Structuring Business Models in a Web Representation

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Abstract

In the context of knowledge-intensive work, making the relevant knowledge available to the people needing it for their work is a key issue. One approach is to capture such knowledge in business models and to make them accessible in a Web representation in the Internet or a company's intranet. Still, the question remains of how to structure models of knowledge-intensive processes appropriately in a Web representation. We have been dealing with this issue in several real-world applications of our modeling approach and its supporting tool. Based upon hypertext structured according to object-oriented principles, we have tried templates and patterns, and developed a unique "pattern" of patterns for pattern languages. In effect, this led from lower to higher level structures, and included both internal and external structure of business entities and processes.

1. Introduction

When work complexity is high in the given work setting, people need much knowledge to get their job done. In such business areas, experienced employees are the true asset of the organization. Therefore, fluctuation of employees raises serious problems:

- When experienced people leave the organization, important knowledge about their work processes may be lost.
- Making new employees familiar with the daily work processes (especially more knowledge-intensive ones) is costly and time-consuming.

While there is no silver bullet for solving this issue, *corporate knowledge management* (CKM) addresses it, among other things, by maintaining an explicit *organizational memory* (OM). Ideally, the OM would store the relevant knowledge and make it accessible to the people needing it for their work.

For the creation of such an OM, *business (process) models* of such work processes are needed. Unfortunately, the usual approaches to business modeling focus primarily on managers and/or analysts. The resulting high-level models are typically used by the management for changing the business rather than by the people for running it.

In this paper, we propose to create and use a business process model as an organizational memory to be used by the employees, i.e., the people supposed to work according to this model (including management, but not exclusively). We focus on the knowledge management issue of making this *implicit* and *tacit knowledge* [16] of the business *explicit* (through *externalization* [15]) and accessible to the people. When people have an OM with an explicit and easily accessible representation of the business process model available, according to which they are supposed to work, they may have a better basis to do so and more ownership of these business processes and also their changes.

We actually built such a business model. The goals of this work were to have

- a complete and consistent description of the processes in the given business area;
- a definition and description of the "business functions";
- a representation of the various links among those entities; and
- accessibility by all the people working in this business area through the intranet.

For building this application, the knowledge-acquisition approach to convert tacit knowledge to explicit knowledge was object-oriented modeling. In contrast to diagrams like UML (Unified Modeling Language)[1], that may not be well

[1] The standardized specification of UML is available at the time of this writing at `http://www.omg.org`.

Proceedings of the 36th Hawaii International Conference on System Sciences (HICSS'03)
0-7695-1874-5/03 $17.00 © 2002 IEEE

understood by all kinds of employees, we supported it with a hypertext/hypermedia tool, where the hypertext structures are organized in classes, subclasses and instances. In the hypertext, at least the text should be understandable, and the structures should be understood intuitively. Any kind of files, including documents and sound, for instance, can be attached to such hypertext nodes. Since several people have been working on this knowledge acquisition task concurrently, we defined a priori a *template* according to an object-oriented metamodel. The resulting hypertext is fully automatically exported to a Web representation (in HTML and using ASP scripts), where it is accessible in the company's intranet. This Web representation provides easy and current *access* for the people to the OM (supporting *internalization*), which helps to improve the efficiency of their work.

In other applications of our approach, we used *process patterns* as an alternative means for imposing higher-level structure on business process models. Since they only provide for structure internal to a process, we defined also an external structure for a business *pattern language*. Generalizing from it, we created a "pattern" of patterns, which was both useable and useful in several applications.

This paper is organized in the following manner, with a focus on building such an organizational memory made of business models. First, we sketch our approach to knowledge modeling. Then we elaborate on the use of this approach for the externalization of tacit business knowledge in order to build the organizational memory. We also illustrate its form as given in our company's intranet. After summarizing a few lessons learned from this application, we show an alternative way of structuring models based on patterns in other real-world applications in two external organizations. In this course, we define a "pattern" of patterns in pattern languages. Finally, we discuss the various structuring approaches used and relate our work to the literature.

2. Our Approach to Knowledge Modeling

Basically, our approach to model the business knowledge in this project was object-oriented modeling. Usually, object-oriented models are represented in a graphical notation, the standardized and most widely used one now being UML. Still, however, many people outside of object-oriented software engineering are not really familiar with UML diagrams. So, representing the OM in UML would have involved the risk that many people simply were not able to understand its language and, therefore, also not its content.

