

Model-Based User-Interface Management for Public Services

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Abstract: Public business processes can be very complex. That makes it hard for citizens to understand these processes and for software companies to implement them into software tools. Changes of the process entail expensive effort in both teaching the citizens and adapting the software. For business processes several model-based approaches have been suggested to deal with high complexity, such as BPMN. However, modelling simplifies work of software developers rather than of citizens. We present an approach where an adequate user-interface with user-centric pertinent information is derived directly from the models. Our approach combines the advantages of having models for the software developers with the requirements of the users. The modelling technique we are using is Event-driven Process Chains (EPCs). EPCs are widely accepted in the commercial area and are comprehensively investigated in the academic area as well. Due to their graphical description they are easy to understand. EPCs are implemented in the ARIS toolset, which offers the possibility to attach attributes to the elements of the EPCs. This paper will demonstrate how these attributes are used to derive a user-interface, e.g. a relevant website or document, for each state or transition of the EPC. The tools used extract the values of the attributes and incorporate them into a web-based user-interface according to the EPC of the modelled business process. Execution of the model then is equivalent to running the user-interface. A change of the process requires a change of the model only, which is much easier to handle than changing the implementation of the user-interface.

Keywords: Business processes, event-driven process chains, user-interface, modelling

1. Introduction

The modernisation of public services is one of the major objectives of the European Union. For this, the e-Europe 2005 Action Plan proposes a set of actions, especially the creation and the establishment of integrated public services (EC 2002). The introduction of directives eases administrative cooperation on a general and legal level. First agreements, such as the Maastricht Treaty in 1993 on free movement lower the barriers and others, such as the European Arrest Warrant are on current development. On the one hand these new and future directives ease the interaction between European public administrations coming along with the European integration process. On the other hand they require public employees to know, to manage and to trigger more administrative procedures related to a high variety of processes and system applications they might not be aware of. E-Government offers new possibilities to public administrations of all administrative levels, including and especially European administrations (Schmidt 2001). At the front office it allows them to provide public services to citizens, businesses and other administrations in a better understandable manner in order to improve service quality on all levels (Schedler 2001). At the back office it empowers them with tools that facilitate their work. The degree of support for e-Government in public administrations strongly depends on its level of implementation, mainly measured by the four stages information, communication, transaction and integration. However, even today the number of governments providing transactional features is very low. Figure 1 shows the level of implementation for different degrees of implementation on national level.

Figure 1 illustrates that most countries already provide information on their public services (e.g. 170 countries offer one or more downloadable forms) but are deficient in realising transactions and integration (e.g. only 38 countries allow to pay at least one fee online). Looking at the cross-country dimension the deficit is even stronger. Transnational public services in Europe, i.e. services that cross the borders of the member states, are poorly, if at all, developed (EIPA 2001). Consequently, electronic support is required, covering all public services and the according processes.

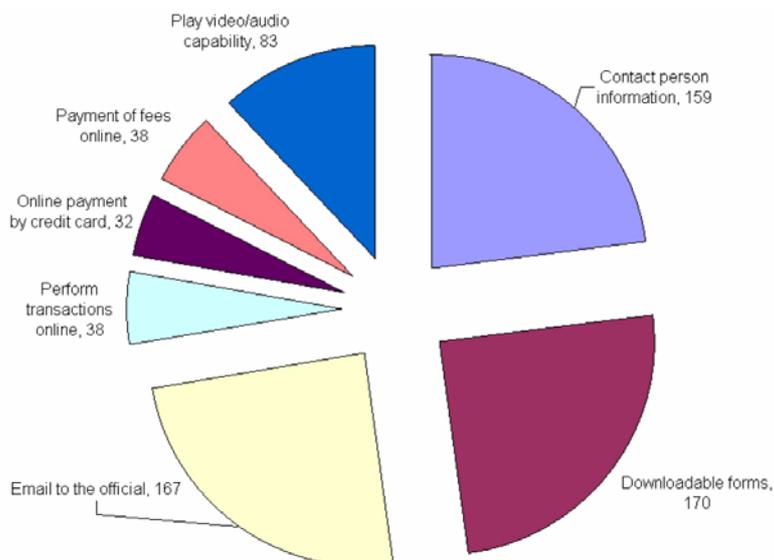


Figure 1: Number of countries providing interactive and transactional features (UN 2004)

