A Knowledge Based Architecture Framework for Integrated Services in an Administrative Law Environment

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Abstract

Service 2000 is a project supported by the European Commission, that started in march 1997 and will end in may 1998. The overall aim of the project is to reduce the efforts for introduction and support of integrated service offering by municipalities to their citizens, by developing a Framework to intelligently support the so called 'one-stop-shop concept', using multimedia and knowledge technology. The papers starts with a tour along the backgrounds and context of the Framework, from a combined knowledge management and AI and Law perspective. Next, the paper gives an impression of the functionality of an intelligent support system framework that was developed, followed by an overview the way the framework is implemented. The papers ends with an discussion of the role that ontologies play in constructing a general framework and in developing operational systems based on it.

1. Introduction

The Service 2000 project is a project embedded in the European TIDE-program [Telematics for the Integration of Disabled and Elderly people]. The one year project started in 1997. Its aims is to reduce the efforts for introduction and s upport of integrated service offering by municipalities to their citizens. Participants are the Dutch Ministry of Interior, the National Association of Local Authorities in Denmark [NALAD] and Bolesian, a Dutch service provider in the area of knowledge technology and knowledge management.

In the first phase an Intelligent Support Framework [ISF] was developed. The framework constitutes a flexible basis for knowledge mana gement and the automated support of knowledge intensive processes, taking into account rapidly evolving knowledge (laws, regulations, policies) being used in a likewise rapidly evolving environment of a local government.

The second phase of the project entails the development of a specific instance of an intelligent one-stop-shop-system based on the framework's architecture. Since the Service 2000 project is embedded in the European TIDE program, the second phase focuses on the elderly and disabled citizens that apply for a provision. Their claims can be based on several acts, like the Act on Provisions for Disabled. The administration of this law involves several knowledge intensive processes, applying medical, ergonomical and legal knowledge.

The challenge of the Service 2000 project is to:

1. **deal with the bias of general knowledge about municipalities' administrations to service their citizens and differentiated knowledge about a specific municipality's administrative organisation and policy;**

2. deal with the development of an operational system applying different types of knowledge, departing from a basic framework.

We will argue that the design decision to use of different types of ontologies as a basis for knowledge representation made it possible to tackle the challenge.

2. The Intelligent Support Frameworks context

The functionalities the Intelligent Support Framework embodies, all attribute to the support of two major contexts in which the framework can be applied. The first is the 'macro' context of a municipality applying regulations and policy in response to a demand of one of its citizens. The second 'micro' context is that of a legal practitioner (laymen or scholar) performing his or her job.

The two environments bear down to two different focal points, looking at the same (computer) system for knowledge management and employment in an administrative law environment. Since the requirements for the knowledge management facilities are a derivative of the knowledge employment facilities, we will first discuss the issues concerning the employment of knowledge. After that the knowledge management issues like distribution and maintenance are dealt with.

For our tour along the points of interest of the Intelligent Support Framework we will make use of a wide-angle lens to show the interesting points in the one-stop-shop context. For the overview of the legal practitioners wishes concerning the organisation and furnishing of his place to work, we will use a zoom lens.

2.1. Knowledge employment

2.1.1. The 'City Hall Shopping Centre' through the wide-angle lens

Starting our 'tour' using the wide-angle lens, we have an overview of the field of integrated service offerings by municipalities to citizen. The overall aim of the Framework is to facilitate the improvement of the service level of local authorities in reaction on demands of their citizens.[1]

There are different types of citizens' demands:

1. a request for information, in general
2. a request for advise, dedicated to the personal situation or
3. an application for a product, service or provision.

The ISF provides a basis for developing and installing support systems for the different 'shops' of a municipality, that may thus gradually develop towards a complete 'City Hall Shopping Centre'[2].

In their civil service tasks the local authorities are assigned the obligation by the national or regional governments to assist its citizens in either recognising or exercising certain legal rights.

Recognising a legal right often implies a knowledge intensive process of a specific (problem) type: an assessment task, to assess to what extend a right exists. Exercising a legal right and more important the assistance the municipality offers to their citizens in doing this, may involve more complex problem types. Often it entails a dedicated advice to the citizen, after careful examination of the citizen's specific needs and circumstances, a diagnosis task, followed by a configuration task for providing a dedicated package of services and products.

1) For a more elaborate discussion of the aims and backgrounds of the S2000 project we refer to Service 2000 deliverables.

2) The concept of a 'City Hall Shopping Centre' is an existing concept in the Dutch govemments developing program Overheidsloket 2000 (Governmental Counter 2000).

