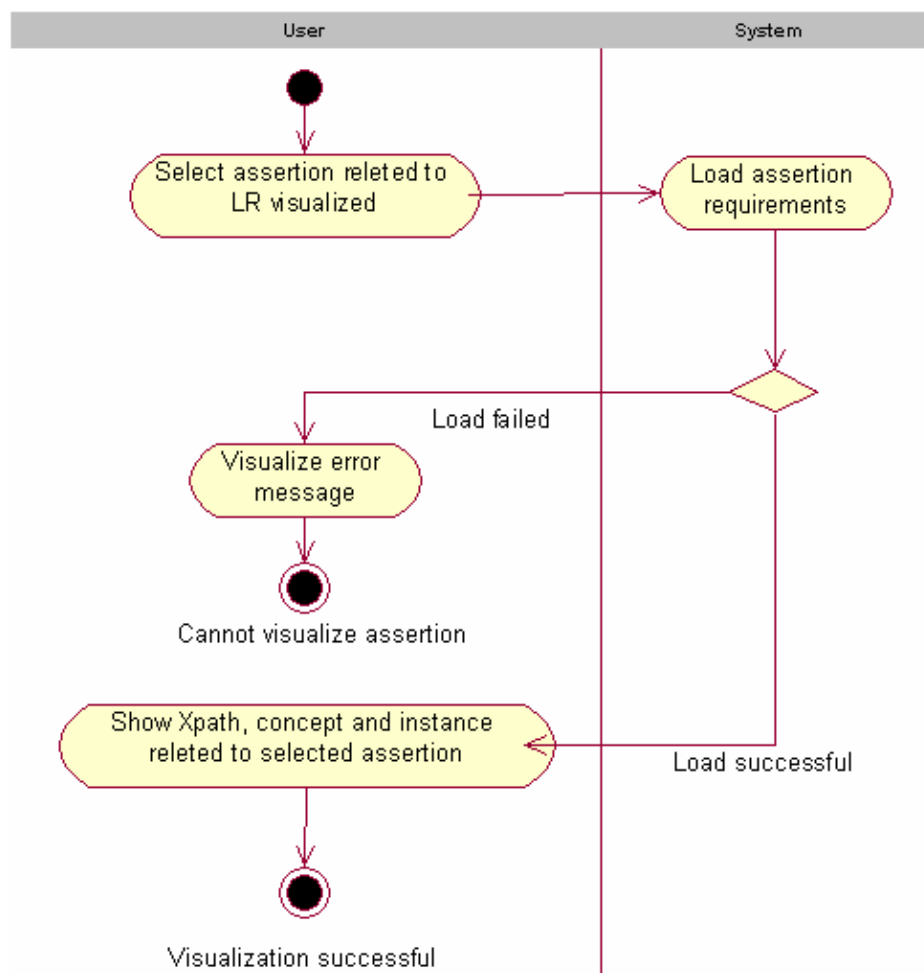


Figure 26. "Choose assertion" activity diagram

Modify Assertion

When a user wants to modify an existing assertion, the system checks if only one legal resource has been selected for this procedure. Then it will check if only one concept from the taxonomies has been selected. The user can select the assertion he wants to modify. A wizard will guide the user to complete this procedure, and the system will finally check if the modified assertion already exists, and will delete the old link between legal resource and concept.

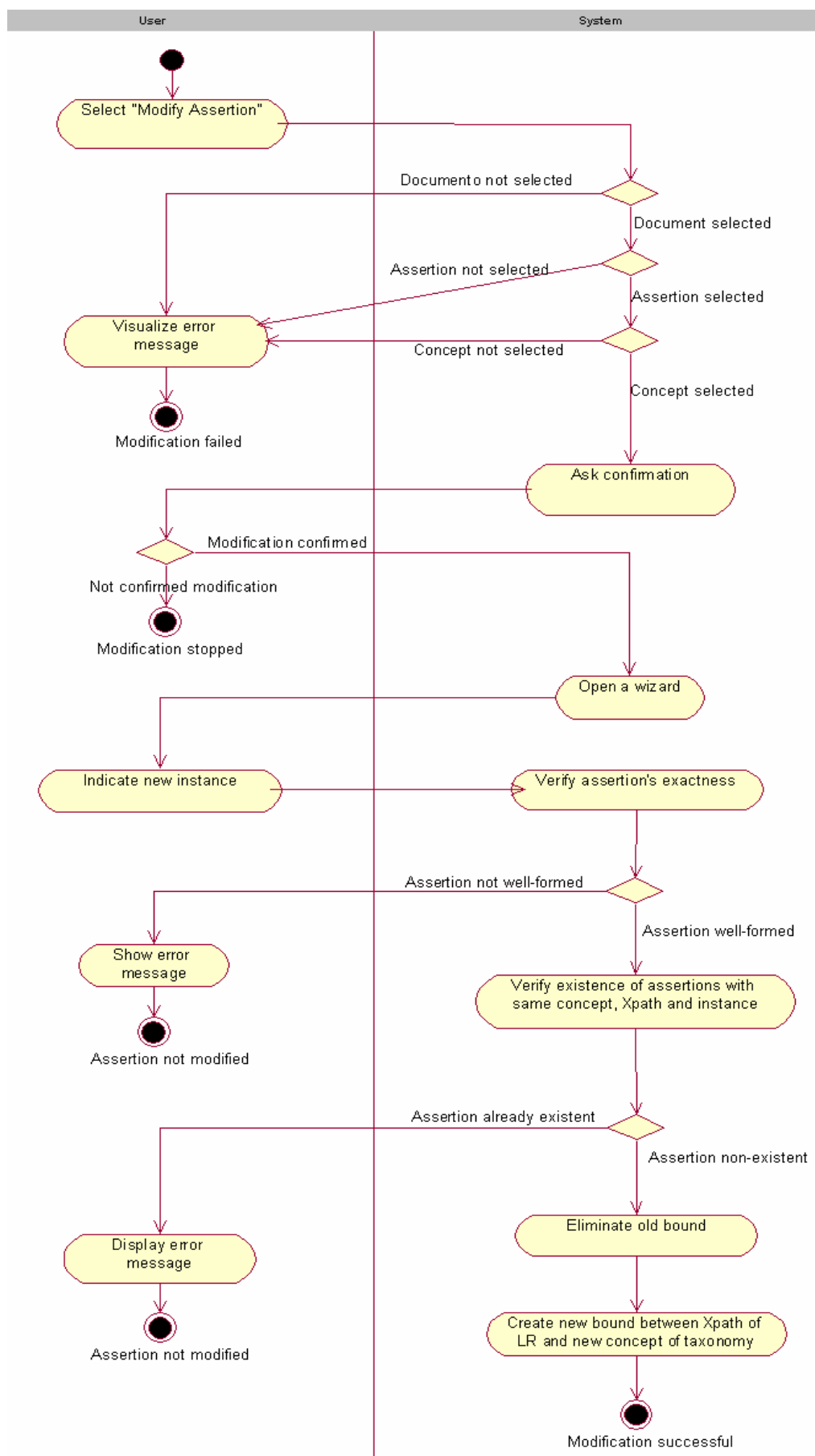


Figure 27. "Modify assertion" activity diagram

Delete Assertion

To delete an assertion, it is enough for the user to select the assertion he wants to delete. The system will then delete the link between the legal resource XPath and the concept from the taxonomy. If the link was the only one related to that legal resource, the system will change also the status of that legal resource, by changing it from indexed to not-indexed.

