PATTERNS AS REUSABLE FRAGMENTS OF KNOWLEDGE

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Abstract: Patterns help to document and reuse existing knowledge. The main goal of the thesis is to formulate methodology for managing patterns. One component of methodology is a software system called pattern management system. Pattern management system can be developed based on the extension mechanism of UML and the topic map technology.

Key words: knowledge management, reuse, patterns, pattern languages, topic maps, meta-CASE, UML

1. INTRODUCTION

The main goal of the thesis is to formulate methodology for managing patterns and projection of a software system called pattern management system (PMS). That tool must allow to create, store and search patterns, integrate them and choose the best if there are alternatives.

[1] defines the concept “knowledge” and stresses, that: “Capturing and codifying procedural knowledge and tacit knowledge of valuable long-term employees is now a major information system issue.” It is the mission of knowledge management that has been defined for example in [2]. Reuse is a general method that uses existing knowledge at any level of abstraction to solve problems. Patterns allow to divide knowledge into manageable pieces. If you have knowledge about a problem and its solution then you can write it down using a general pattern form that includes among others such sections as name, context, problem, forces, solution, examples [3]. Pattern language is a set of related patterns that expresses knowledge of some domain.
In my master thesis [4] the development of PMS, that manages patterns that are represented as narratives, has been started. Patterns were used to develop that system in order to demonstrate usefulness of the patterns. Patterns that describe concepts of documents [5] were used in order to project conceptual model of the system. Patterns that describe concepts of plans and activities [5, 6] were used in order to project the system that manages information about activities that are associated with patterns. In my doctoral thesis I want to further design such system. Many patterns are also partly documented using models of some visual modeling language like UML (Unified Modeling Language). It is possible to describe a problem, the solution and examples, using visual modeling. But it is also necessary to present some components of patterns as narratives. Therefore I want to extend the PMS so that it can support the use of UML models.

According to [7] information systems development practitioners invent, combine and adapt fragments of methods to a development situation rather than wholly adopt a published methodology. It is a process that is similar to the use of patterns. Such fragments can be considered as patterns. PMS can be used to store and use these fragments.

PMS must help to carry out pattern management process. Description of this process helps to identify the requirements to such system.

2. PRELIMINARY RESULTS

Procedure to tackle the research problem described in Sect. 1 is composed of several subtasks.

2.1 Development of pattern management process

Management of patterns contains following activities:

- Creation of patterns.
- Management of licences. The idea of patterns is to make knowledge available to all interested parties. Patterns can be redistributed using OpenContent License [8]. This licence enables authors to release their work into the public domain for reproduction and modification.
- Continuous evaluation of patterns because knowledge is evolving.
- Usage of patterns.
- Promotion and teaching of patterns.

Next, the usage of patterns is described more precisely. Application of patterns (reuse) is a human problem-solving behaviour. Patterns that describe the right problem in the right context must be searched before solving the problems. For example, patterns that can be used to develop
information systems, can be identified as a result of strategic analysis. Two categories of patterns may be searched:

– Patterns that are the building blocks of the expected outcome.
– Patterns that guide the development of the information system.

Result is a list of patterns for each project of information system development. These lists are reviewed and complemented during each project.

The amount of different patterns may be large. [9] has found that time pressure is one of the highest priorities of Internet time development. Time to find appropriate patterns is limited. It may take a lot of time to find the most appropriate pattern that helps to solve the problem. It is necessary to quickly find a sub-optimal solution. [9] has found that modern methodology must describe goals and constraints but not exact rules how to achieve these goals. Therefore the description of the method for using patterns is quite straightforward:

2. Determine the constraints (for example time constraints) that you have to follow.
3. Narrow your search-space by determining the types of patterns that you want to use.
4. Try to divide your problem into smaller problems.
5. Try to search the most appropriate pattern for each problem.
6. If you don’t find an appropriate pattern then generalize your problem and repeat the search.
7. Decide for each found pattern whether it solves the problem in the right context.
8. If the pattern has appropriate problem and context then you have found what you are looking for.
9. Search for more patterns if your constraints allow it.
10. If you have found many patterns that help to solve the problem, then choose the best solution or try to narrow your search-space. Use some decision method, like Saaty method [10], to choose the best pattern.