Instead, we used our own hypertext-based approach RETH (Requirements Engineering Through Hypertext), which was originally developed for acquiring and representing requirements. So, we need to review some of the features of this tool and its supported method. RETH's basic approach (and using hypertext for it) is described in [8], and the tool's mechanism for semi-automatic link generation in [10]. Scenarios, goals, domain entities, etc. are all modeled as objects in RETH. Classes and instances are distinguished, and they are described in one hypertext node each in the tool. In this way, descriptions in natural language of, e.g., glossary entries are integrated in the object-oriented structure. Classes can have superclasses and subclasses, which is useful for modeling generalization/specialization hierarchies (taxonomies). In fact, the RETH tool can make itself concrete suggestions for creating such a hierarchy. The tool also implements *inheritance* in such hierarchies. The hypertext nodes in RETH have internal structure through so-called *partitions*, which can represent object attributes, associations and aggregations. Based upon hyperlinks, the tool can make itself suggestions for associations [7].

Fig. 1 illustrates a typical window of RETH's user interface. Its left part shows a hierarchy of hypertext nodes according to the class/subclass and instance structure. Each node is either labeled with the symbol "C" for class or the symbol "I" for instance. The right part of the window shows the content of the node that is selected in the left part. Each partition of the node can be expanded (through selecting "+") or collapsed (through selecting "–"), depending on its current state in the user interface. As an example, *Scenario description* is currently shown expanded. It contains a textual description of a typical sequence of actions for requesting hardware, which includes hypertext links, e.g., to *Project leader*. Instead of text, a partition may contain attachments of any kind of file (including pictures, sound or video), which makes the hypertext actually a simple form of *hypermedia*.

RETH runs on standard PCs under Windows 95, 98, NT, 2000 and XP. The status of the tool is like that of a product (beyond alpha and beta versions), but it is not sold as such. Instead, it is used internally and in the course of consulting (also externally).

Additionally, RETH denotes a *method* supported by this tool. A process of scenario-based requirements engineering can be found in [9], which builds upon the *metamodel* of this method. It defines which objects are to be represented and which relations between objects. For example, goals and scenarios are to be represented as well as a many-to-many relationship between them. It associates in the model goals with those scenarios whose execution achieves them. As an example, Fig. 1 shows the object-oriented *link* between the scenario instance *Requesting hardware* and the connected goal instance *Hardware available* according to the association *Achieve* (as represented in the RETH user interface on the right side). This means that *Hardware available* can (normally) be achieved by *Requesting hardware*. It

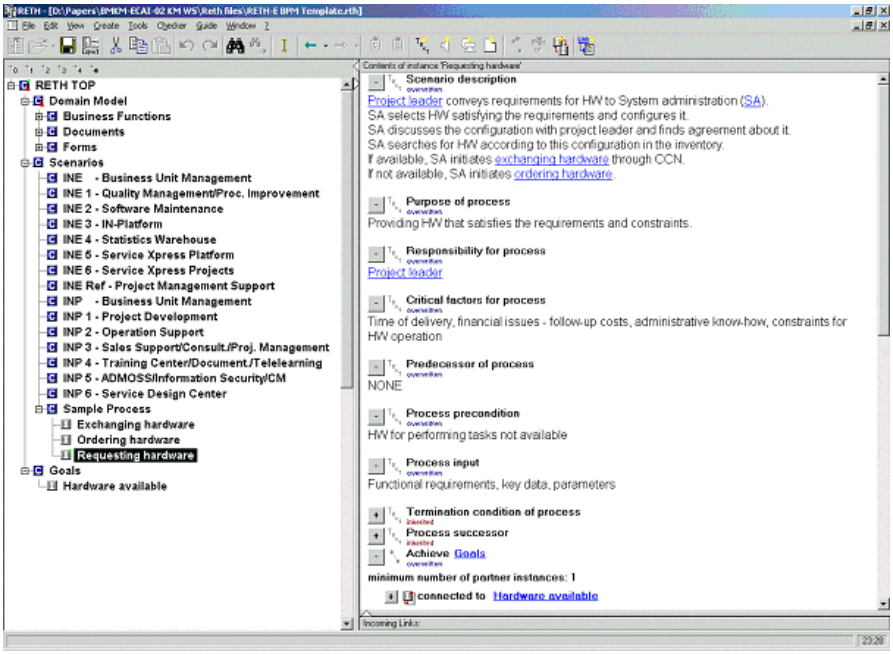

Figure 1. A screen dump of a typical RETH window illustrating the template.

can (normally) also be achieved by *Exchanging hardware*, as an alternative means.

In order to help people getting started in using the tool in a purposeful way (according to the method), we devised and implemented a *guide* [11]. Its support covers both the conceptual level to represent scenarios, goals and their relationship and the more technical level of how to do that with the given tool.