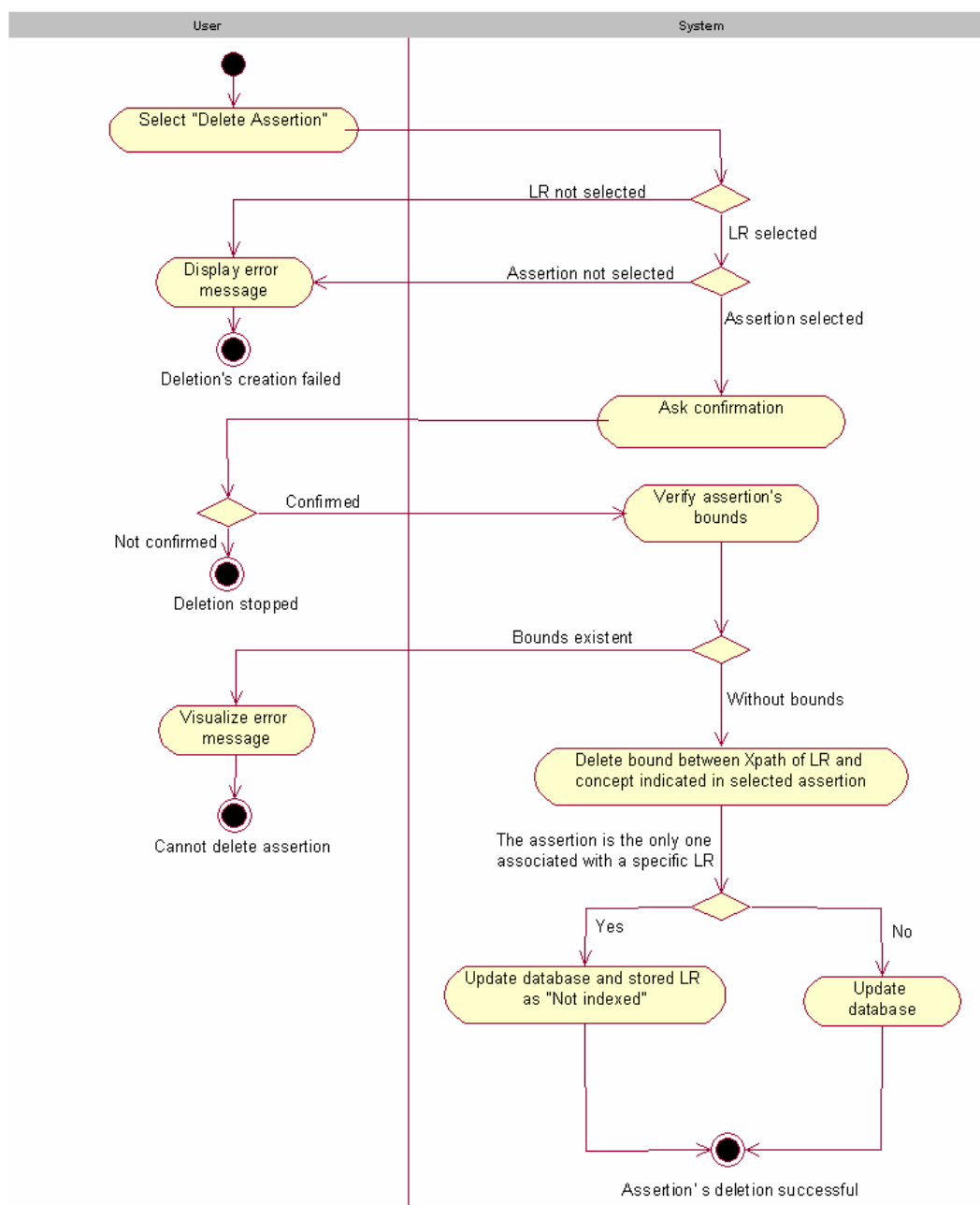


Figure 28. "Delete assertion" activity diagram

Navigator

Syntactic Search

With this procedure, all the legal resources that contain the string inserted by the user are retrieved. The result is the link-set to the resources retrieved.

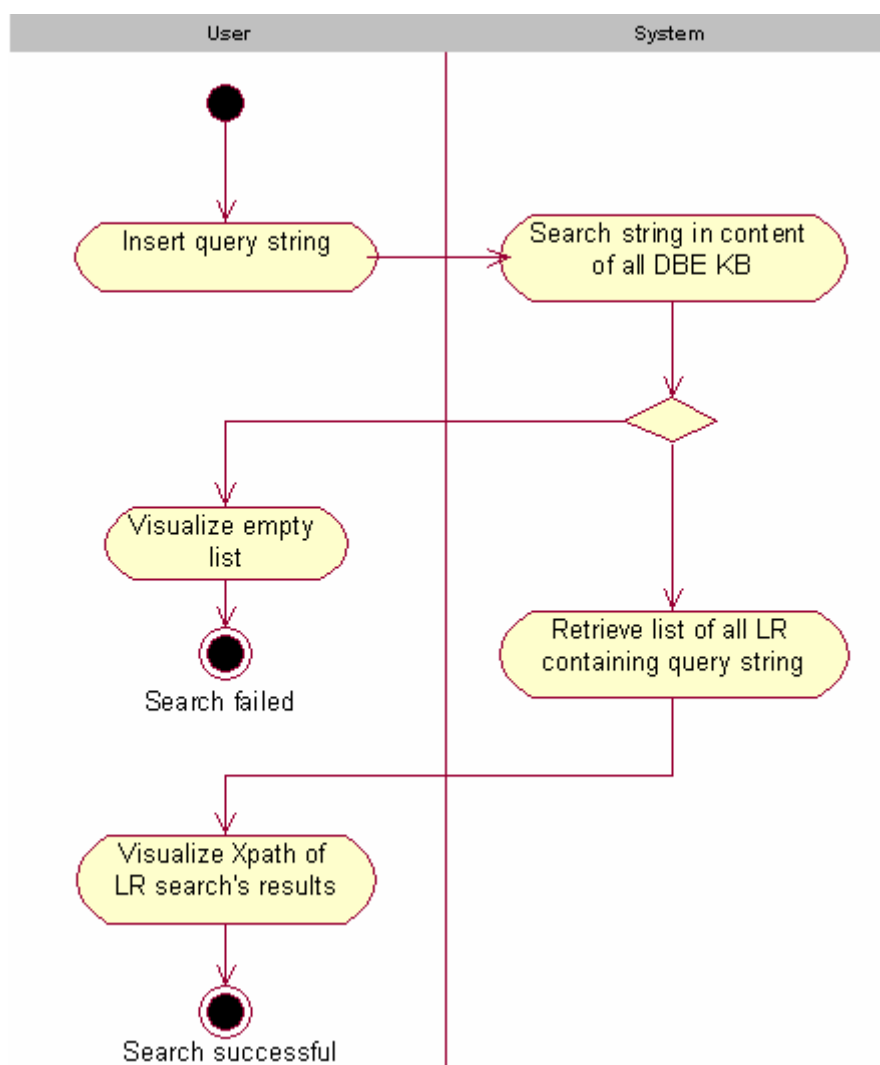


Figure 29. "Syntactic search" activity diagram

Semantic Search

In the following diagram, we modelled the semantic search procedure. In order to perform this kind of search, the user can choose one or more concepts from one or several taxonomies. The system will search and retrieve all the legal resources for which at least one assertion (containing the concepts selected) exists.

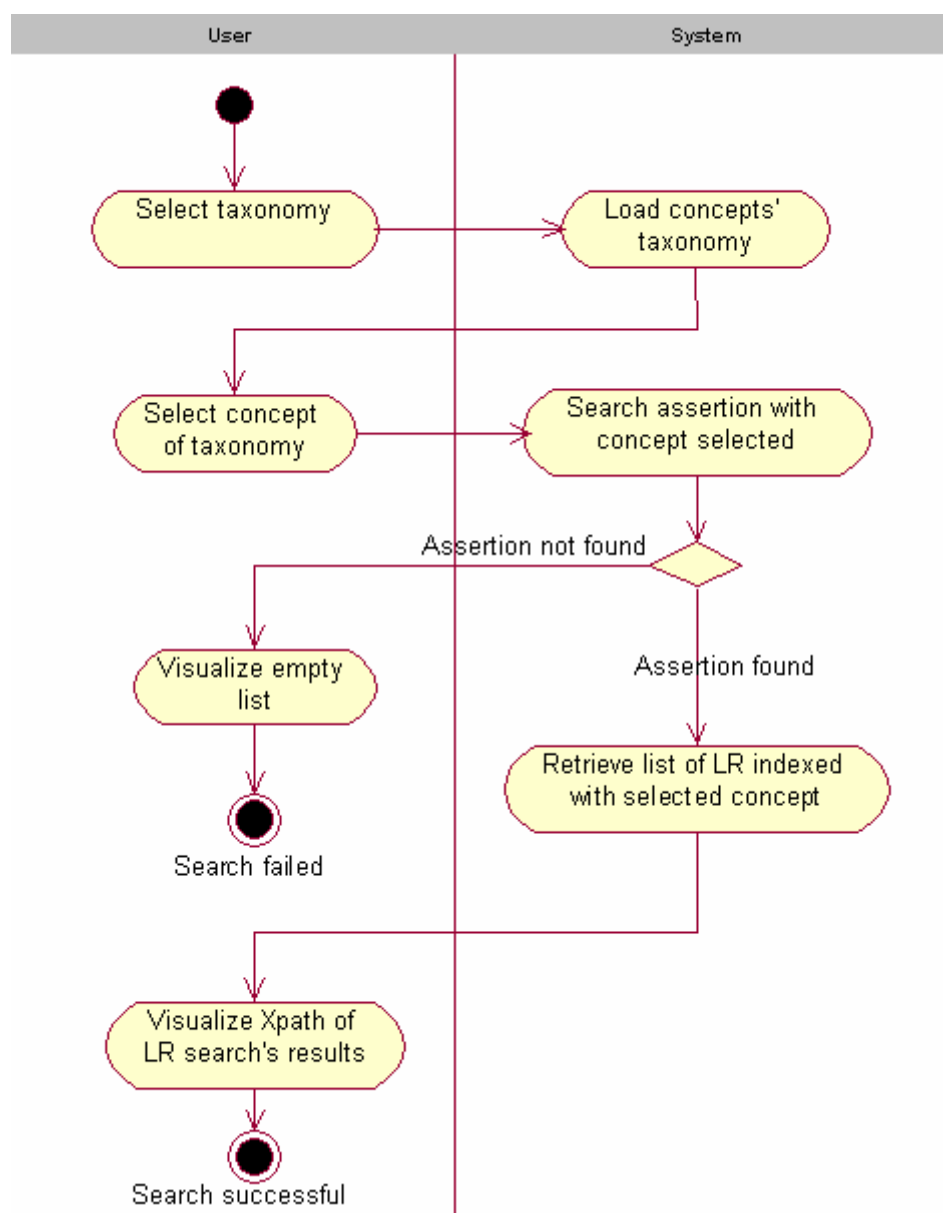


Figure 30. "Semantic search" activity diagram

Visualise Legal Resource

With this procedure the system will display all the details of a legal resource contained in the result set of a syntactic/semantic search and previously selected by the user.