Criteria that help to choose the best pattern have been developed:

– How well does this pattern solve the problem in this particular context?
– How profound is the documentation of the pattern?
– How many successful and documented applications does this pattern have?
– How many implementation details about solutions are available?
– How general is this solution?
– How quickly is this solution understandable?
– How widely has this pattern been published?
– How much experience does local organization have about this pattern?
– Is it an isolated pattern or part of a bigger pattern language? It is better to use patterns that is part of some pattern language, because it helps to find related patterns (problems).

2.2 Development of PMS

PMS contains a Meta-CASE tool, that allows to extend the metamodel of UML. PMS also contains a database where additional information about patterns is stored. UML allows to describe the structure of object-oriented design patterns using the modeling element “collaboration”. But representation of patterns in the UML 1.4 has some limitations:
– It is only possible to describe one component (part of solution) of one type of patterns (object-oriented design patterns).
– It is not possible to describe additional components of the pattern.

UML 1.4 permits to extend itself by built-in extension mechanisms, that allows new kind of model elements to be defined. PMS can be built using the profile for patterns. Goals of patterns profile are:
– Allow to use visual modeling tool for managing patterns.
– Allow to describe components of patterns using visual models.
– Allow to associate narratives with model elements.
– Contribute to the creation of register of patterns.

Patterns profile must define new model elements (in brackets are existing model elements that are the foundation for new elements in the profile):
– Pattern language (package).
– Pattern (package).
– Association between pattern languages (permission).
– Association between patterns (permission).
– Components of a pattern:
  □ Problem (package).
  □ Solution (package).
  □ Example (package).

Other components of patterns can be defined using tag definitions. It is necessary to associate constraints with tag definitions and packages to determine which pattern components are required. Hierarchy of pattern profiles can be created because patterns have some common components but patterns of different domains can also contain additional components. According to [11] extensions must not conflict with or contradict the standard semantics of UML. Each model element can be owned only by one package. Packages can access and import model elements that are in other packages. Problem is that there may also be generalization and aggregation
relationships between patterns. One pattern can also be part of many pattern languages.

Another component of PMS is a database, which contains additional information about:

- Events that have happened with the pattern.
- References to information resources about the pattern.
- Licences to use the pattern.
- Results of reviews of the pattern.
- Parties, who are interested in the pattern.
- Experts, who can review or complement the pattern.
- Profiles of experts and other interested parties.

Functions of PMS, that need further investigation, are searching of patterns, identification and integration of similar patterns.

Topic map is an ISO standard for describing knowledge structures and associating them with information resources. Single patterns and pattern languages can be distributed as topic map documents expressed in XTM (XML Topic Maps) syntax [12]. Topic maps can be used in order to describe patterns at different level of abstraction:

- Pattern domain level, that describes important concepts and associations of pattern domain.
- Pattern language level, that describes pattern language.
- Pattern content level, that describes the content of a pattern. For example it could describe important concepts of a problem or a solution domain.

Topics at each level are associated with topics at the same level and with topics at the neighbouring level. Associations and associated topics provide additional context for users. Topics can refer to information resources about patterns that are in different formats and in different locations.

Transformations between topic maps and models that are produced by CASE tool are needed. Some CASE tools allow to save their models as documents expressed in XMI (XML Metadata Interchange) syntax. Then it is possible to use XSLT (eXtensible Stylesheet Language: Transformations) to convert them to XTM documents using additional information from the database of PMS.

Experts can develop many topic maps about patterns and therefore provide different “views” to different users. Views can be created using profiles of users.

In the future there might be many PMS's and a central register of patterns that contains the latest information about all the patterns. If new pattern is created then it will also be sent to the central register using XML as communication language. One function of the central register is to search similar patterns or pattern languages and integrate them.
3. CONCLUSION

Patterns allow to divide knowledge into manageable pieces. The main goal of the thesis is to formulate methodology for managing patterns and projection of the software system called pattern management system (PMS). Projection of pattern management process and PMS has been started. Topic map technology, UML profiles and a Meta-CASE tool help to create PMS.

Future work includes the development of PMS prototype and description of a methodology for managing patterns. Methodology will be described as a pattern language.

REFERENCES