In the given project, the rationale for the decision in favor of our approach was the following:

- object-oriented modeling, which the people involved were familiar with;
- machine-support for hyperlink generation [10], which made creating links very inexpensive;
- possibility of separate development through several people concurrently, which was necessary due to the involvement of different departments;
- automatic export facility for the intranet, which was the distribution medium of choice; and
- in-house consulting (through the author of this paper), which was easily and quickly available and less expensive than external consulting.

So, object-oriented modeling was deemed to be useful, but several of these arguments relate to our tool and its underlying hypertext approach as well.

3. Creating a Business Model

Based on this approach to knowledge modeling, an OM containing a business model has been created in our environment, a large (software and hardware) systems development division of a large multi-national company. The departments involved work in the field of telecommunications. Since nearly fifteen departments have been involved, this task had to be split into pieces, one for each department and one for each of the two business units containing these departments. Creating the OM was initiated in the course of a so-called business improvement project. The main incentive for the people to model their processes was increased reputation and praise for contributing to this prestigious project.

3.1. Core structure as a template

Before the real work of building this business model was started, a small team including the author of this paper built a core structure as a *template* for several reasons:

1. providing help for getting started;
2. defining a higher-level structure;
3. facilitating uniformity of representation of the various business processes.

Fig. 2 illustrates part of this core process structure through a UML class diagram. (This diagram was automatically generated from the RETH representation illustrated

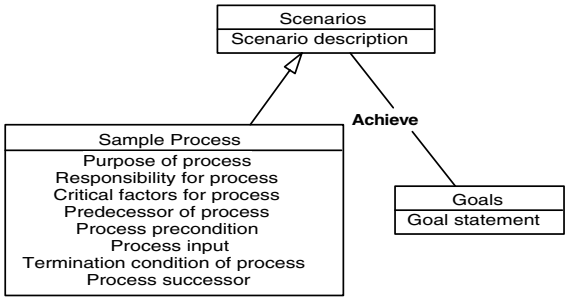

Figure 2. A UML class diagram of part of the core process structure.

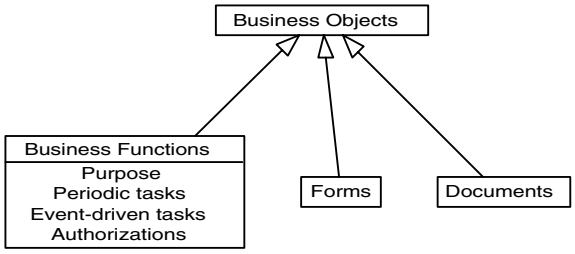

Figure 3. Classification of business objects.

in Fig. 1.) While the real process structure was defined in German, we explain it in English in order to facilitate its understandability in the context of this paper. This diagram shows that *Scenarios* and *Goals* are related to each other as sketched above for the RETH metamodel (and illustrated on the right side of Fig. 1). This relation is represented here through an object-oriented association.

Since concrete examples are usually easier to understand than theoretical explanations, this template includes a sample process as well. Fig. 2 shows that the class *Sample Process* is a specialization of the class *Scenarios*. That is, the sample process is a special class of scenarios. In the RETH tool, this is shown through indentation (see Fig. 1 again).

Based on this specialization relationship, *Sample Process* inherits the object-oriented attribute *Scenario description* from *Scenarios*. In addition, it has its own attributes like *Process precondition* for the characterization of the process. The RETH tool can show both inherited and newly defined attributes (on the right side of its window). *Sample Process* also inherits the association with *Goals*, which means that the relations between processes and their goals can be explicitly represented. *Requesting hardware* is an instance of the sample process and therefore (indirectly) of the class of scenarios (see Fig. 1 again).

Fig. 3 illustrates another part of the core structure, a classification of business objects. *Business Functions* (e.g., business unit manager or project leader), *Forms* (including document templates and check lists) and *Documents* are specializations of *Business Objects*. Only for *Business Functions*, the core structure predefines general attributes for their characterization: *Purpose* (in the business), *Periodic tasks*, *Event-driven tasks*, and *Authorizations*.

While the use of UML notation primarily served the purpose of specification, such diagrams were given to the developers of the OM as well. Still, their representation to work with was the object-oriented hypertext in the RETH tool (see Fig. 1 again, where *Domain Model* is given instead of *Business Objects*, as explained below). This was also the basis for the Web representation of the OM to be finally used.

After the template was developed, it was reviewed and internally released.

3.2. Knowledge externalization

While a few informal process descriptions existed already, the major part of the business model had to be made explicit from tacit knowledge about the daily work, which is called *externalization*. For this task, the template described above was provided for all people supposed to model the process in their part of the business area: department managers or employees which they authorized to do the job on their behalf. Due to the predefined structure and the exemplary text from the sample process, they did not have to figure out on their own in which form the processes were to be described.

