Knowledge Repository and Knowledge Mapping

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ABSTRACT
In this paper we use the concept of knowledge repositories and its uses in various applications, we have explored how to construct a strong knowledge repository, what are the fields to be considered while constructing a knowledge repository and how these knowledge repositories influence knowledgeable action. We have also discussed about knowledge mapping, constituents of knowledge mapping. Different stages of Mapping from the Knowledge Repository and the different types of mapping. We subsequently explored the factors that is to be considered while constructing the knowledge repository, we have suggested a model for DSS using knowledge repository, finally we have given a simple area where knowledge mapping can be applied with knowledge repository.

General Terms
knowledge mapping, knowledge repository, decision support systems.

Keywords
knowledge mapping, knowledge repository, decision support systems.

1. INTRODUCTION
Organized repository of knowledge consisting of concepts, data, objectives, requirements, rules, and specifications. Knowledge repositories depend on 1.artificial intelligence 2. expert system based retrieval, and 3. Human based retrieval. In AI , it takes the form of data, design constructs, couplings, and linkages incorporated in a software. In Expert system it takes the form of physical documents and textual information. An Knowledge Repository is a system that systematically captures and continuously analyses the knowledge assets of an organization. It is a collaborative system designed for a 2 way communication where people can query and browse both structured and unstructured information in order to retrieve and preserve organizational knowledge assets and facilitate collaborative working. A Knowledge repository can be basically constructed in 2 ways 1. structured 2. unstructured. A structured repository can be constructed by any RDBMS packages stored in the form of tables. In unstructured knowledge repository, the main focus tends to be on storing unstructured, explicit, forms of knowledge such as unwritten local rules and procedures. The aim is to be able to retrieve data in a context sensitive way using the simple keyword-based retrieval. Such systems might use techniques such as Social Network Analysis or collaborative filtering in order to provide the required "context" for the data. By providing context sensitive retrieval of data these systems claim to move beyond simple information retrieval and to act like a true Knowledge Management System (KMS). The term KMS is also justified by the capacity of such systems to use inference mechanisms to (semi-automatically) generate new information by filling sections of a document, proposing hints or showing reasons “why” and “why not” a certain outcome should happen.

Some potential application areas for such systems are:
(a) to identify relevant experts  
(b) to identify potential areas for collaboration  
(c) to identify Networks of Practice  
(d) to uncover hidden knowledge.

