

Knowledge Management – The Most Likely Prime-Mover For The Next Decade

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Abstract: Knowledge provides the power for solving most of the human problems and with the influx of information in the new economy, it is perhaps the meaning of this information, which provides the key to our success. Thus, one of the main issues for our continuing sustenance in future will be the way we manage our knowledge assets. In this context, this paper relates some of the author's recent experience in knowledge system development for the maritime sector and the expected changes in developmental trends for such knowledge-based systems.

1. Introduction

The illusive human expertise is not an easy item to capture and expert or knowledge-based system development efforts have been traditionally thwarted by the difficulties in knowledge elicitation. Thus, there was no explosive growth of the knowledge-base industry during the nineties. However, with the advent of information overload through media, Internet and improved telecommunications, the need for knowledge management has steadily increased over the years. Additionally, the increase in employee turn over, rapid changes in technology and requirements for quicker learning of these new technologies have resulted in an organisational need for improvement in the way the knowledge assets are managed in an organisation.

The paper describes the benefits of developing knowledge-based systems (KBS) and traditional methods of developing such systems while drawing reference to the development of a KBS prototype on a maritime regulatory domain. Some challenges and lessons learnt during the development are also given. Finally, there is a discussion on the expected changes in developmental trends of future knowledge-based systems.

2. Benefits of a Knowledge-base System

The motivation for development of a knowledge-based system is primarily to provide an avenue for knowledge or experience capture. Traditionally, such systems could be seen to provide advisory roles and effectiveness of such systems could be evaluated by comparing the advice of the domain expert and the KBS output.

When the knowledge and the expertise required are made task specific and the same is provided as guideline for a particular task, KBS could function as

a performance support tool. However, heuristics required for performing the task should be accurately captured and represented in the KBS system.

Requirements for KBS are now increasingly felt as the rate of change of the content in a knowledge domain is much higher compared to earlier decades. Hence the need for a dynamic knowledge management platform, which could immediately capture knowledge as it is generated on day-to-day basis and at the same time provide an avenue for immediate means of using this knowledge for informed decision making.

3. Traditional Development Methodology of a Knowledge-base System

Buchanan et al. (1983) suggested a classical iterative KBS developmental model, which is shown in the Table 1.

<i>Stage</i>	<i>Description</i>	<i>Performed By</i>	<i>Followed By</i>
1. Identification	Characterise important aspects of problem. Identify participants, problem characteristics, resources and goals.	Domain experts, knowledge-engineer	2
2. Conceptualisation	Make key concepts and relations from identification stage explicit.	Knowledge-engineer	3
3. Formalisation	Identified concepts are represented in a formal language.	Knowledge-engineer	4
4. Implementation	Knowledge from formalisation stage is represented in an expert system shell	Knowledge-engineer	5
5. Testing	The completed system is tested on sample cases and the weaknesses are identified	Domain experts, knowledge-engineer	6
6. Revision	Redesign and re-implement the system, in light of the results from testing	Knowledge-engineer	1-4 (Depends on what system modifications are needed)

Table.1 KBS Developmental Stages

In a traditional KBS development environment the knowledge-engineer is expected to be very familiar with the knowledge domain. For example, in a shipyard, a knowledge-engineer is expected to be knowledgeable in the domain of estimating, ship-board maintenance, quality control or on safety related issues while developing the knowledge-based system for these domains. Such a development process is time consuming and could be a very challenging job for the domain experts as well as for the knowledge-engineer.

Apart from the familiarity with the knowledge domain, Musen (1999) identified the following duties of the knowledge-engineer during the various stages of development.

The knowledge-engineer should be able to:

- characterise the reasoning tasks necessary to solve problems
- identify the major domain concepts
- categorise the type of knowledge necessary to solve problems
- identify the reasoning strategies used by the experts
- define an inference structure for the resulting application
- formalise the above in a generic and reusable way.

The responsibilities of the knowledge-engineer may seem overbearing in the traditional KBS development methodology. On the other hand, the role of the domain expert becomes more passive following this methodology as he plays a supportive act trying to explain the knowledge domain to the knowledge-engineer. These processes may lead to instances when true knowledge representation may take many time-consuming iterative loops.

KBS development processes are different from standard software engineering development cycles and the following linear model, modified from Giarratano and Riley (1998, p.321), is being suggested.