The project “e-Justice”, funded by the European Commission in the 6th Research Framework Program, has developed, amongst others, a concept for a model-based user-interface management for public services. The specification was not limited to representation issues but covered the whole lifecycle of public service visualisation, business processes and application systems. Approved process modelling methods were used to design an enhanced representation that improves the transparency by visualising business processes of public services, and thus helps to promote mutual trust between individuals and authorities who are subject to different legal orders. This concept has been implemented into a demonstrator called Lexecute. Two steps were taken to formulate an adequate business process model. The first step was to interview practitioners and to consult legal texts. This step enabled the creation of semi-formal models in preparation for the second step, which was to verify the findings and formalise the process. The business process models resulting from this work provide new perspectives on public administrations and their services, as well as they reveal new potentials for modelling methods in the field of e-Government. The project started in March 2004 running for 24 months with the participation of 16 organisations coming from 6 different countries.

2. A model-based approach

Citizens often complain about the large amount of documents to read and to fill in order to apply for a public process. There are several reasons for their disaffection, such as

- The same information has to be given several times for different applications,
- The order of the single steps within the process is unclear,
- The reason for giving certain information at some stages is unclear,
- The amount of information to be understood to fill in documents is too big.

IT support and a transparent description of public and legal processes is thus required to increase the trust and the usability for citizens. We present an approach to make IT solutions possible based on models.

2.1 The e-Justice concept

Business processes of public services can be very complex. Due to their high complexity, these business processes are difficult to understand and to implement into software. Implementing them is also complicated by the fact that implementation requires expertise in both, the e-Government area and software engineering. A process modelling language provides a common language for administrative responsables and IT experts. In this paper we demonstrate the representation of business processes by using Event-driven Process Chains (EPCs). EPCs are an easy to understand modelling language and are widely used in the business process area, e.g. for the reference models of SAP R/3. EPC models contain a few graphical elements representing events, functions and their causal relationship. Logic connectors are used to describe merging or splitting of sub-processes. Due to the complexity of public services, the process models can be very complex as well. However, several techniques, known from business process modelling can be applied, such as hierarchies and modularisation. These techniques are explained later in this paper.

In order to decrease the complexity, the information is reduced to the needs of one procedure or case (Becker 1995). The information is gathered along a business process to enable a case and the procedure to be properly used. As the required information is still too complex to be displayed within the graphical representation, the business process model is enriched with additional attributes. These attributes are not shown in the graphical representation but are underlying the objects that represent a single step (function) of the business process. The values of the attributes can be extracted automatically and are represented in a separate 'info-box' available to the user. In fact, this 'info-box' may be used as the actual user-interface and does thus completely abstract from the model. However, the model firstly acts as a framework for deriving the user-interfaces and secondly can be used for getting an overview over the process and for navigating through it.

2.2 Context-sensitive information

Business process models facilitate the navigation within a process and provide information exactly where it is required. For example, an application process can be subdivided into several single steps where each step represents a certain input. The input cannot only be stored and re-used later, it can also be evaluated and the future process depends on the input. This leads to less information to be read and to be given by the user and helps to avoid redundant or useless information. The processing of context-sensitive information is a main advantage of business process models. In contrast to a document based process, where it is aimed to have documents as general as possible, for model based processing the aim is to get as much information as necessary and as little information as sufficient. Although the models themselves are very complex because they represent complex processes, each single step to be processed is simple and the user is guided through the process automatically.

2.3 States and steps

A main problem for citizens who are requesting a public service is that they are not sure about their current state within the entire process. A business process model can be used as a map for navigating through the process. Moreover, a business process model provides information about the current state and the next step. The separation into states and steps is not only important for providing a better understanding to the user but also for the modelling itself. The most important modelling languages, such as Event-driven Process Chains (EPCs) or Petri nets are based on these simple elements and their causal relation. Figure 2 shows the graphical representation of an event, representing a state, and a function, representing a step. The arc between the event and the function represents the causal relation between them. Here, the event has to be satisfied to enable the function, i.e. if the current state of the process is the one represented by the event then the next step is the one represented by the function.