Knowledge and knowledge maps
Knowledge is the key term in knowledge management. Knowledge can be defined as a form of solution with context, experience, interpretation, and reflection. It has a rich value form of information that is ready to be applied to decisions and actions (Davenport, Pruskak 1998). The knowledge is generally defined as a dynamic human process of justifying personal beliefs as a part of the aspiration for truth. There are numerous definitions of the terms ‘knowledge map’ and ‘knowledge mapping’. Stanford (2000, 2001) defines it as follows: “Knowledge mapping is any visualization of knowledge beyond the textual one for the purpose of eliciting, codifying, sharing, using and expanding knowledge”. Graphical symbols play an important vital role in each knowledge map; their positions and relationships are mostly expressed with the use of arcs or edges. The knowledge map must show a progression of ideas with relationships, beyond their being just spatial. Knowledge maps include conceptual relationships such as the chronological, hierarchical, associative, causal, logical and evaluative ones (Stanford 2001). The solving process should contain at least four steps of the Simon’s problem decomposition, i.e. intelligence activity, design activity, choice activity, and review activity (Simon 1960). Gordon (2002) also shows that knowledge maps may be referred to as the maps of the way of acquiring knowledge. The knowledge maps are important as building knowledge tools as well as thinking tools (rogers 2000). Baron (2004) states that each knowledge map simplifies the visualization of the reality and it has to be segregated based on the attribute it exists, of the evaluation or solution of the (successfully) solved problem. A knowledge map is a special type of a reality model, for instance a reality image. According to us a Knowledge map is “A knowledge map displays, sources, flows, constraints and sinks of knowledge within an organization. It is a navigation aid to both explicit (codified) and tacit knowledge, showing the vital information and the relationships between knowledge stores and the dynamics”. (Šubrt, Brožová 2007) suggested the following classification of knowledge maps
   - Descriptive maps,  
     - Weak descriptive maps ,  
     - Strong descriptive maps  
   - normative maps ,  
   - Prescriptive maps
Descriptive maps (weak and strong) describe and simulate the real situation. Weak descriptive maps describe the real situations using different kinds of symbols and arcs connecting them. Graph theory models are typical tools for building this kind of maps. Passing through this map helps the user to understand the problem and to increase his/her level of knowledge of “how” to solve a problem. The mutual positions of objects (elements) are unimportant, only the symbols themselves and the quality of their relationships are relevant for the map reading and problem solving; not only objects, symbols or texts are important for strong descriptive knowledge maps. To be a knowledge map of this type, the item must use spatial relationships to elicit, share and codify knowledge (Stanford 2001). Such a knowledge map must show a progression of ideas with relationships beyond their being just spatial. geographical maps are typical representatives of strong descriptive maps. Normative maps are related to a typical standard or norm, to optimal solution, or to the best decision, in this case, the aim of the knowledge map is to introduce the approach of how to reach the target (solution), or how to reach the comparative norm. Strategy maps cover the major part of this knowledge map type. Strategy maps are a way of providing a macro view of an organization strategy, and provide it with a language in which they can describe their strategy, prior to constructing the metrics to evaluate the performance against their strategy (Stanford 2001).Prescriptive maps (Baron 2004) follow the normative and descriptive maps. They help to find ways to the solution selected according to the normative map. The prescriptive maps are mainly oriented on the process, not on the state or decision, so they have to consist not only of elements and branches but also of milestones.

Usage of Knowledge map for knowledge seekers . Using knowledge map in organized knowledge involves large bodies of interconnected facts. A Knowledge Map is useful for organizing related information in a structured manner that facilitates comprehension by showing the connections between the information pieces. Knowledge Maps can be used with other tactics such as Knowledge Frames, Outlines, and Analogies. When used with a Knowledge Frame, a Knowledge Map can show the structured layout of the information, while the Knowledge Frame provides the details, knowledge seekers look for Location, ownership, validity, timeliness, domain, sensitivity, access rights, storage medium, use statistics, medium and channels used, Documents, files, systems, policies, directories, competencies, relationships, authorities, boundary objects, knowledge artifacts, stories, heuristics, patterns, events, practices, activities and flows, explicit and tacit knowledge which is closely linked to strategies, core competencies and market intelligence.

Various System approach and their knowledge maps

<table>
<thead>
<tr>
<th>Knowledge map</th>
<th>System approach</th>
<th>Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mind map</td>
<td>Problem definition</td>
<td>Understanding the problem</td>
</tr>
<tr>
<td>Concept map</td>
<td>System definition</td>
<td>Quantification concepts and their relations</td>
</tr>
<tr>
<td>Descriptive map</td>
<td>Mathematical model</td>
<td>The best solution searching, model experiments, model solution</td>
</tr>
<tr>
<td>Normative map</td>
<td>Problem implementation</td>
<td>realization of chosen solution</td>
</tr>
<tr>
<td>Descriptive map</td>
<td>Model creation steps</td>
<td>Stages of creating knowledge objects in linking to university site</td>
</tr>
<tr>
<td>Evaluation</td>
<td>Knowledge object visualization and application stage</td>
<td>Knowledge map creation steps</td>
</tr>
</tbody>
</table>

Different stages of Mapping from the Knowledge Repository

<table>
<thead>
<tr>
<th>Knowledge object acquisition and extraction stage</th>
<th>Stages of creating knowledge objects in linking to university site</th>
<th>Knowledge map creation steps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge object indexing and mapping stage</td>
<td>Knowledge object visualization and application stage</td>
<td>Topics, ideas or concepts</td>
</tr>
<tr>
<td>Knowledge object generation stage</td>
<td>Knowledge object acquisition and extraction stage</td>
<td>Branches</td>
</tr>
<tr>
<td>Transformation</td>
<td>Knowledge object generation stage</td>
<td>Evaluation</td>
</tr>
</tbody>
</table>

Knowledge model overview

A knowledge model has 3 parts each capturing a related group of knowledge structures, each part is called as a knowledge category.