The uniform and clear *structure* facilitated a uniform appearance of the overall business model. In addition, we organized tutorials for introducing those people to the approach, the template and the RETH tool even before they started their work.

After that, several people have been working concurrently using the tool, each one on his or her part. This was facilitated by the divide-and-conquer approach of partitioning the OM into parts for each organizational unit involved.

They also brought in additional information in the form of traditional documents (in MS Word or simple ASCII text), emails, spread sheets and MS PowerPoint presentations. When a traditional document already captured some of the process knowledge, it was attached to the node where it was newly structured, supporting *traceability*. Other information that is better described in various kinds of files comprised concrete forms and checklists, information about tenders, documentation about regulations and reports, etc.

After some parts of the overall process model have been more or less completed, we began to install a *glossary index* to the most important pieces of information. Since the content of the OM is subject to changes, enhancements and updates, working on this index is also an on-going activity.

Whenever significant changes have been made to the

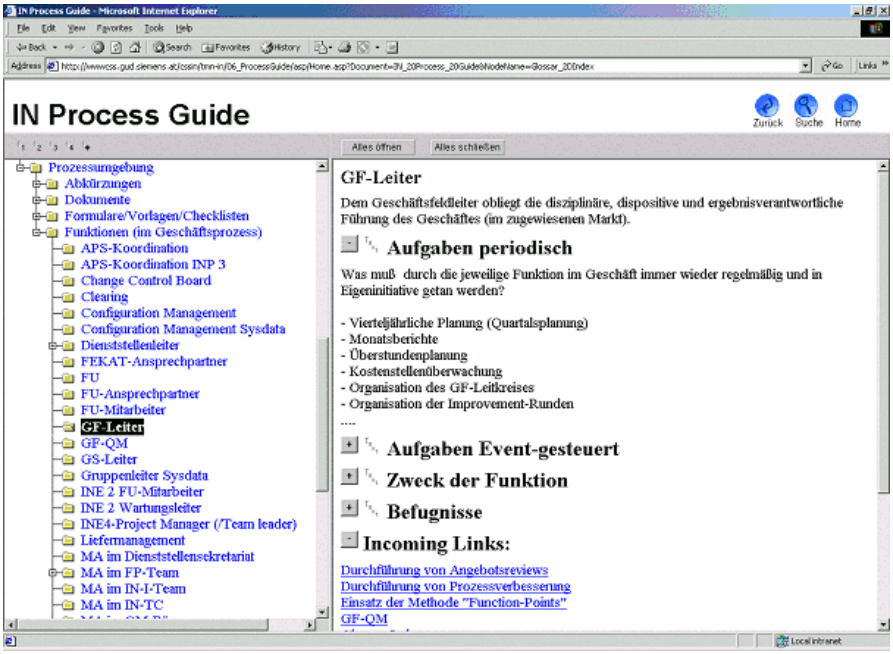

Figure 4. A screen dump of a Web-browser window illustrating a business function.

content of (part of) the OM in the RETH tool, the updated OM is made accessible in the intranet. Such an update simply involves connecting the separate parts, exporting them fully automatically to a Web representation and uploading it to the Web server.

4. The Resulting Business Model Accessible in the Intranet

In principle, it would have been possible to install the resulting business model as an OM in the form of a RETH hypertext/hypermedia repository on each employee's desktop. This would have meant, however, to make them all familiar with this tool, at least for browsing. This should not have been too hard, because RETH's user interface is similar enough to well-known Web browsers and MS Office products. But having to use yet another tool is always an obstacle to adapting to the new and unfamiliar. In addition, everyone involved would either have to get access to the same file server, or other strategies for distributing new versions of the OM would have been needed.

So, the more appropriate and timely fashion to provide access to such an OM seems to be making it available in the intranet. Since providing a machinery for direct access to RETH through the intranet would have been more expensive and was not even necessary, we employed the already existing export facility of RETH for HTML pages. In fact, this facility provides a look-and-feel similar to that of the RETH tool through the usual Web browsers (for browsing of a snap-shot only). The hypertext links in the RETH tool are just normal URLs in HTML. The explorer-style representation including the hierarchy is provided through an implementation via *active server pages* (ASP). Much as in the RETH tool itself, each file attachment is linked into the HTML representation. While most kinds of pictures are directly embedded in place, for all other kinds of attachments dedicated programs are called (based on their file extensions).