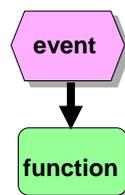


Figure 2: Graphical representation of an event and a function as elements of EPCs

Additional elements are common depending on the modelling language. For example for EPCs, used in this paper, models of organisations are used to describe the actor of a function, i.e. the people or the role that processes the function. An example is given in Figure 3.



Figure 3: Example of organogram and function

2.4 Hierarchies and modules

Beside the simple and easy-to-understand graphical representation of business processes, modelling offers the representation of complex processes in different abstraction levels. Depending on the degree of information detail the process can be described in different levels, where a function is refined in an underlying level.

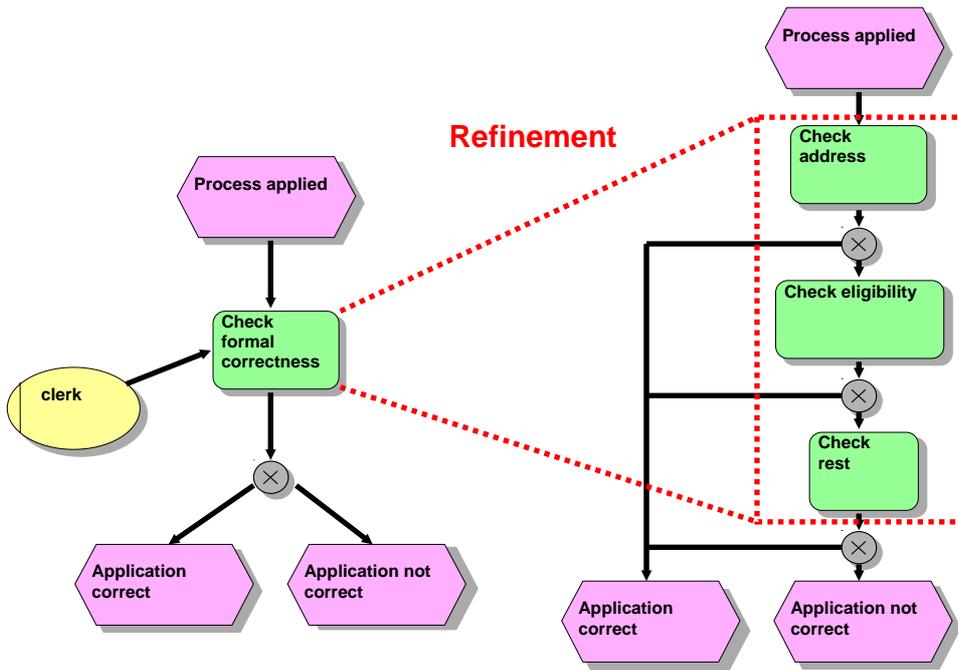


Figure 4: Example of refinement

Figure 4 shows a simple example of a refinement of a function. The left-hand side of the figure shows an abstract model of an application process. The only function within this process models is the checking of the correctness of the application. The right-hand side of the figure shows this model in more detail. Here the function “check formal correctness” is split into three sub-functions representing a single step each. However, each of these functions might be refined again in an underlying hierarchy level. The hierarchical structure makes complex models more compact and offers both, an overview of the entire process and a very detailed view of selected parts of the process. Another concept for handling high complexity of processes is modularisation. Modules are parts of the model that often appear in the process and hence the model can be re-used elsewhere as part of the process. A typical example of a module in a public process is the sending of documents. There are different types of sending, such as via email, mail or fax, and hence different types of receiving. Nonetheless, wherever in the process a document can be sent and received, an adequate module can be used in the model.