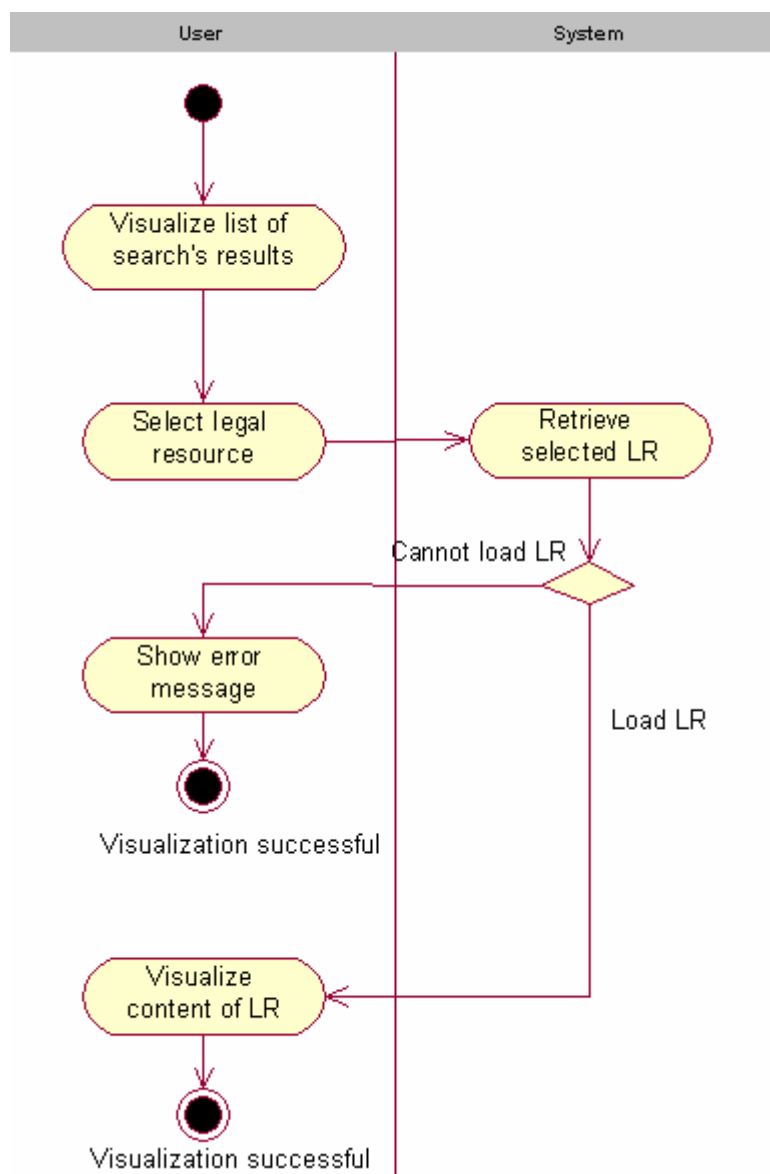


Figure 31. “Visualise legal resource” activity diagram

CA ValidatorChoose contract

This procedure is very similar to Choose Legal Resource. Before a user can choose a specific contract from the repository, the system will display all the available resources. The contract chosen by the user will be retrieved and then visualised according to its structure. The system will check also if the resource chosen by the user has already been indexed or not. If it was already indexed, the system will retrieve and display all the links contained in the contract. If one of these procedures is not successful, an error message will be displayed to the user.

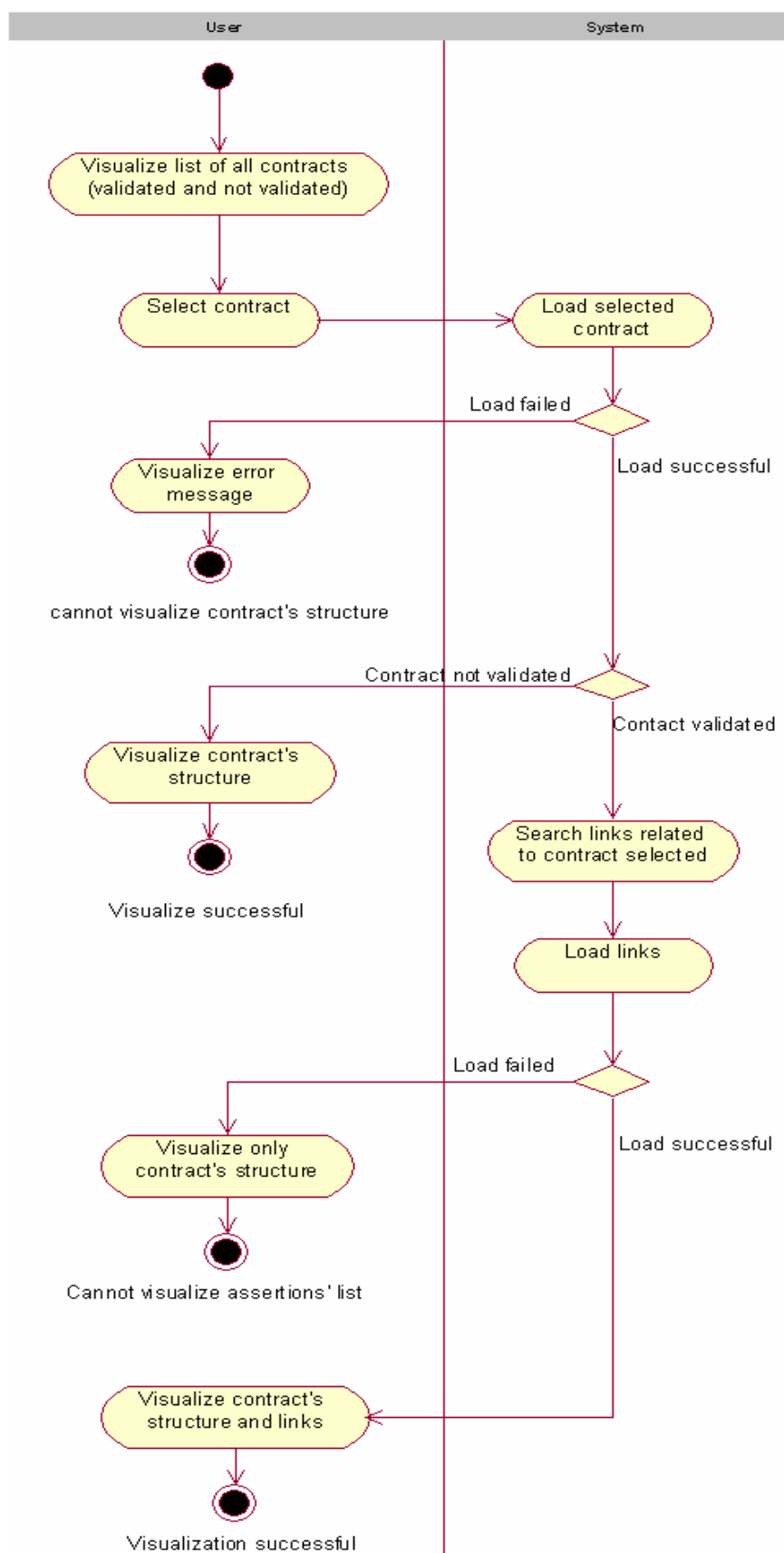


Figure 32. "Choose contract" activity diagram

Create link

In order to create a new link, it is necessary to select a contract and a legal resource of the regulatory Framework KB. The system will help the creation of a new link with a wizard.

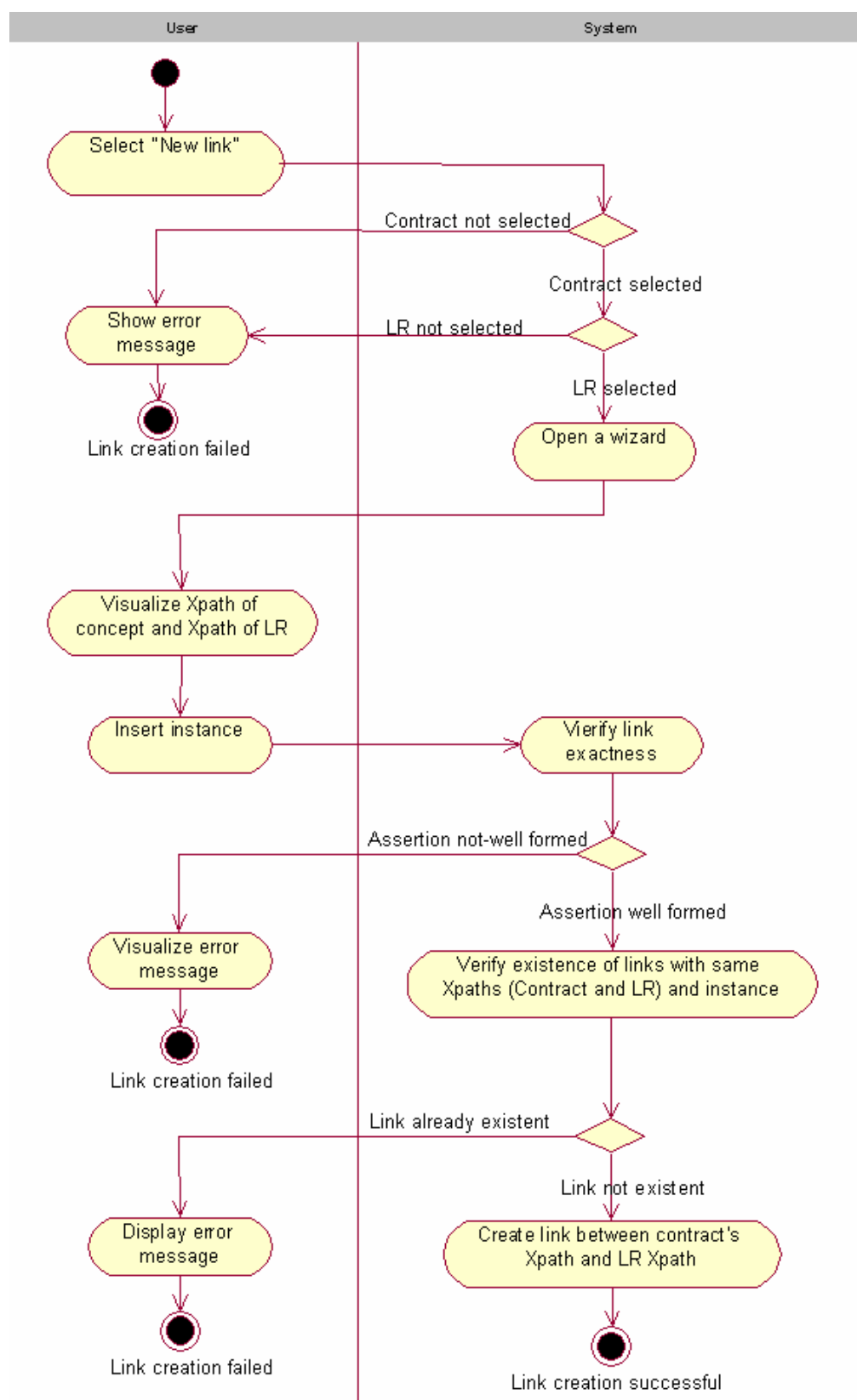


Figure 33. "Create link" activity diagram

Choose link

With this procedure, it is possible to visualise the details within a link. The user will select the desired link, and then the system can retrieve and visualise the link's details.