In order to give an idea of the size of this OM, it currently contains about 400 hypertext nodes (one per HTML file) and more than 60 attached files. For illustrating it, we show a screen dump from its appearance in MS Internet Explorer. While the text is in German, especially the structure should be clear from the explanations above. Fig. 4 illustrates the representation of the business function *GF-Leiter* (business unit manager) in the OM, including its glossary entry (directly below the title) and its attributes. These are the attributes (as named in German) which are defined in the core structure for *Business Functions* in general (see Fig. 3 above), but filled in with specific text.

Much effort has been spent by the developers of this Web representation to make it look much like the user interface of the desktop application (compare Figs. 1 and 4 in this respect). In fact, also the Web representation had the same icons for classes and instances as the desktop application. End users of the Web representation, however, turned out to be less interested in the fact that this indicates an object-oriented model and often did not even understand the sym-

bols of these icons. So, we made this representation configurable at the time of the export and use mostly the configuration with folder icons now as shown in Fig. 4.

While the hypertext links in the RETH tool are bidirectional (i.e., they can be traversed in the opposite direction as well), URLs are inherently unidirectional. In order to provide the same navigational options in this regard also in the Web representation, RETH automatically generates extra URLs for the other direction as well. Fig. 4 shows some of them under *Incoming Links*.

Process descriptions look much the same as business functions in this representation. While the latter are structured according to Fig. 3, however, process descriptions are structured according to the *Sample Process* in Fig. 2.

A major issue with such a representation of an OM in the intranet is finding the relevant pieces. Therefore, we offer three possibilities of *access*:

1. glossary index,
2. string search and
3. specialization hierarchy.

While the first two of them are fairly standard, the access through the specialization hierarchy seems to be unique in our approach.

Explanations of the purpose of this OM, its structure, user interface and the navigational possibilities are given in extra Web pages. These are linked to from the same page from where the OM itself is accessible.

5. Lessons Learned

According to observations, this OM has been used primarily for guidance on both rather trivial tasks (like registering for tutorials and seminars) and more intricate and important processes (like preparing and reviewing tenders). Unfortunately, we do not have experimental data about the usefulness of our approach. Still, let us summarize a few generalized lessons learned from observations and feedback:

- *Providing a template is useful.*
  First, it was not too difficult to include the already existing process descriptions for parts of the overall business process covered here. The files of the traditional documents containing them were attached, and their content elaborated and structured according to our template. This template provided both an appropriate form and helped to find missing spots in the given descriptions.

  Making the tacit knowledge about the yet unspecified processes explicit was, of course, harder. Again, however, the template served its purposes well to both help getting started and to come up with rather uniform descriptions. In particular, the template provided a higher-level structure than the object-oriented hypertext per se.

- *A Web representation of an OM makes it accessible.*
  Making the OM available in the intranet using Web technology supports its accessibility, since the users can access a central repository in a timely fashion. Still, keeping the model current requires extra effort. However, the fully automatic export facility of the RETH tool avoids the cognitive overhead otherwise involved in dealing concurrently with the model content and the technicalities of a Web representation.

- *Hyperlinks facilitate the access to definitions and can be installed easily.*
  In contrast to usual glossaries in extra documents, a glossary entry for important terms, abbreviations and acronyms is just a mouse click away through the hyperlinks. While installing such glossary links manually requires much effort, using the RETH tool allowed their automatic generation in most cases.

- *Creating the Web representation with RETH is fast and inexpensive.*
  In contrast to hand-crafting Web pages and their links as URLs, the semi-automatic link generation in and the automatic export from the RETH tool are fast and inexpensive.

- *Strict naming makes it harder but also clearer.*
  In order to make the semi-automatic link generation feasible, RETH enforces a single name space of nodes. Sometimes this makes people feel restricted, but it has the advantage of always making clear what is meant with a given name.

  There was even an additional advantage of being strict in this regard. When independently developed parts were integrated, from time to time a few name clashes occurred. Again, this caused problems at first glance. However, it helped finding out deeper problems with overlaps in related departments of the organization. It uncovered that they either used the same name for something different or, that they both dealt with the very same process.

- *Specialties of the development method and tool are to be hidden from end users.*
  While object-oriented modeling helped to achieve a clean structure of the OM's representation, end users were not necessarily interested in the technicalities of a particular modeling approach. Therefore, the node *Domain Model* is renamed to *Business Objects* in the course of the Web export, for example. In addition,

other icons for classes and instances can be used now that "hide" the object-oriented approach of development, while still keeping the clean structure.

In particular, the experience with an early prototype showed that specialties of the modeling tool should be hidden from the end users. For example, the RETH tool requires a common anchor node for installing new nodes at the top level of the hierarchy (RETH TOP). For browsing the Web representation, it is not needed, and its original purpose was not understood by some end users. Therefore, this node is not exported to the Web representation any more.