2.5 Modelling conventions

The modelling methods and languages, which have been proven to be of great value for the modelling of business processes in the industry, were partially adapted to meet the specific requirements of public services. Although the objectives of a commercial business may not be congruent with those of public administrations, it is considered that public services could benefit from the application of business process modelling methods. Basically, there are four distinguishable functions in the field of business process modelling: describing, analysing, simulating and configuring. Only the configuration function is used as a basis for the automation of business processes. The describing function aims at improving transparency and communication in complex processes, whereas the analysing and simulating function of a model support the optimisation of business processes. During the development of the concept, additional attributes and functionalities were deemed necessary and therefore the common modelling methods had to be extended. To reduce the modelling complexity and to ensure a user-centric and process-oriented approach, a modelling convention was defined that will be described in this section. The modelling convention restricts the use of modelling methods to enhanced EPCs (eEPC), Petri nets, organograms and Entity Relationship Model languages for data/information modelling (Chen 1976, Chen 1983). The organogram is a simple hierarchical graph of organisational units that can be linked to the eEPCs. The eEPC and the Petri-nets are the most relevant methods for the conformity to the process-orientation. Since the eEPC models are mainly appearing in the user-interface they were limited in their number of object types (for a detailed description of possible enhancements of the EPC see: Rump 1999). Only the object types shown above and the object type of application systems were used in order to avoid confusion. For a further complexity reduction the idea of pools and swimlanes was adapted to the eEPC (Klein 2004, BPMI 2005) and was used for the representation of a business processes communicating with each other between two or more public

services/administrations. Through the expert interviews we have defined specific attributes for every object that are mainly applicable to the function object. The following table shows the defined attributes for every used object type in e-Justice.

Table 1: User-interface context information

Attribute	Value
Name	Name of the function, i.e. "application"
Description	Textual description of the function, i.e. In order to get a "Vollstreckungsbescheid" (enforcement order), i.e. an executory title, the "Antragsteller" (claimant) has to apply for it explicitly.
Legal basis	Specifies the legal basis, i.e. §§ 699, 702, 703 II ZPO (German Code of Civil Procedure)
Deadlines	Specifies the start and the end of a function or a period of time in which the function must be done, i.e. 31.12.2005
Costs	Gives the total costs of a function for the actor (manually, if applicable)
Documents	Gives the documents which are needed to trigger a function or which are generated by a function, i.e. Zustellungsnachricht Mahnbescheid (notice about the service of order for payment) Antrag Vollstreckungsbescheid (application enforcement order)
First actor	Specifies the organisational unit which triggers the function, i.e. "Antragsteller" (claimant)
Object path	Specifies the path in the model where the function is located (for orientation purposes), i.e. "Mahnverfahren" (Order for payment procedure -Germany) \ Procedure "Vollstreckungsbescheid" (enforcement order)
Triggering process path	Give the process path, which triggers the function, i.e. Order for payment procedure (Germany) \ Procedure "Mahnbescheid" (order for payment)

With the definition of specific attributes with additional information in the relevant context, it is, for example, possible to gain access to relevant legal texts exactly where they are of importance within the procedure. For the language problem, which inevitably occurs with the representation of technical (legal) terminology in a foreign language, a practical solution was found by using a multilingual glossary. Furthermore, time limits and the costs of the procedure were taken into account, because they were considered to be essential information in respect of all procedures in the public sector. The relevant information for the user is presented in a tool called Lexecute. The purpose of this tool is to enable a comprehensible representation and visualisation of business processes in public services. Due to the fact that it is an adaptive method, it can be directly applied to represent any public service, supplemented by interactive components that allow for an easy navigation within the model. In a nutshell the modelling convention was established on model types, objects symbols and types, attributes, objects caption (see section 2.1) as well as the model layout (Becker 2005).