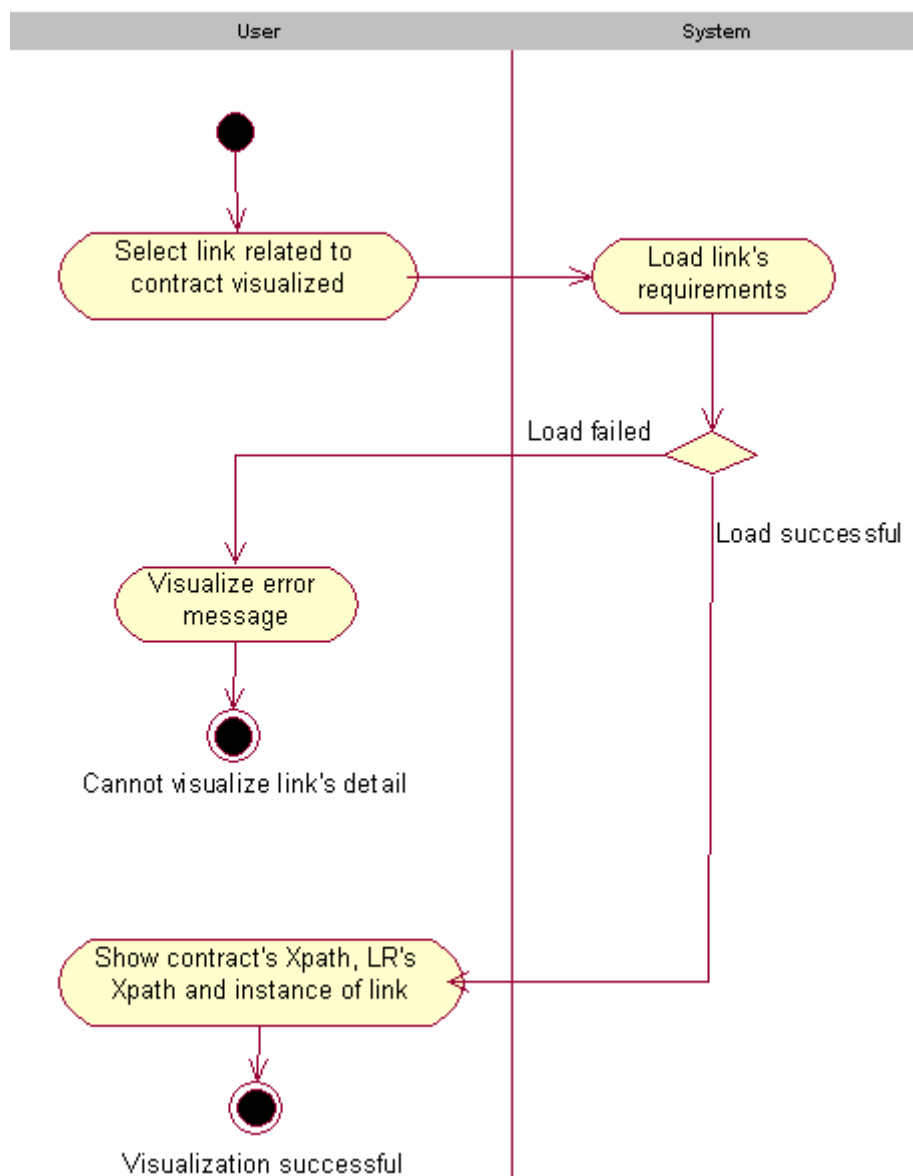


Figure 34. "Choose link" activity diagram

Modify link

In order to modify an existing link related to a specific legal resource, it is necessary for a user to have selected a contract, a link, and the new legal resource. After these selections have been made, the system will help the user modify the existing link with a wizard.

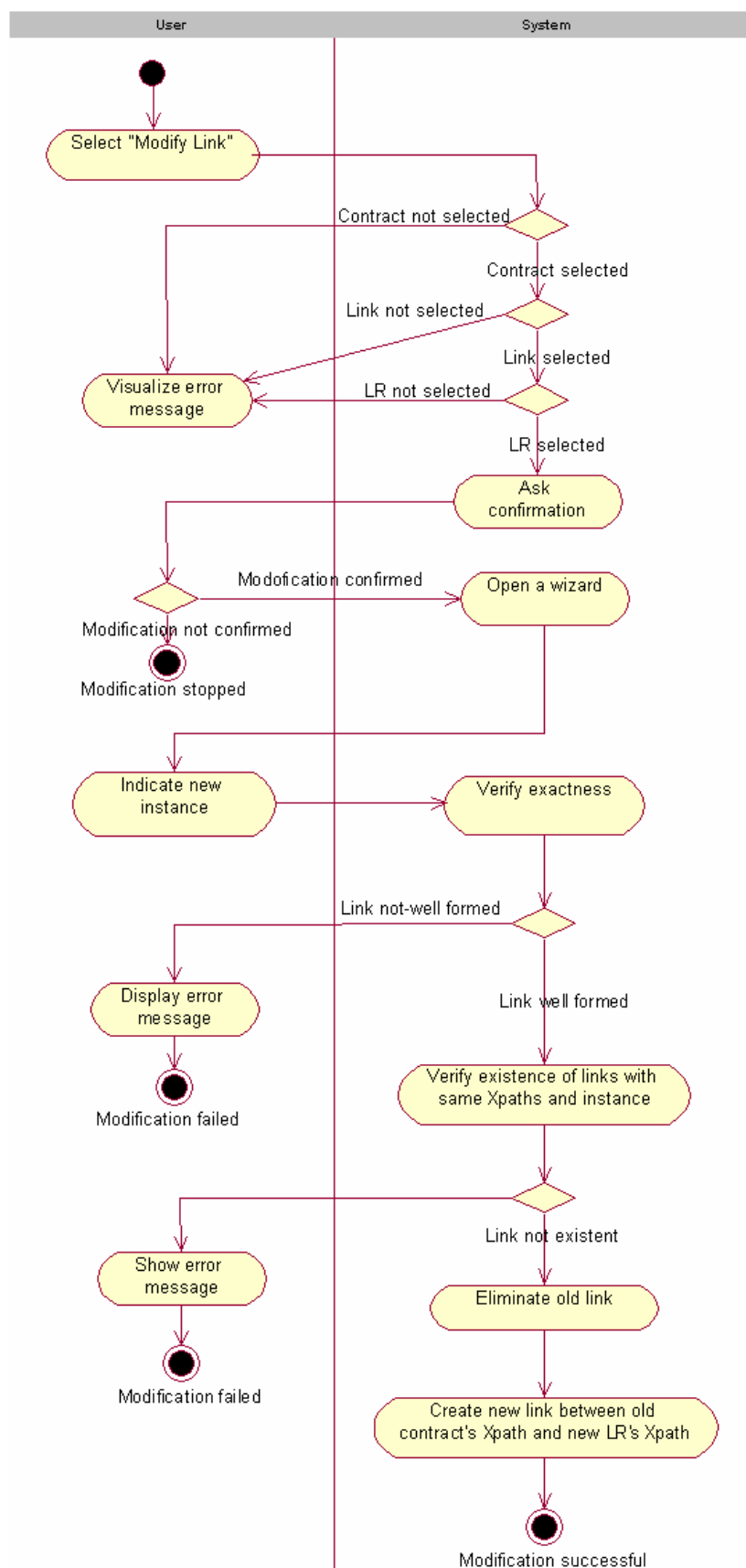


Figure 35. "Modify link" activity diagram

Delete link

To delete an existing link from a contract, it is enough for the user to select the contract and, within the selected contract, the link he wants to delete. The system will then delete the link between the legal resource XPath and the contract. If the link was the only one related to that contract, the system will change also the status of that contract, by changing it from validated to not-validated.