- Domain knowledge
- Inference knowledge
- Task knowledge

Inference knowledge
The inference knowledge contains the description of the basic inference steps. Inferences are the basic building blocks of the reasoning. Reasoning represents the lowest level of the functional decomposition.

Task knowledge describes what goal an application pursues and how these goals can be realized thru a decomposition into subtask and inferences.

Domain knowledge specifies domain specific knowledge and information type that depends on the application. Domain knowledge contains definitions and relationships. A domain knowledge can be compared to data model or object model.

Domain Knowledge

Domain knowledge describes the main static information and knowledge objects in an application domain. The 2 main key ingredients are

1. Domain schemas
2. Knowledge base

Domain schema:
Domain schema is a schematic description of the domain specific knowledge and information thru a no of type
Identifying and generating patterns is the fundamental task involved in building a knowledge repository. Some of the basic principles involved in the construction of knowledge repositories are:

1. Pattern should describe concrete solutions
2. Patterns in clusters are easier to understand
3. Patterns describing alternative solutions should have proper guidelines for choosing an appropriate solution
4. Links among patterns and other knowledge sources should be more explicit
5. Structure of patterns should not be complex
6. Patterns that use words and terms that have different meaning, create unnecessary confusion which should be avoided
7. Patterns should specify explicit purpose and usefulness of knowledge repository

Patterns in knowledge repositories fall into 2 main components.

1. The knowledge component
2. The usage component

The knowledge component answers questions such as:
- What problem does the pattern solve?
- How this problem can be solved?

The usage component answers questions such as:
- When can the patterns be reused?
- How can the patterns be reused?
- What are the consequences of using the pattern?
- Where has the pattern been used before?
- What are the consequences of using the pattern?

Knowledge repository can be constructed by using the following fields:

<table>
<thead>
<tr>
<th>Name of the field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Pattern should have a name that reflects on the solution</td>
</tr>
<tr>
<td>Problem</td>
<td>Describes the issues that the pattern addresses with the given context</td>
</tr>
<tr>
<td>Context</td>
<td>Describes the preconditions under which the problem and the proposed solution seems to occur</td>
</tr>
<tr>
<td>Forces</td>
<td>Describes the relevant forces and constraints and how they interact or conflict with one another</td>
</tr>
<tr>
<td>Solution</td>
<td>Describes how to solve the problem</td>
</tr>
</tbody>
</table>

Major issues to be considered when designing a Knowledge repository

The objective for the design of knowledge repositories are:

1. The repository should have a scalable and expandable architecture that works well under the current experimental scale as well as for the future multiple domain, multiple knowledge structures.
2. The repository should use XML based schema language to create a neutral knowledge platform for integrating and displaying multiple knowledge structures.
3. The repository should promote interoperability. It should have the capability to import other patterns.
4. The repository should be user participatory and user friendly.

Problem solving using DSS and Knowledge objects

Problem based learning is one of the most important aspect of integration of DSS and knowledge repository.
Problem solving using DSS and Knowledge objects derived from [5]

CONCLUSION

Application of Knowledge repository and Knowledge Mapping—one of the main application is to determine the ways to build the knowledge map for e.g. a knowledge map and a repository for universities using a specific information format which contains object, resource and function. The developed knowledge map helps to make links between different concepts and learning pathways which improves the efficiency in learning and collaboration. This paper primarily discusses the design and development strategy for building Knowledge Map and Knowledge repository. We would like to build Knowledge Map for a university to show how the university can utilize the knowledge map by using information searching and processing strategy. This paper will also evaluate the effectiveness of the Knowledge Map in terms of communication link between the knowledge providers and seekers in the university through an evaluation method.

REFERENCES