2.6 Lexecute

Lexecute is a demonstrator for the concepts developed within the e-Justice project. Lexecute runs on every common Internet browser. Figure 5 shows a screenshot of Lexecute. The interface of Lexecute consists of three windows:

- The navigation tree window
- The 'info-box' (the user interface)
- The model window

The upper window on the left-hand side shows the navigation tree. The navigation tree is designed in Explorer-like style and provides an easy access to all levels of the model. Although the navigation through the model is also possible via the model window, the navigation tree allows direct access to very detailed levels of functions and their sub-processes. The model window shows the EPC model of the process. On the highest level of abstraction the entire model is shown. It is possible to display the detailed sub-processes of functions by double-click on these functions. The process model shows the states, steps and causal relation

between them. The process model also provides information about the actors of functions, about data bases used in the process and about logical conditions for merging and splitting sub-processes. The process model represents all possible behaviour starting at the initial state until an end state has been reached. A process model can be used as a common language of law experts and non-experts. It also facilitates the comparison between similar judicial processes of different countries and it can be used for teaching about the modelled process. The main advantage of our approach, however, is that the user-interface is automatically derived from the model. Evaluating the values of parameters within the model does this. Details are discussed later in this paper. The user-interface, or info-box, is shown in the lower left-hand side window. Here, a web page is shown, which is a value of a model's parameter. Yet, the 'info-box' might also contain links to documents, legal texts, detailed descriptions and information or costs. Due to the fact that it is much easier to change a model than to change software, with our concept it is much easier to manage changes of processes and still to provide an appropriate user-interface.

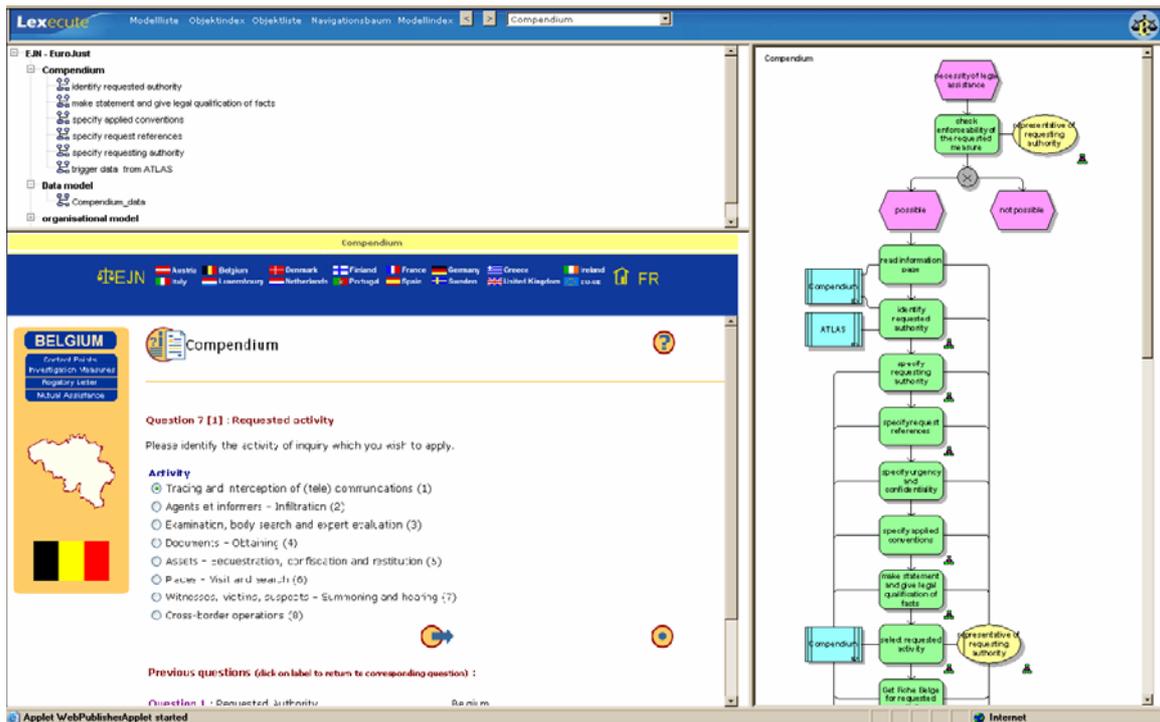


Figure 5: Business process-oriented user-interface for public services

Considering cross-border public administration practice, language is one crucial obstacle that public employees face. Although other languages may contain corresponding terms, they may often have very different meanings. Thus, a pure, literal interpretation of all terms does not produce the desired result of an easy-to-understand model. That is why it was decided to retain the legal terminology of the corresponding original language in the model, but offer possible translations for these terms. The multi-lingual version of the demonstrator displays the legal term in inverted commas in German followed by a corresponding translation in brackets. This way the content will remain, and the user can either rely on the pre-selected translation or undertake further research regarding the meaning of the foreign term.