Requirements and instruments

For the support of all these different knowledge intensive processes the employment of supporting knowledge is required and one or more dedicated (Legal) KBSs may be put in as instruments to meet the requirements. In Service 2000 the KBSs within the ISF are constructed using the CommonKADS (or a related) framework.

We will make use of examples from the second phase of the Service 2000 project. This phase entails the development of a specific instance of a one-stop-shop system, based on the general framework's architecture. The system supports the municipal 'shop' where elderly and disabled citizens can apply for provisions and services. Their demands can be based on several national laws or local regulations, for instance the Act on (national) Provisions for Disabled[3]. The administration of this law involves a knowledge intensive process chain, consisting of a detailed analysis of the needs and impairments, followed by an advise on the right provision package and a legal assessment of the advise given the citizen's claim, specifying the necessary alterations, ordering, scheduling the delivery and drawing up the loan contract. This process chain, shown in Figure 1, is typical for an administrative law environment (i.e. the execution of administrative law, not the design and drafting of administrative legislation). The supportive knowledge is also indicated. Note that besides legal knowledge also medical, ergonomical and administrative knowledge is needed.

As we saw, the Intelligent Support Framework makes a distinction between active and passive support knowledge. Here we change our lenses and put in a zoom lens, since this distinction is especially relevant from the point of view of the legal practitioner performing his job. It will help to identify the user requirements regarding an efficient place to work.

3) Dutch: Wet Voorzieningen Gehandicapten, WVG.

2.1.2. The legal practitioners place to work through the zoom lens

The cabinet of knowledge management instruments for the legal practitioner is a rapidly developing area. The Internet and intranet developments, for instance, have led to new possibilities and therefore to new insights and priorities.

We believe that, especially within the legal domain, knowledge management should take into account two different points of view: the co-operative perspective and the individual perspective. Knowledge management may then simultaneously support distribution and sharing of expertise between co-operating practitioners and registration and management of knowledge of individual practitioners.

The current Intelligent Support Framework for management and use of legal knowledge, expertise and documentation, can be regarded as part of a larger framework for the development of (software) 'furniture' for the lawyer's place to work. The larger framework should support the lawyer not only when he is working as an expert, but also when he is performing his daily routines, like:

- monitoring progress and deadlines,
- planning and scheduling of activities,
- internal and external communication, (electronic and paper mail);
- registration and invoicing hours spend;
- drafting documents;
- storage and retrieval of (both case dependant and case independent) documents.

Thus a framework emerges that is structured along three lines:

- knowledge (expertise) and information management.
- document management;
- workflow management.

The Framework's current version mainly focuses on the first one.

Through the zoom lens, Figure 2 - The legal practitioners place to work shows the structure underlying the support functionality for the legal practitioner's place to work:

Term index or thesaurus

The Term index or Thesaurus is the backbone of the framework, incorporating different ontologies. All concepts relevant for representing the framework's administrative law environment like the types of legal knowledge sources ('act', 'regulation', 'jurisprudence'), the 'processes' within the process chain, the different legal domains within scope ('health', 'welfare', 'administrative law') are themselves part of a (high level) legal ontology. The domain ontology part of the Thesaurus represents the concepts from the world of the municipality servicing its (elderly and disabled) citizens, for instance 'provisions' (like 'wheelchair', 'meals on wheels' or 'nursing'), and 'agents' ('citizen' or organisations like the 'supplier'). At top level these ontologies should be fixed, the lower levels must be maintainable.

Knowledge and information storage and use

Different types of (both case dependant and independent) knowledge and information sources can be stored and accessed. Most often the legal knowledge and information takes the form of documents; (fragments of) these documents can be linked to one or more terms of the Thesaurus. Each term thus may serve as a gateway to the attached documents, whenever the term is 'active'.

Documents that can always be found in the surroundings of the lawyer's place to work are:

- **laws and statutes**
- **case law**
- **doctrine, internal handbooks, heuristics**
- **protocols, procedures, instructions**
- **checklists**
- **case files (notes, correspondence, contracts)**
- **leaflets**

For the passive process support, knowledge that is present in a document format is activated through the activation of thesaurus terms. The lawyer is supported in gathering the knowledge and information sources that are relevant for his task, but actual reasoning is not supported. Passive support is used to display background knowledge, dedicated to a specific process.