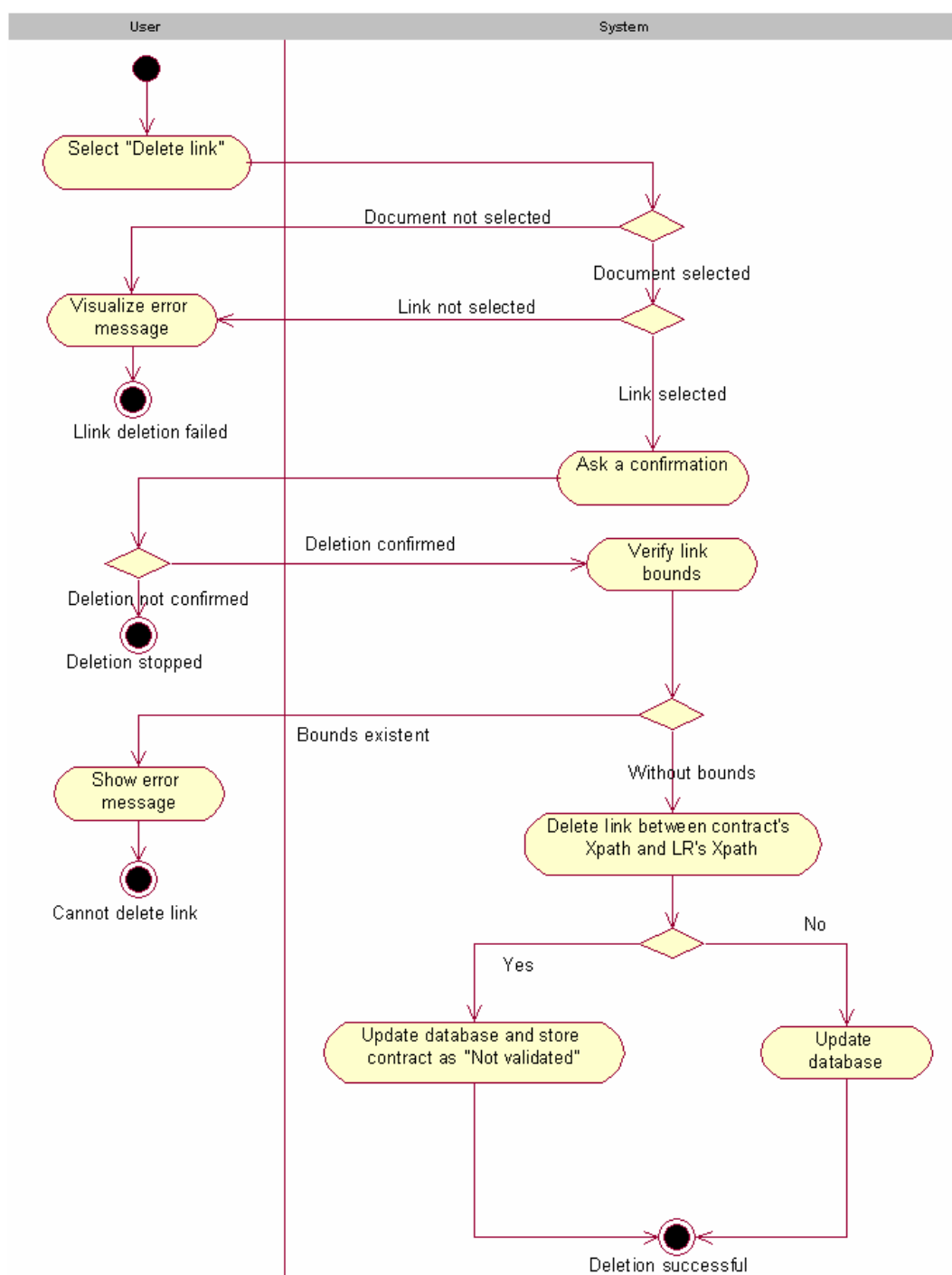


Figure 36. “Delete link” activity diagram

7.4.2 Sequence Diagrams

The sequence diagrams proposed in the present section describe the main interactions, in terms of temporal sequence of messages exchange, among different system components. In order to improve their clarity and readability, the diagrams describe the “main success scenarios”, in which no exceptions and failures occur. Moreover, it is important to notice that some of these possible scenarios have been aggregated in the same sequence diagram, in order not to break the logical sequence of the main operations. As a consequence, there is not a one-to-one correspondence between the use cases proposed in the previous sections and the sequence diagrams described here.

Upload Legal Resource

In order to upload a legal resource into the Regulatory Framework Knowledge Base, the user provides the system with the desired document and then it is stored within the DB, as shown in the following picture.

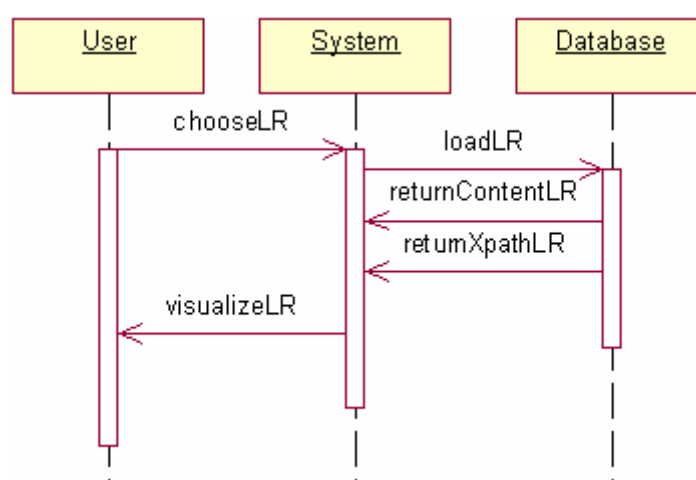


Figure 37. “Upload legal resource” sequence diagram

Semantic Indexer

Choose LR - Choose taxonomy - Create Assertion

The following picture describes the complete procedure to create a new assertion. Notice how this diagram aggregates several use cases, in order to provide a seamless description of the operation.

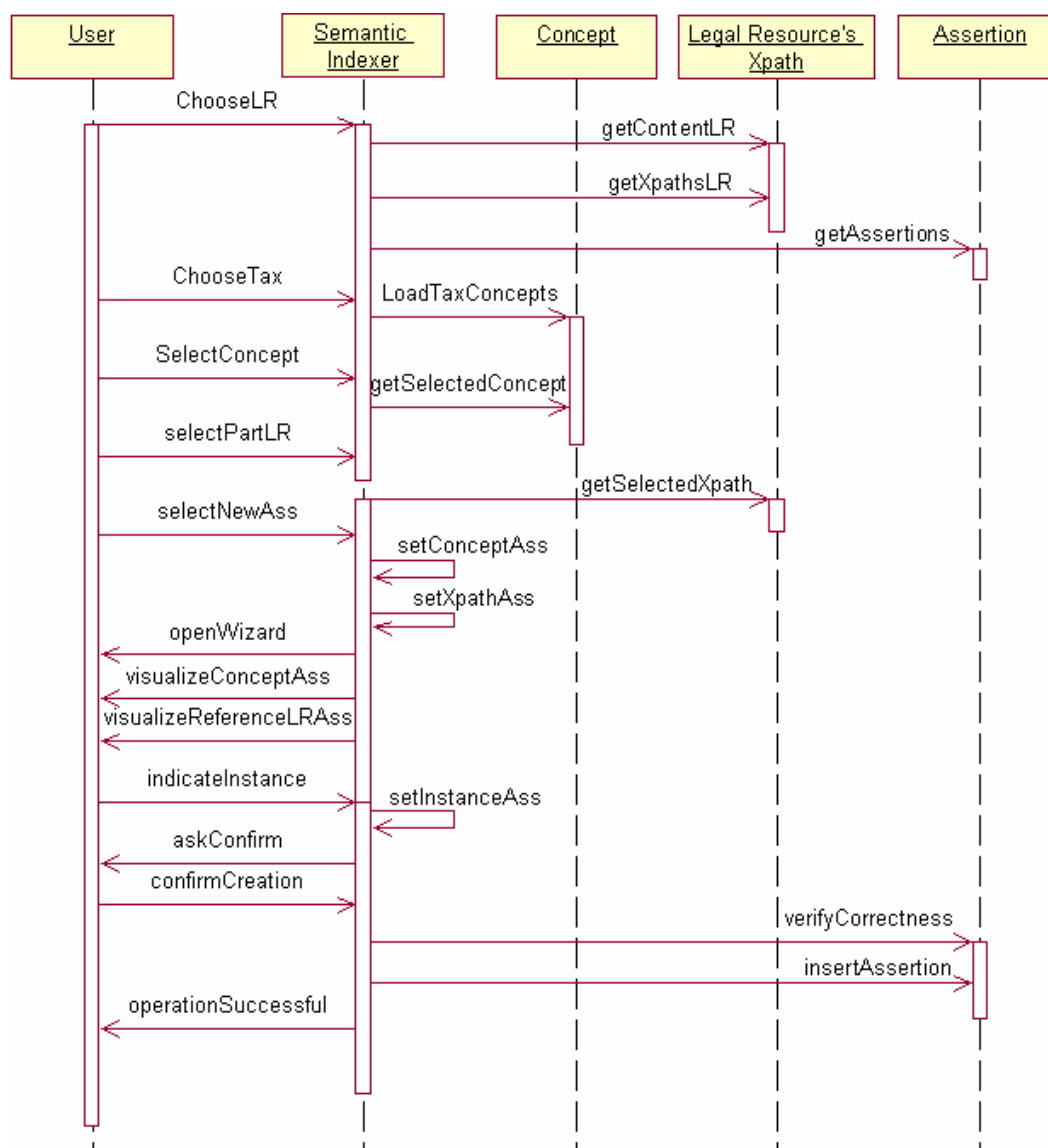


Figure 38. “Choose LR - Choose taxonomy - Create Assertion” sequence diagram

Choose LR – Choose Taxonomy – Choose Assertion - Modify Assertion

As in the previous case, this diagram aggregates different activities, in order to describe the temporal complete procedure to modify an existing assertion.