- *End users want a usable interface to the OM.*
  In general, end users of the OM want to have reasonable usability of the related Web pages, which means that attention should be paid to aspects of human-computer interaction. For example, they want to see a relevant part of the hierarchy on the left side immediately, not just a few nodes on the top level. Similarly, they want to see some content (text or a picture) immediately and not just the structure of a node. Therefore, either the glossary text or the content of the top-most partition is shown at least and immediately on the right when a node is browsed.

- *Easy access to the content of an OM is a key issue.*
  An important issue is easy access to some object in the OM, be it a document or a process description. Therefore, the entry node when getting into this Web representation is the glossary index. In contrast to the early prototype, there is string search available through an icon that is always visible on the top of each page. In addition, our approach offers yet another access path through the object-oriented hierarchy.

6. Applications in Other Organizations

Based on the positive experience with this approach, it is also used in the IST HyperKnowledge project (see `http://www.verbundplan.at/HyperKnowledge/`) in two user organizations (which is not yet finished at the time of this writing): Verbundplan, Austria and the Riga City Council, Latvia.

Instead of using scenarios as reported above, modeling is performed in terms of *Enterprise Knowledge Patterns* (EKP) [3] in this project. Each pattern chunks together a description of a problem with that of a solution, as well as other descriptions of, e.g., context, much as usual in current pattern approaches. Otherwise, the overall approach to making an OM available in a Web representation is more or less the same as described above.

One of the applications is modeling a business process at Verbundplan that deals with managing large unexpected outages of hydro pumps and their components (based on a case study of the Malta Power Plant). Fig. 5 illustrates part of this application. The left side shows the overall structure of this process, which primarily centers around process phases. These processes are described using *process patterns*. (EKP also supports other kinds of patterns, like goal and actor patterns.)

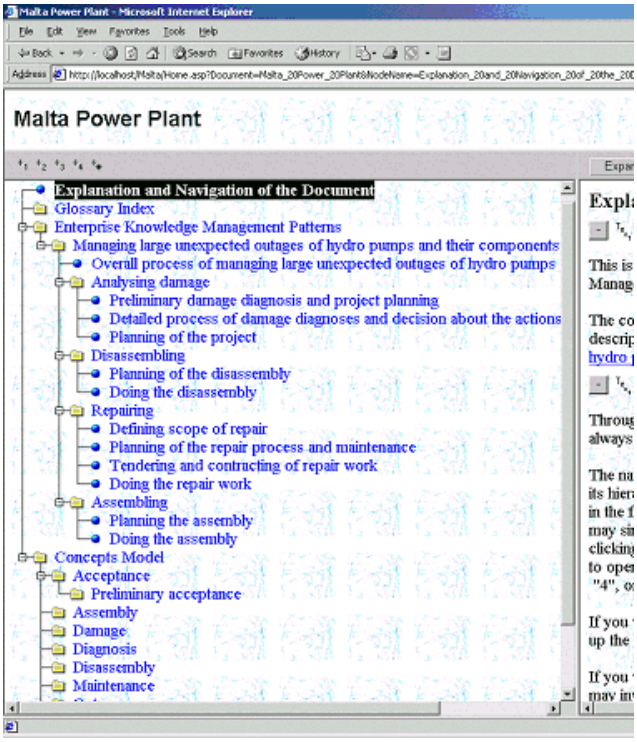

Figure 5. Process structure in an application at Verbundplan.

Based on the lessons learned from the previous application reported above, in this Web representation a folder icon is used instead of "C" for classes again. For indicating instances, a ball icon is used here instead of "I".

6.1. Pattern language

While the patterns are important, even more important is the *pattern language* [5]: it is a language that comprises patterns and how patterns are put together in meaningful ways, in a certain sequence.

If we want users of our patterns to apply them in meaningful ways, we need to present them in a structure that suggests such uses. In our approach, this was done based on object-oriented principles, but we strived for a higher-level structure of the process knowledge. In the course of developing such a structure for the Malta application, we devel-

oped a certain hierarchy of process patterns using process pattern classes. Fig. 5 illustrates the result.

For example, the class *Managing large unexpected outages of hydro pumps and their components* covers the overall process of handling the large outage of a pump in the Malta power plant. It is broken down into several subprocesses, e.g., *Analysing damage*, *Disassembling*, etc. These are again represented as process pattern classes, actually as subclasses of *Managing large unexpected outages of hydro pumps and their components*. The concrete process patterns, e.g., *Preliminary damage diagnosis and project planning* are represented as instances of these subclasses.