Clearly we have come to the field of 'retrieval' [Bing, 84] [Salton, 89]. The 'intelligence' of the ISF retrieval is still limited. Current limitations are for example the facts that full text retrieval is not implemented, query expansion is handled by allowing the user to browse through the Thesaurus, manual maintenance of the Document Base and Thesaurus. The intelligence of the retrieval process may be improved in a next version of the framework, along the lines sketched by many people working in the field of AI (and Law), especially working on intelligent retrieval using ontologies [Mauldin, 91] [Wildemast & De Mulder, 92].

For active process support, knowledge must be present in the format of a knowledge model within a Knowledge Based System. The system not only activates the applicable knowledge, but is also able to apply the knowledge, resulting in for example the conclusion of an assessment task.

2.2. Knowledge management

2.2.1. Knowledge management in general

Management of knowledge within the local government environment is dependant of many factors, like: the constitution of the state and the basics of the legal system (civil law or case law), the organisation, the strategies for workflow-management [Swets et al, 96] [Verhoef & Joosten, 96]. The government as an organisation dealing with its productive machinery, where knowledge is regarded as one of the means of production; it is a recent model, that the 'knowledge manager' may handle to structure his work.

Knowledge management then entails:

- knowledge planning and control;
- knowledge quality management;
- knowledge acquisition;
- knowledge distribution and knowledge sharing;
- knowledge maintenance.

For each of these management issues either a centralised or a decentralised strategy can be applied. On the one hand quality standards and a proper amount of central control are needed, on the other hand the proper amount of flexibility and self-organising mechanisms is needed to ensure workable and realistic knowledge management solutions [VNG, 91].

Within the ISF some instruments are present for knowledge management, i.e. instruments for distribution, sharing and maintenance. The other knowledge management fields are dealt with once an actual one-stop-shop system is designed, using the framework as a skeleton. During the design process it is for example determined what knowledge must be incorporated in the system. After that other decisions must be made: what knowledge sources are available, in what form will the knowledge be incorporated, what quality criteria must be met when the knowledge is applied. These choices are dependant of for instance, the future user profiles (educational level, experience), the (in)stability of the knowledge and the (in)stability of the organisation. Highly formalised knowledge can be used for automatic application. This is useful for the support for non-scholar professional user, or in environments where a high quality or uniformity level is required. Yet, the costs, for formalisation and maintenance of the knowledge are high.

2.2.2. The management of (legal) knowledge intensive environment through the wide-angle lens

In the municipalities administrative law environment, most processes are in fact 'execution of legislation'. Because of this, general principles of justice act as quality requirements for especially the KBSs, the Thesaurus and the Document Base contents [Dunné & Kottenhage, 94].

Principles of justice – like: equality before the law, legal security, the right for appeal, principles of proper administration – have consequences for the contents and version control of knowledge bases. Such principles also have their implications for the weight of costs and benefits of the knowledge formalisation process.

Examples of functionalities that can deal with the knowledge maintenance requirements are: proper version control of knowledge bases, making use of alternative knowledge sources (like: a KBS using case based reasoning techniques, that contains more recent case law as a way of bridging a period in which maintenance of the knowledge base is done). This last solution has the advantage that the alter-

native knowledge source, can also be used as a general verification tool, providing a 'second opinion' for a specific case.

2.2.3. The management of the legal practitioners knowledge environment through the zoom lens

Using our zoom lens, travelling at relatively high speed, we give a brief overview of the individual's knowledge management needs and instruments.

For the legal practitioner efficient management of knowledge and documents is vital. The ISF offers functionality to:

1. add a document to the document base;
2. link the document or fragments of it to one or more terms in the Thesaurus;
3. add or delete Thesaurus terms;
4. link Thesaurus terms together.

These functionalities enable the user to activate background knowledge and (personal) experience during a specific process. Especially when the user can (is allowed to) store and retrieve case dependant documents (like memorandums of oral pleading, contracts, formal decisions, notarial acts, correspondence) the framework is used for building and maintaining a personal centre of expertise and helpdesk. Furthermore the Thesaurus can be used for storing information about a specific term, describing all it's properties. The term 'supplier' for example, may be linked to many instances of suppliers, stating their names, addresses, opening hours. Thus the framework may be used to create a personal or team 'Baedeker' for a certain domain.

3. The functionality of the Intelligent Support Framework

After an overview of the context of the Intelligent Support Framework we now switch to an engineering point of view, to describe how the knowledge employment and management requirements as described in the previous chapter, are dealt with by the actual system.

The Intelligent Support Framework offers the end user two main functionalities when it is running in operational mode:

1. Providing information about the provisions present in the system;
2. Supporting a care demand or application for services or provisions.