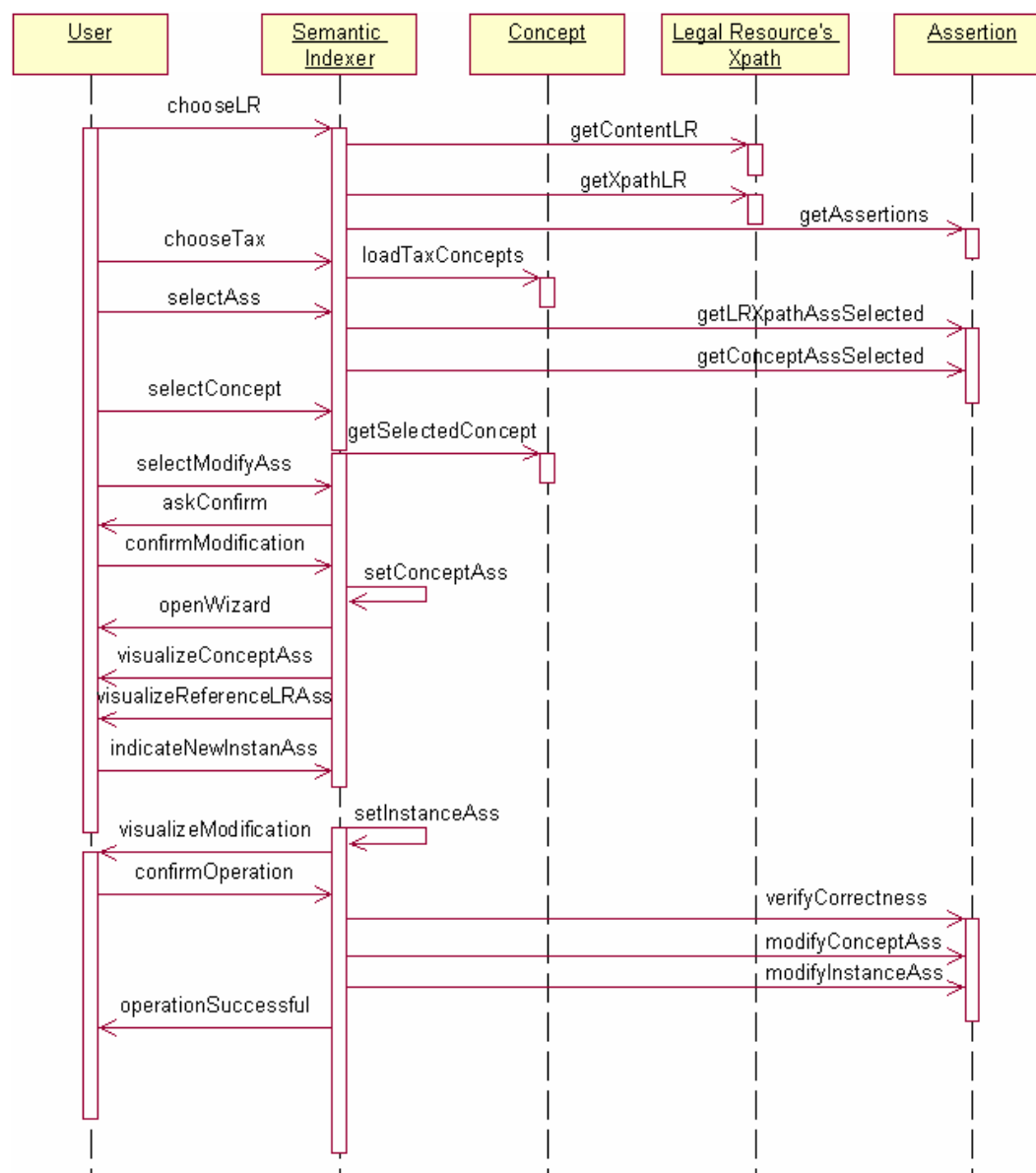


Figure 39. “Choose LR-Choose taxonomy-Choose and modify assertion” sequence diagram

Choose LR - Choose Assertion - Delete Assertion

The following diagram describes the messages exchanged in performing the complete procedure to delete an existing assertion.

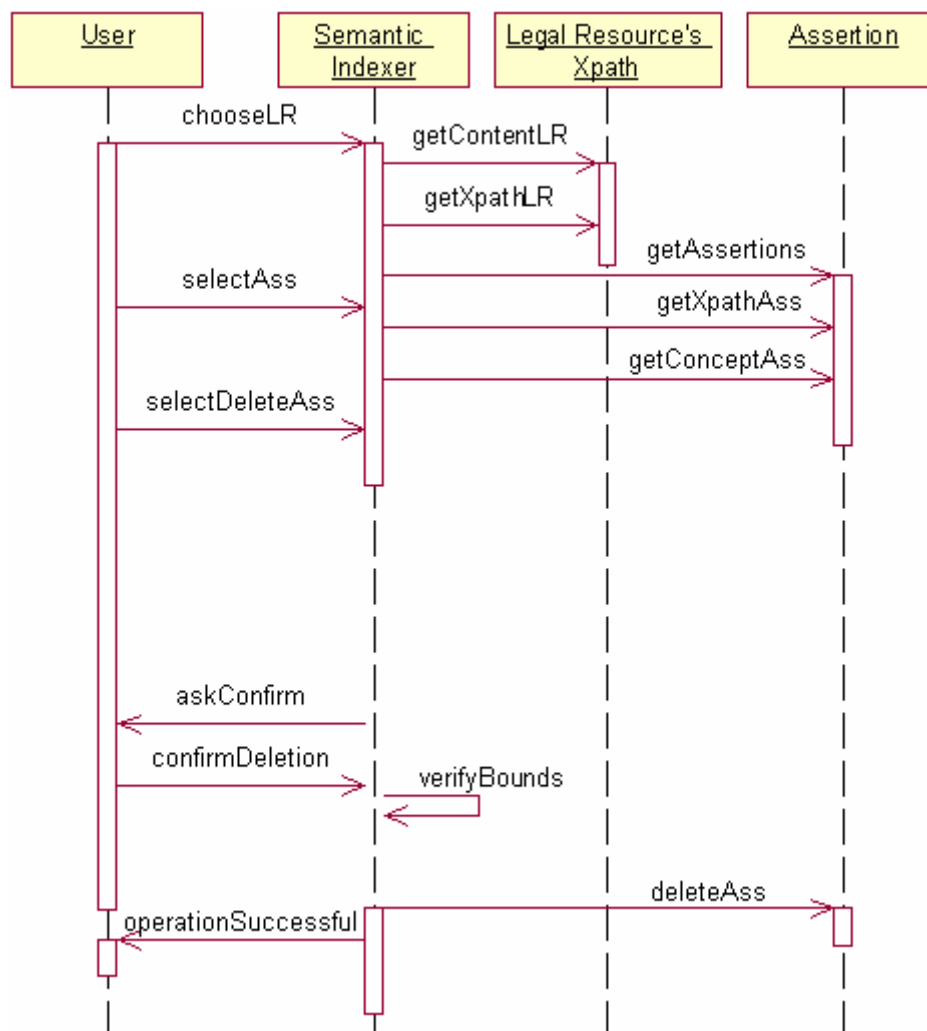


Figure 40. “Choose LR - Choose assertion - Modify assertion” sequence diagram

Navigator

Choose Taxonomy - Syntactic Search - Visualise LR

The following diagram shows the messages exchanged in order to perform a syntactic search among the indexed legal resources stored within the Regulatory Framework Knowledge Base.

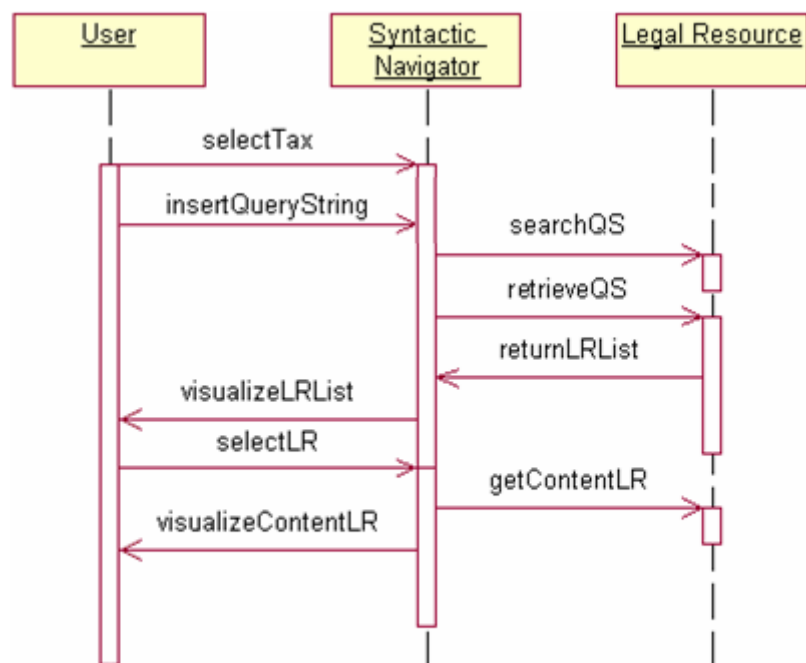


Figure 41. “Choose taxonomy - Syntactic Search - Visualise LR” sequence diagram

Choose Taxonomy - Semantic Search - Visualise LR

The following diagram shows the messages exchanged in order to perform a semantic search among the indexed legal resources stored within the Regulatory Framework Knowledge Base.