In order to give a high-level account of the overall process, a pattern instance named *Overall process of managing large unexpected outages of hydro pumps and the components* describes it. In fact, it specifies how the lower-level patterns are to be applied in the course of performing the overall process. In addition, the typical sequence of applying these lower-level pattern instances is in the given order from top to bottom in the hierarchy.

6.2. A "pattern" of patterns

Generalizing from this application, we can view this structure of the pattern language as a *"pattern" of patterns*. It can be characterized as follows:

- break-down of a process P into several subprocesses P_i
- P_i represented as subclasses of the class of processes $C(P)$ encompassed by P
- a high-level description of P itself is represented as an instance of the class $C(P)$

Note, that this high-level description of P is also a process pattern in this application, since it chunks problem, solution etc. together. It is just on a higher level of abstraction. Another view of this decomposition from an object-oriented viewpoint would be to model the process decomposition as an aggregation of processes. According to this ontological choice of representation, P would be the whole (aggregate) and P_i the parts. In such a representation we would have lost, however, the inheritance mechanism that the RETH tool supports for inheriting information from classes to their subclasses and instances.

In applications at the Riga City Council, we *reused* this "pattern" of patterns for structuring the process descriptions. Fig. 6 illustrates the first use in a licensing application for the Department of Transportation.

In this example, the class *Administrating Passenger Transportation Licenses Pattern* covers the overall process. It is broken down into several subprocesses, e.g., *Document submission (stage 1) pattern*, *Decision making (stage 2) pattern*, etc. These are again represented as process pattern classes and instances, actually as subclasses and instances of *Administrating Passenger Transportation Licenses Pattern*. The concrete process patterns of the first stage, e.g., *Physical person applies* are represented as instances of the subclass *Document submission (stage 1) pattern*. The typical sequence of applying these lower-level process pattern instances is in the given order from top to bottom in the hierarchy.

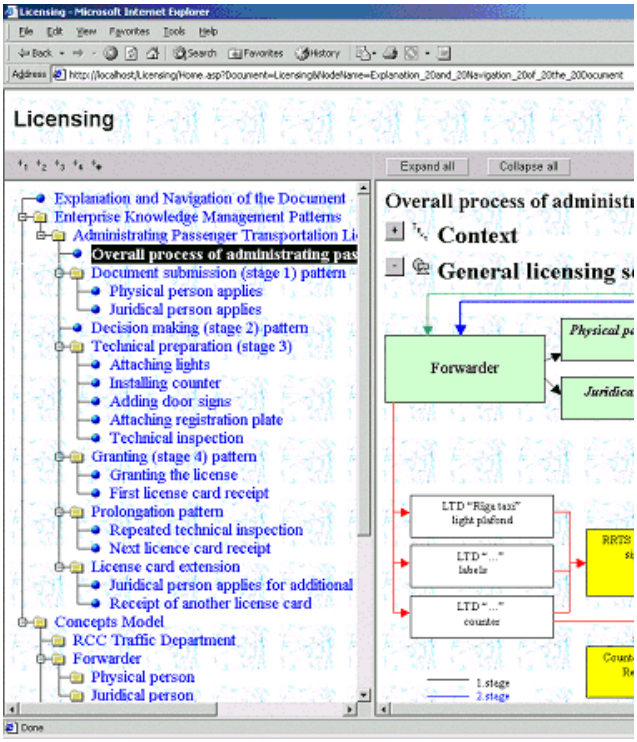

Figure 6. Process structure in an application at the Riga City Council.

In order to give a high-level account of the overall process, a pattern instance named *Overall process of administrating passenger transportation licenses* describes it. In fact, it specifies how the lower-level patterns are to be applied in the course of performing the overall process, and it does so in a flow diagram. While we have argued against using a graphical language like UML for exhaustive representation of business processes in such an application, diagrams and pictures can, of course, help to get a quicker and better understanding of certain ideas when added to textual descriptions. Whether or not such a diagram is useful for the people will largely depend on their familiarity with the notation.

In principle, this "pattern" of patterns can be applied recursively, leading to a deeper process hierarchy. In fact, this

was the case in one of the applications at the Council of Schools of the Riga City Council. For example, the overall process of service provision is described on a high level and broken down into subprocesses, e.g., for failure handling. This process is, again, described on a high level and broken down into subprocesses itself.

Note, that this "pattern" of patterns is not a pattern in the sense of chunking problem and solution together like the patterns in the language. But it defines a certain structure that can be used over and over again, both recursively and across applications. In this sense, it can be viewed as a "pattern" in the usual sense of the word.

7. Discussion of the Structuring Approaches Used

Now let us discuss our various approaches to structuring a business model in a Web representation and in particular the process knowledge contained there. Table 1 gives an overview of the structuring approaches used in our applications, distinguishing between the internal structure of some entity or process, and the external structure of organizing them and their relations.