The way the ISF operates to offer the two functionalities is determined by the profile of the user and the channel he uses to communicate with the system. The ISF will only provide information and support tasks to whom the user is authorised, to the end user it seems that all not authorised possibilities aren't even part of the application he is interacting with.

The way the interaction with the system takes place is determined by the level of experience of the user and the possibilities of the medium used. A more experienced user will be offered a more complex, but efficient interaction while a less experienced user will be guided step by step through the system. The extent to which multimedia features are used is determined by the possibilities of the medium used, which can be for example a dedicated program on a personal computer, a point of information in a public area, the Internet, a voice response system, teletext on demand, etc. Next to the operational mode, the ISF also has a maintenance mode, which enables an application administrator to add and modify knowledge present in the ISF. The framework will adjust the way it fulfils the operational mode based on the knowledge entered in the maintenance mode.

3.1.1. Primary and secondary information providing

The ISF has two ways of providing information. The first way is primary information providing, meaning providing information on request of the user. The framework will guide the user from a first inquiry via general information classes to the desired information topic. An information topic is a term from the domain ontology (e.g. a wheelchair or a taxi-service). From the domain ontology terms links are present to documents, where information can be found, such as a description or a reference to a brochure or leaflet. Also a link to other domain ontology terms can be present, like an organisation to refer to. What information about a topic will actually be shown depends on the type of user. A citizen will only see public information, a civil service worker will also see information like internal information bulletins.

The second way the ISF provides information is by 'spontaneously' providing information about the task at hand or about the questions the system asks the user while performing another task than primary information providing. This information can give the user an explanation of the reason why the ISF asks a question, provide background information about the context of the question or give information about the task at hand, like the protocol for this task or the related law. Since the secondary nature of this information, it is the choice of the user whether or not the actual information in the related topics is looked up.

Secondary information is thus provided by a combined use of a domain and a legal ontology specifying information topics, and a system ontology that enables activation of the right system components to provide the information.

3.1.2. Passive and active task support

There are two ways the ISF can support a task, passive and active. Active support means that a Knowledge Based System (KBS) realises the support. This systems has the initiative, it leads and guides the user through the task by asking for relevant input and by presenting one or more outcomes. An example would be an assessment of the suitability of a provision for a citizen. By asking (case dependant) questions about the citizens conditions and environment the KBS could conclude what package of provisions would be the most suitable solution. This conclusion will be presented to the user and used as input for a next task.

Passive support means that the user has the initiative, and the support functionality takes the form of a (case independent) checklist or an instruction that are 'simply shown'. The conclusion of the user will be asked, registered and used as input for the next task.

Passive and active task support – like information providing – stools on the activation of concepts in the domain and legal ontology (especially the process at hand) followed by activation of the system ontology concepts.

3.1.3. Applying the right knowledge

When a certain task is supported by multiple Knowledge Based Systems (KBSs) the ISF will select one of the KBSs for primary support. This KBS will be allowed to ask questions to the end-user in order to fulfil its task. This selection of KBS is case dependant, meaning that the KBS is chosen that is most likely to succeed for this case. When a selected KBS fails an alternative KBS will be executed. The framework will see to it that the second KBS will not ask questions that are already asked by the first KBS. When a KBS succeeds the ISF will execute all remaining KBSs without allowing them to ask questions. If those KBSs succeed, the ISF will have multiple outcomes for one task. The user will be asked which one to use for the next tasks. The advantage of this approach is that incomplete or partially outdated

knowledge can be compensated by other KBSs that contain (partially) overlapping knowledge.

3.2. The implementation of the Intelligent Support System

The Intelligent Support Framework is a framework for public information and service support system. Because it is a generic framework that has to be implemented at several locations, the technology used to implement the framework must be flexible enough to cope with any size or environment. Since public information and services tend to change frequently due to changes in legislation and service offerings, a system based on this framework must be highly maintainable. The technical architecture must guarantee the scaleability and portability of the framework. The functional architecture and the technical architecture together must guaranty the maintainability of the system.

3.2.1. Architecture

Figure 3 - Main building blocks gives an overview of the building blocks that together make up the ISF.

Knowledge Broker
As the supervisor, the Knowledge Broker has control over the co-operation and communication of the building blocks and external applications. The Knowledge Broker routs input it receives from one building block to one or more other building blocks. In the background, it constantly monitors the overall process.

Interaction pre-processor
The interaction pre-processor is an application dedicated to a specific type of interaction with the user. It makes sure that there is a strict distinction between content and form of the communication process. This is necessary in order to define a general framework, that provides a valid basis for a specific system. Different one-stop-shop systems may have many different user types and will have to operate in many different types of environments.