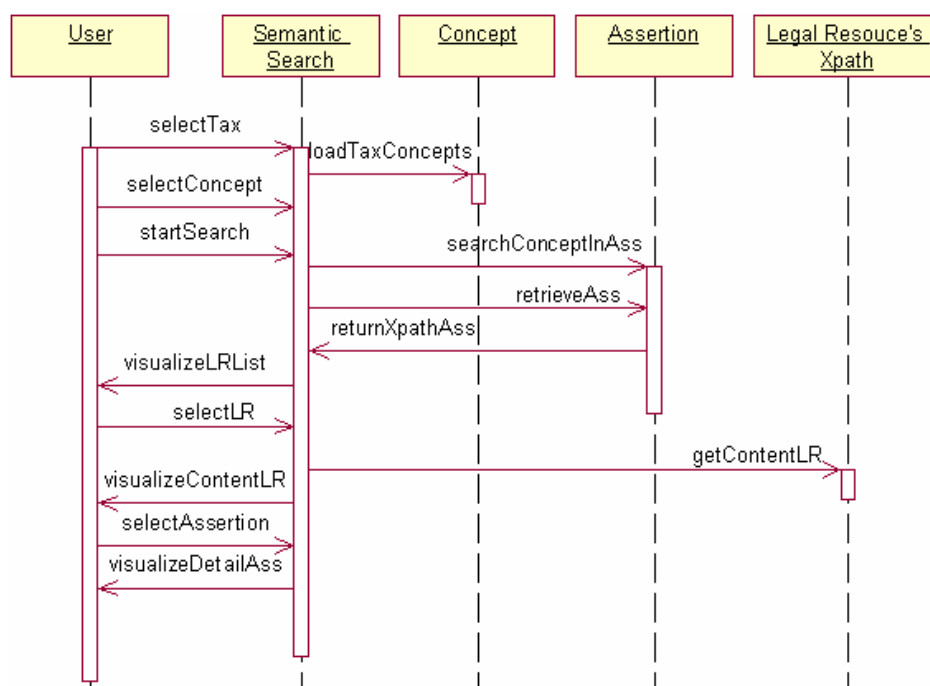


Figure 42. “Choose taxonomy-Syntactic Search-Visualise LR” sequence diagram

Validator

Choose Taxonomy - Choose Contract - Create Link

This diagram describes the procedure to create a new link between a contract and a (part of a) legal resource.

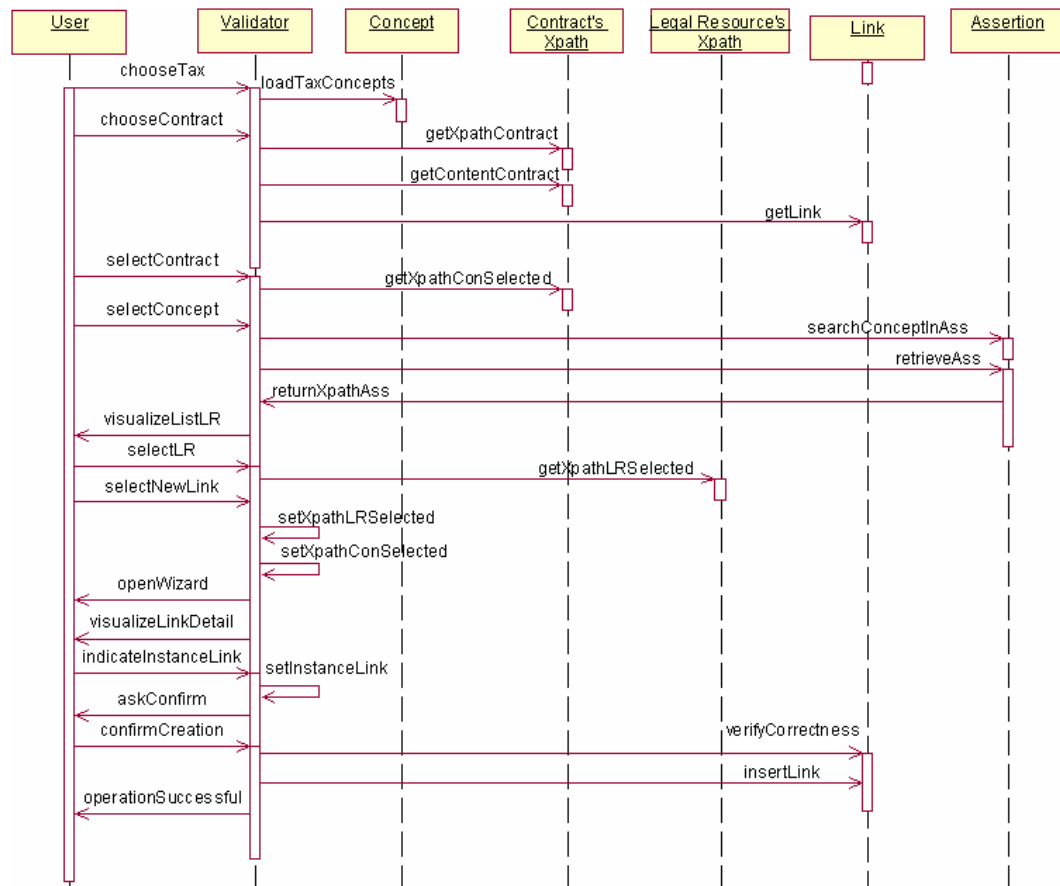


Figure 43. “Choose taxonomy - Choose Contract - Create Link” sequence diagram

Choose Taxonomy - Choose Contract - Choose Link - Modify Link

The system provides the user with the capability of modify an existing link. The messages exchanged among the system components involved in such procedure are shown in the following diagram.

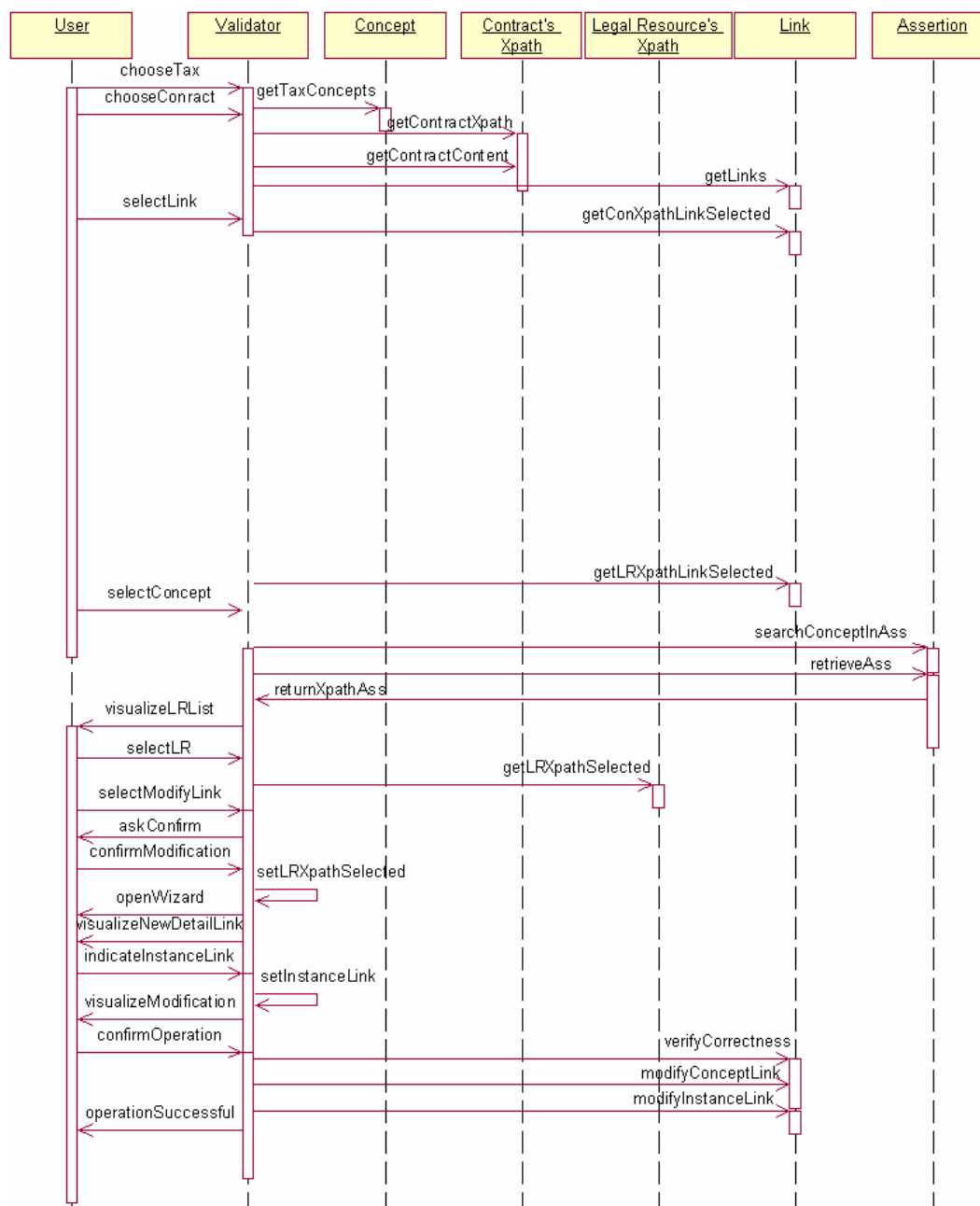


Figure 44. “Choose taxonomy-Choose Contract-Choose and Modify Link” sequence diagram

Choose Contract - Choose Link - Delete Link

The following diagram shows the complete procedure to delete a specific link, among the links related to the contract selected by the user.