Table 1. Overview of structuring approaches used.

Structure	internal	external
Pattern Language	—	"pattern" of patterns
Patterns	predefined attributes	—
Template	predefined attributes	predefined hierarchy and associations & links
Object-orientation	attributes	class/subclass hierarchy and associations & links
Hypertext	partitions	nodes & hyperlinks

Since the business model is made available in a Web representation, hypertext structures with nodes and hyperlinks are common. The internal structuring of hypertext nodes through partitions is more unique in our approach, however, much as using object-orientation as a means of organizing a hypertext. While taking these together provides already much more structure than usually found in the Web today, it is still rather general and low-level.

More special-purpose structuring with a focus on business process modeling was needed, and it was provided with a template in the first application and with patterns in the other. It is not yet clear, which of these approaches would be preferable in general, but note that patterns per se provide only *internal* structure through predefined attributes. Therefore, it was important to provide an approach for external structuring as well, which is the unique "pattern" of patterns.

When reflecting on this "pattern" of patterns in hindsight, however, the external structure of processes imposed by it depends in no way on the fact that the processes were themselves represented as process patterns. The very same external structure would be possible if the processes were represented, e.g., based on scenarios as in our first application. So, we may even think of it as a general high-level structure for organizing processes.

8. Related Literature

Finally, let us relate our overall approach to some work reported in the literature, with a focus on structuring based on hypertext.

Our work shares its hypertext basis with several approaches for issue-based argumentation structures, e.g., gIBIS [4], IBE [12] and SIBYL [13]. They differ among each other primarily in their argumentation framework. In contrast, our work presented in this paper does not make use of any argumentation approach but several other high-level structuring approaches.

KMS [2] makes also use of hypertext and hypermedia for managing knowledge. In addition to more usual links for cross references, KMS is strongly based on hierarchical links. This is a first step to object-oriented structuring, but our work is much more elaborate in this regard. Since it covers both specialization and aggregation, it can be used to model a domain like business processes along both these "dimensions" as illustrated by the "Process Compass" in [14]. Therefore, it also supports the navigation through richly interconnected networks of related processes and activities using such a compass. The RETH tool even automatically suggests specialization hierarchies and associations.

In the object-oriented community, scenarios are typically dealt with in the form of *use cases*, which can be viewed as classes of scenarios. In fact, use cases have been proposed for business modeling previously [6]. Our approach to business modeling is analogous from a conceptual point of view, although it is transferred from requirements engineering. As argued above, however, is does not center around object-oriented diagrams and, it has more focus on goals. According to our best knowledge, using such an approach for building an OM for CKM is new.

The approach of Answer Garden [1] for structuring an OM is quite different from ours, arranging questions in a diagnostic branching network. Our approach is, of course, more timely in providing the OM in a Web representation, which is automatically generated from its RETH representation. Making an OM with business processes available in a Web representation was presented in [17], but in the form of a workflow management system.

So, the major contribution of our work is the much more

elaborate way of structuring the OM, and on different levels. For higher-level structuring we use object-oriented modeling and patterns, and finally even a new "pattern" of patterns.

9. Conclusion

Using several real-world applications of our modeling approach, we showed how to create Web representations of business models for the people who are supposed to work according to them (and not "just" for higher management and analysts). They preserve knowledge of the various organizations involved and provide it, e.g., for new employees not yet familiar with their daily work processes. More experienced employees still can make use of, e.g., checklists and document templates in such a repository.

A major issue involved was how to structure models of knowledge-intensive processes appropriately in a Web representation. Based upon object-oriented hypertext, we provided more high-level structure using templates and patterns, and developed a unique "pattern" of patterns for pattern languages. The latter facilitated reuse of a high-level structure for organizing process knowledge. In summary, we dealt with structuring at lower and higher levels, and both with internal and external structure of business entities and processes in a Web representation.

Acknowledgments

We would like to thank the RETH development team for all the effort and dedication to develop this tool as well as its Web export, especially Mario Hailing, Vahan Harput, Stefan Kramer and Yong Wang. We also acknowledge the hard work of those creating the Web application in our company as presented here, especially Gerhard Hackl and Sonja Hofbauer who contributed in designing the core structure. Mario Hailing, Vahan Harput and Paul Johannesson provided useful comments to an earlier draft of this paper. The ongoing applications in the context of a trial project named HyperKnowledge are supported by the European Union under the contract number IST-2000-28401, see `http://www.verbundplan.at/HyperKnowledge/`. The process structure for dealing with the Malta Power Plant application was developed together with partners from Verbundplan. The resulting pattern of patterns was applied together with partners from the Riga City Council.

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