Thesaurus
The ISF Thesaurus covers the structure and contents as described in the previous paragraph about the legal practitioner's place to work. It incorporates both a domain ontology and a legal ontology, that are both fixed at their highest levels, but that can be adjusted for a specific environment at lower levels. For the domain and legal terms, information about security and privacy and the relation to external data models, may for instance be present. Also information about relevant documentation may be part of the Thesaurus' contents for these terms.

Next, the ISF Thesaurus incorporates a system ontology part. It defines the concepts relevant for the implementation of the framework, it's building blocks and their specific properties, like the Document Base, Knowledge Based Systems, Interface Preprocessor or Case Bases. For the system ontology terms, the information stored in the Thesaurus may be information about versions and last updates. The system ontology part of the Thesaurus is also fixed.

Finally, part of the ISF Thesaurus serves as the Information model of the ISF, containing 'current' information about a particular case, like information about the client or the provision at hand. This part of the Thesaurus is again fixed for a specific one-stop-shop system. The terms in the Thesaurus can be linked to objects outside the Thesaurus. Those objects can either be objects within a KBS or within the objects of external applications or databases. Thus a mapping from internal to external information models can be realised, relevant for efficient data administration.

Summarising the Thesaurus at top level incorporates the following parts: domain ontology, legal ontology, system ontology, client related concepts.

KBS
A KBS is an application within the ISF that supports or executes knowledge intensive processes. There can be one or more KBSs present within a specific Intelligent-service-shop System. The architecture of KBSs (even within one system) can be very different.

A KBS may contain explicit knowledge about the domain and the inference processes[4]. However, another KBS may show a Case Base Reasoning architecture leaving the knowledge implicit, but using historic or previously processed cases to reason with, in order to reach a conclusion for a new case.

4) These explicit models will be based on the CommonKADS 'paradigm'.

Document base
The Document base incorporates all documents that may be useful for the users. Examples of possibly relevant documents are shown in the figure, like for example: laws, regulations, jurisprudence, leaflets, handbooks and checklists. In the Thesaurus links exist between Thesaurus terms and documents in the Document base.

Security & privacy gateway
The Security & Privacy gateway is the part of the ISF that guards the communication between the internal and the external world of the ISF and checks for privacy sensitivity of data that is being communicated.

Interface to external application or database
The Interface to external applications or databases is a separate application, for the same reason a separate Interaction Pre-processor is identified in the ISF. The Interface communicates with the external applications and first makes translations, if necessary.

4. Discussion

Returning to the two issues that where identified as the main challenges of the Service 2000 we first state that making use of ontologies as a method to represent knowledge helped to overcome the problem of common knowledge versus differentiated knowledge. Not only do ontologies enable modular and relatively understandable representation of knowledge. Concepts within the ontology can easily be typed as being either common or specific, thus enabling a clear demarcation between the general framework's part of the ontology (the fixed parts) and the municipality specific parts of it (the maintainable levels). Maintenance can be done by the local administrator or knowledge experts.

The second challenge, to realise an operational system, based on a general framework, was tackled by introducing the 'engineering view' in the Thesaurus: the system ontology and client related parts of the Thesaurus. The strategic knowledge necessary to make the different ontologies co-operate in an effective way, is incorporated in the Knowledge Broker combined with it's close relation to the system ontology. The Knowledge Broker enables the system to 'activate' a structure consisting of both legal ontology concepts and domain ontology concepts. Given the structure, the Knowledge Broker will activate the proper system ontology concept in order to invoke the proper system response, like showing a document, starting a dedicated KBS or activating a next step within the process chain. Thus a flexible framework is established. A framework that will be reusable to build operational systems in different environments, that may vary in their administrative and technical organisation and the (legal) knowledge they apply.

When comparing our legal ontology with other legal ontologies, like Valente's Functional Ontology [Breuker et al, 97] or Frame-Based Ontologies of Visser and Van Kralingen [Visser & Bench-Capon, 97], we conclude that the legal ontology present in the Thesaurus covers only a part of a full sized legal ontology. The ISF legal ontology merely identifies the different areas of legislation and policy that are relevant for a specific administrative task of a municipality, and within each area the relevant legal knowledge sources. The ISF legal ontology, being part of the framework, does not model the contents of these legal knowledge sources; it's aim is merely to identify them, and provide an 'entrance'. When a operational system is developed, a task specific legal ontology would be needed to model the knowledge present in a KBS dedicated to task specific support. Only then explicit identification of for example 'norms', 'acts', or 'responsibilities' becomes relevant.

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