3. Verification

The use of modelling languages offers the verification of the models, i.e. the proof of the correctness of the modelled process. There are several correctness criteria for business processes of public services. For example it must be ensured that the process never ends in an undesired or undefined state. Documents or any other items that are important for the process must not get lost or left somewhere within the process and citizens who apply for something or inquire something must get an appropriate response. Van der Aalst (Aalst/Hee 2002) has defined the so-called soundness criteria for Workflow Petri nets. Petri nets is a formal modelling language. The soundness criteria can be applied to EPCs as well if these EPCs have a formal semantics. Soundness comprises all-important properties like the ones discussed above. There has been an ongoing discussion about the formal semantics of EPCs (Nüttgens 2002). It has been shown that there are EPC models that do not have a formal semantics, which is caused by the non-locality property of the OR and XOR join operators (Aalst 2002, Kindler 2004). This non-locality leads to ambiguous interpretations of EPC

models if there are join operators that mutually depend on each other. However, for many EPC models of realistic business processes the semantics is non-ambiguous. Recent developments (Cuntz et.al. 2005) offer a fast calculation of the underlying transition system that is needed for verification. Tools like EPCTools can be used to

- Visualise the dynamic behaviour of the process model
- Compute the formal semantics (the underlying transition system) of the model
- To check whether certain correctness criteria are satisfied, e.g. to check whether the model is sound.

4. Concept evaluation: Scenario of rogatory letter with the European judicial network

The concept of model-based user-interface management with its components of process-orientated context information, modelling conventions and verification was evaluated in two scenarios. In this paper we will use and describe the scenario of a rogatory letter with the European Judicial Network (EJN, for detailed information see <http://www.ejn-crimjust.eu.int/>). In this public service a rogatory letter is designed from a requesting authority and sent to a requested authority. This cross-border process is used for example to get information about certain persons or cases, to arrest or interrogate suspects. The EJN offers several web-based tools to its users to help them in the administrative steps. The EJN-ATLAS allows the identification of local competent authorities where the rogatory letter can be sent. The EJN-Fiche Belges provides the users with relevant information on administrative conditions and legal basis on categorised activities requested in the rogatory letter. The EJN-SOLON is a multilingual glossary of legal term equivalences (see also section "The e-Justice Concept"). The EJN plans to integrate them in one single user-interface named Compendium. Figure 6 gives an overview of the rogatory process model using the Compendium. The rogatory letter processes differ depending on the requesting and requested authority. However, the overview model is the same for all processes. The functions represent the questions to be answered. Initially the process is in start state necessity of legal assistance. Being in this state the representative of the requesting authority enters the requested measure and the system checks the enforceability of the requested measure. The outcome of this check is either that the legal assistance is possible or not possible. If legal assistance is impossible the process ends. Otherwise the interactive rogatory letter process starts. If the requested measure can be enforced, an information page appears. This information page is part of the Compendium (rectangle connected with the function read information page). The model of the rogatory letter process has been developed in collaboration with Eurojust/EJN, Den Haag, and the EJN contact point of the General Prosecutor Office Zweibrücken, Germany.