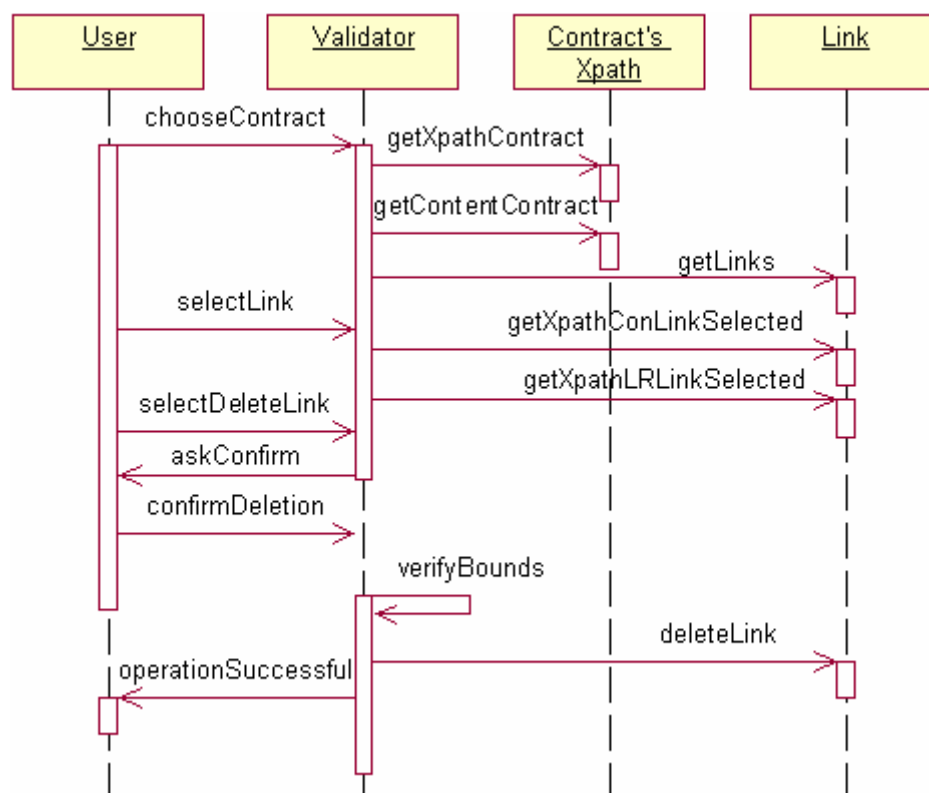


Figure 45. “Choose Contract - Choose Link - Delete Link” sequence diagram

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Appendix A: BSBR and Agreement

In this part of the document we want to explore some issues related to the opportunity to express Contract and Agreement. Actually, the only model in the DBE project, useful to express and represent Contract and Agreement is the BML model. In particular, we can consider the BML metamodel with its Business Process package in order to instantiate Contracts and Agreement models. The Business Process package is represented in the following figure.

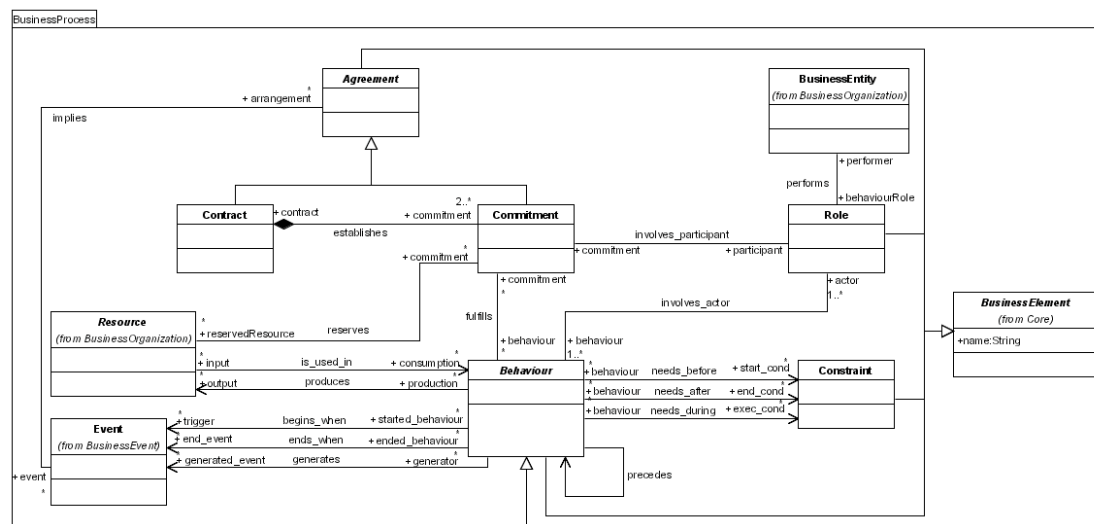


Figure 46. Business Process package of the BML metamodel

Another way to express and represent Contract and Agreement, to be taken in consideration for the future development of the research, is related to the use of *Semantics of Business Vocabulary and Business Rules* (SBVR), that is a submission by the Business Rule Team to an OMG Request For Proposal called Business Semantics of Business Rules (BSBR). OMG issued the BSBR RFP in order to create a standard “to allow business people to define the policies and rules by which they run their business in their own language, in terms of the things they deal with in the business, and to capture those rules in a way that is clear, unambiguous and readily translatable into other representations” [OMG]. In particular, SBVR enables [BRT]:

- business vocabularies construction, whose definitions represent shared understanding among a community of business people and whose contents are uniquely identified by this community;
- rules formalization, based on vocabularies; these rules should be expressed in a language close to natural (business) language, called Structured English but, at the same time, representable from an information technology point of view, in order to allow their sharing and transfer.

Appendix B: Using Regulatory Framework tools with non-XML files

In this document, part of our research was conveyed on focusing on how the knowledge can be best represented through the association of assertions with parts (XPaths) of legal resources. As mentioned in section 5.2.1, we assumed that legal documentation is available in XML format. Anyway, this choice does not hamper the use of the framework with legal resources in a different format. In fact, the mechanisms we defined could be used to create assertions about monolithic/non-structured legal resources (for example in pdf format), where the assertion would be applied to the whole document. Nevertheless, this possible application should imply some problems related to the effectiveness of the framework: creating assertions about an entire document does not provide more information than using a not indexed resource. For this reason, even though technically allowed, using non-XML files as input does not represent a desirable solution.

As a consequence, it is necessary to explore how this (not technical) format constraint impacts on the real usability of the framework.

Though many initiatives were started to define standards for representing legal documents, actually there is no a unique way to represent data for the legal domain. Anyway, considering the current trends (see section 5.2.1), it is predictable that in the future such resources will be available in an XML format, even if at the moment, there is no clear indication about when this might be fully realized and implemented.

As a consequence, the solution proposed results viable for a medium/long term scenario. In order to make the whole framework effectively usable from now on, such proposal could be completed with a mechanism enabling the translation of non-XML resources into XML documents. What we are going to specify, is a preliminary mechanism that should allow a user to “format” a pdf, doc, rtf etc. file into an XML file, with an assigned schema, that can be used as input for the indexing process.

By the term “format”, we indicate all those operations needed to produce a file in a XML-format from an existing document, filling the XML structure with the document content

According to what we stated in section 5 and then in section 6, this “pure” back-end process is intended to be performed by a Lawyer SME or a Government Body who is in charge to feed the knowledge base of the legal resource. Whereas this process is modeled to support the mechanisms already specified, any tool that could realize it, should be thought as loosely-coupled with the tools for the DBE Regulatory Framework.

Moreover, we assume that XML schemas for representing appropriately any kind of legal resources are available to the the Lawyer SME or a Government Body.

The process followed for the format of a non-XML legal resource is presented in the following figure.

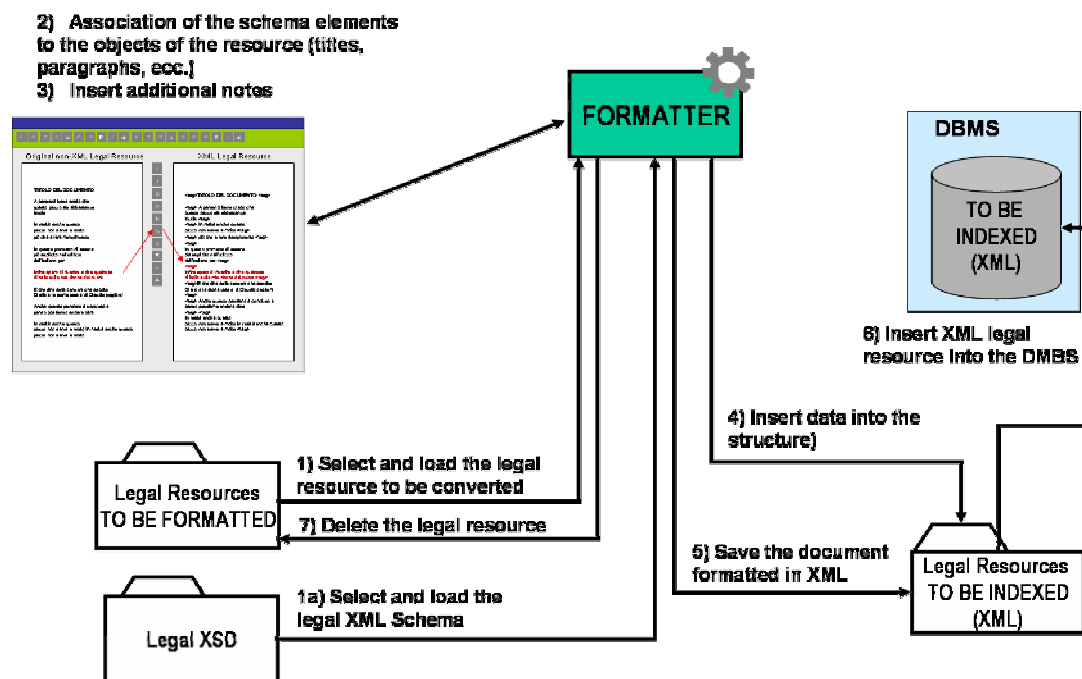


Figure 47. The formatting process: internal view

It starts with loading the file and choosing the XML schema according to which we want to perform this operation (1 and 1a).

Then, structure tags from the XML schema will be assigned to the legal resource (2) with the possibility to report also some notes(3). The new XML document is generated, it is filled with the data contained in the original legal resource (4) and it is saved in a local folder (5). Finally it is uploaded on the DBMS (6) while the original document is deleted from a temporary folder containing all the legal resources to be formatted.

Thus, once the process is ended successfully an XML copy of the legal resource can be uploaded to the knowledge base and be ready for the indexing process.