5. Achieved improvements

The visualisation concept was evaluated with the above-described scenario. In order to ensure that the user-interfaces can be integrated the structure needs to be integrated. Therefore, a data model integrates the data from the EJN-ATLAS, EJN-SOLON and EJN-Fiche Belges, which is shown in Figure 7. The information that was found included the attributes previously defined in the expert interviews. The LEGAL BASIS included in the FICHE BELGE is specific to an activity (e.g. a psychiatric medical examination – 303) as well as to a country (each country has a different regulation for a psychiatric medical examination, if at all). The description is included in the REQUEST at different stages and the REQUEST as well as the REQUEST POSITION withhold the deadlines. The documents relevant to business process steps of a public service are of course the REQUEST itself as well as the CONVENTION (which was excluded to be a legal basis in the expert discussions) and the DOCUMENT. In this case study no costs were identified since it is a system to be accessed actively only by other European Public Administrations and agreements exist to provide these public services to each other free of charges. Nonetheless, we believe the costs information to be of high relevance and an important issue for the integration of public services. Practitioners and users need to know what costs to expect (not only in the first steps of public service processes but also the consecutive steps). These similarities were identified in a first single case study and then validated in two further single case studies. Further on, it was also possible to identify strong similarities in most data models with the generic order definition as it is defined and used in SAP (Scheer 1996). An organisation unit (here AUTHORITY) is requesting n elements (to be delivered at fixed time or deadline, here REQUEST POSITION) from another organisational unit (here AUTHORITY) at a certain TIME using a document (here REQUEST). The most common difference was that the requested element(s) can again be composed of several sub-elements/documents and that these causalities are not known to the primary requesting organisational unit. It should be noted that these elements are generally documents (notification, certificate, forms, etc.) (Adam 2003).

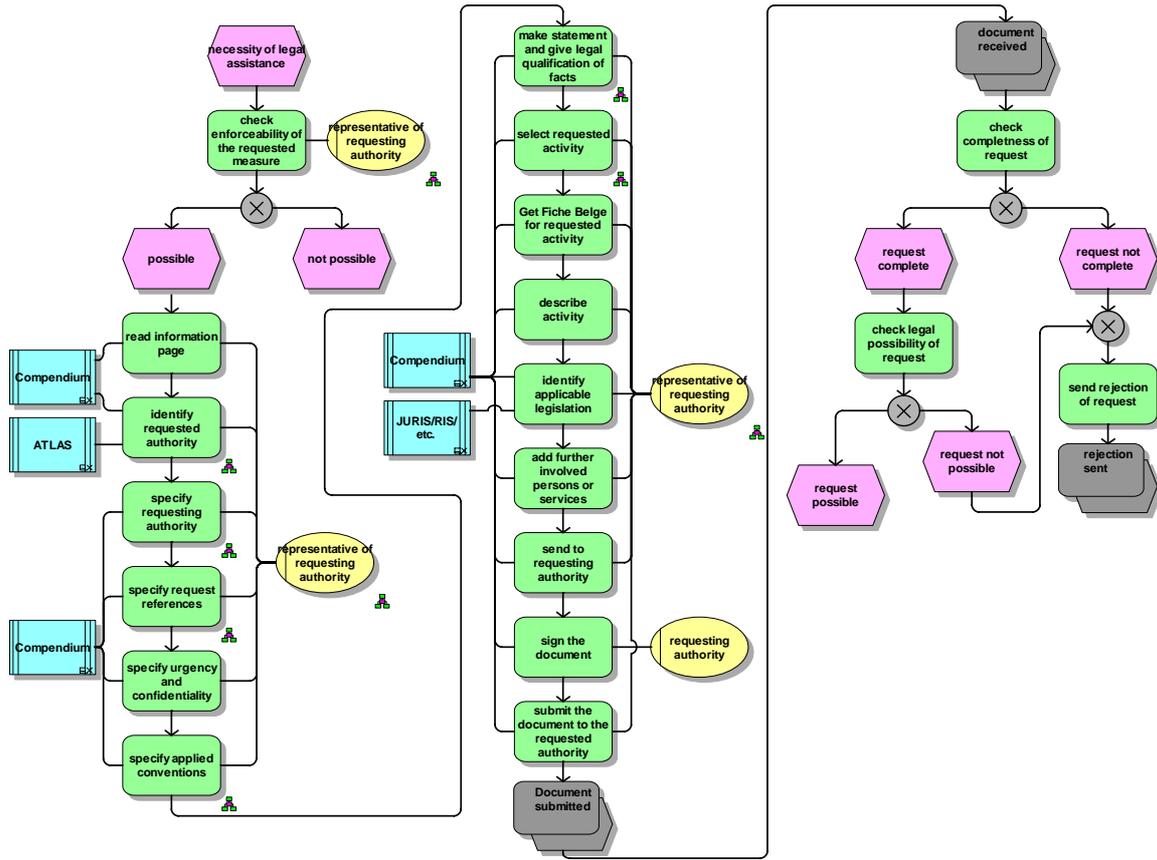


Figure 6: EPC of the EJM-Compendium

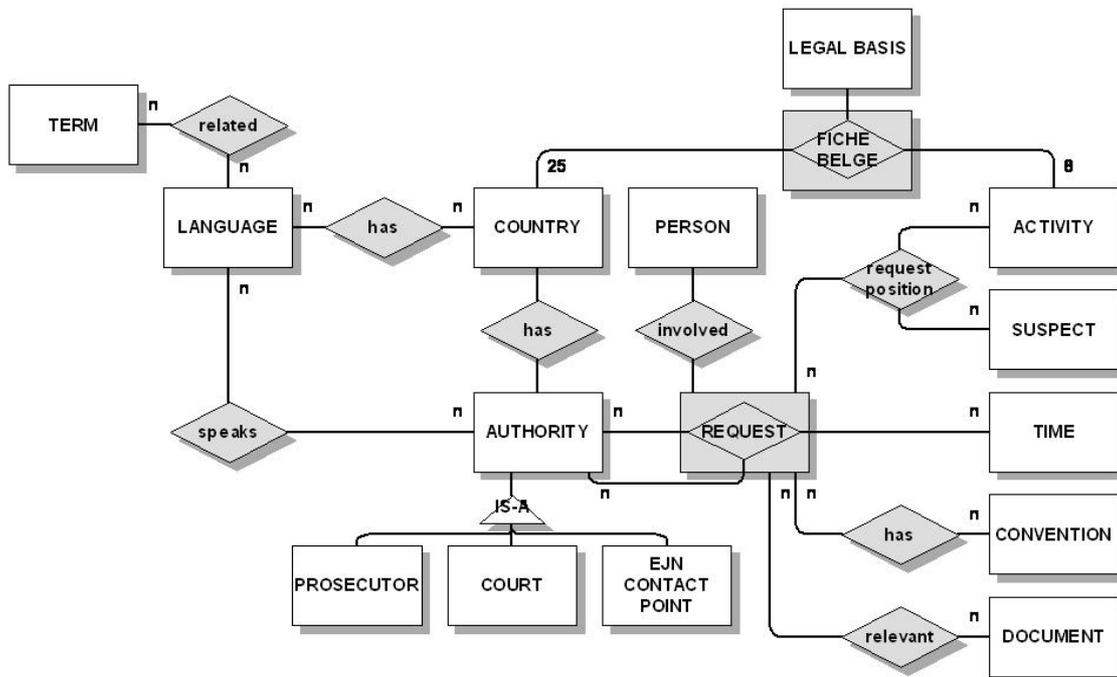


Figure 7: Entity relationship model of the EJM-compendium

In summary it was discovered that attributes of the model-based representation concept for public services exist in all the analysed case studies (except for the COSTS attribute, which is not relevant to the public service processes between authorities subject to multilateral agreements). Furthermore, with the e-Justice

approach the user interfaces could be integrated into two of the case studies. In some cases this approach even allows to identify possibilities for business process simplification and redundancy avoidance.

In order to provide a fast and realisable solution the e-Justice concept includes a multi-lingual solution for relevant "technical" terms, allowing a translation into any language without distortion of the initial meaning. This solution leaves the possibility to integrate a multi-lingual ontology for technical terms fully integrated into the user-interface. The link to the EJM-SOLON exists but would require further automation and above all a content management system for the maintenance of the significances. It was also established that the legal basis and the fast access to it is a strong requirement for user-interfaces in public services, especially on a cross-national level. In the current stage of concept development the access to legal information is ensured using a hyperlink to databases accessible freely in several member states of the European Union. However, to ensure the full integration into the user-interface, the retrieval of the correct required legal basis (depending on locality, version, etc.) should be ensured using a web service. Finally, the model-based approach to user-interface management allows it to ensure that the relevant and required information of the public services defined with the practitioners is provided in the right context.

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