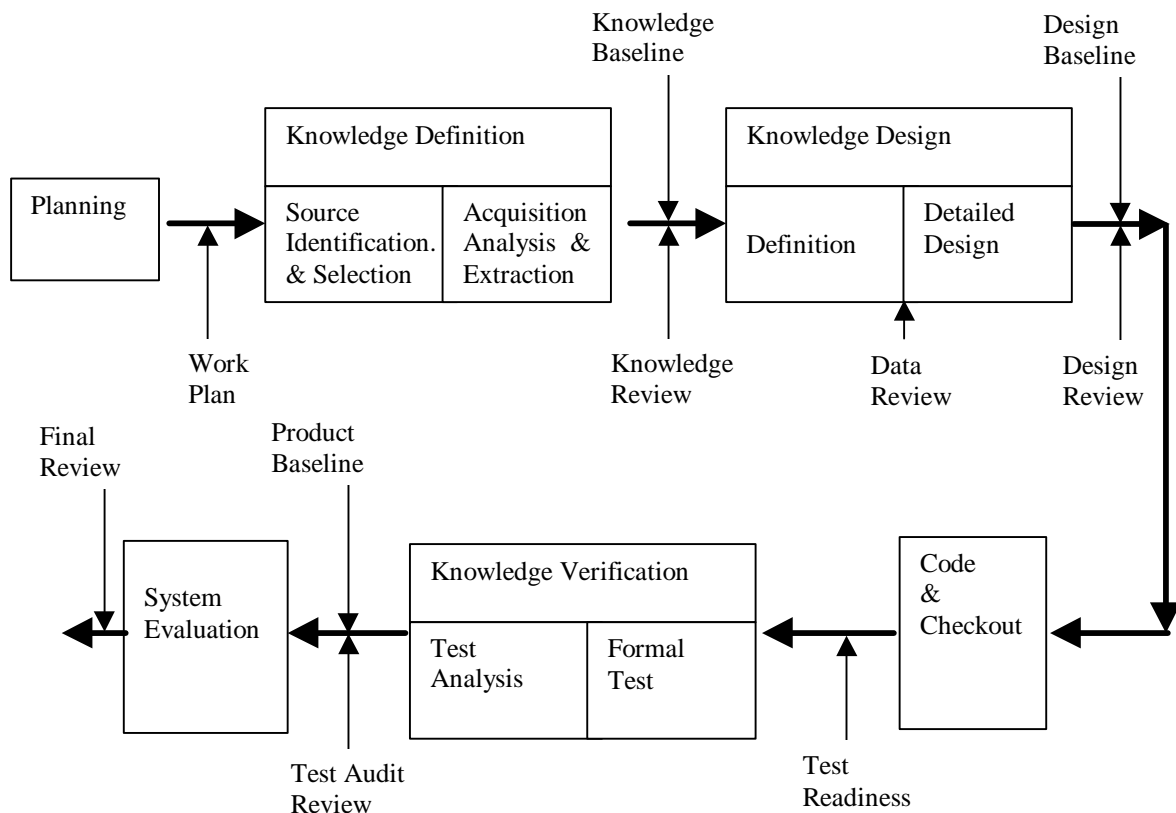


Fig.1 KBS Development Lifecycle

The development process, shown in Fig1., should be considered as a part of a spiral where each stage of development could be considered to adhere to the linear model shown. Strict adherence to such processes will ensure quality of the product developed. It is important that there is adequate commitment from both developer and the domain experts on this from the very beginning.

4. Developing a KBS on a Maritime Regulatory Domain

A KBS prototype was developed for assisting approval processes for the classification society, Det Norske Veritas. The main task flow is shown in Figure 2. using the dark arrows. The prototype is developed to provide just-in-time assistance for the approval engineers.

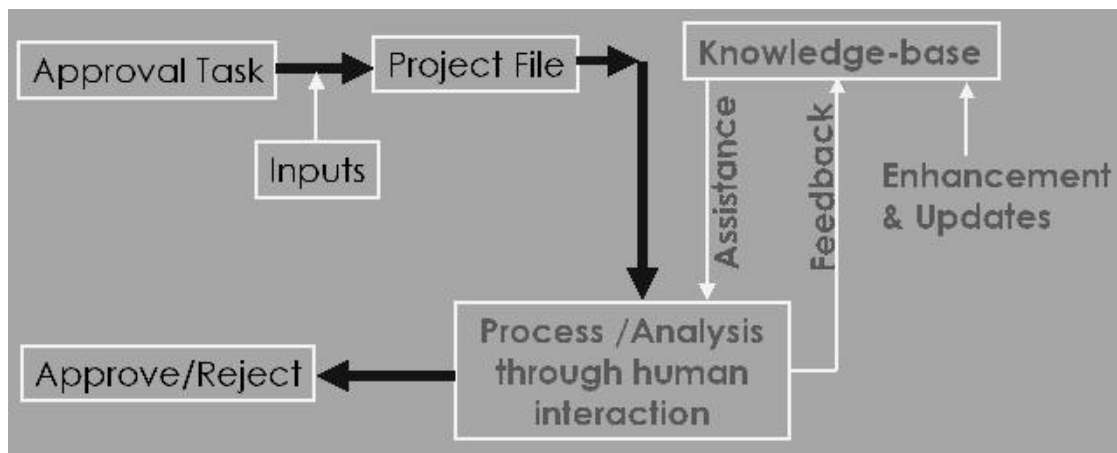


Fig.2 KBS Development for a Maritime Regulatory Domain

The guidance given in the KBS is in the following form:

- Any approval tasks is first broken down into smaller sub-tasks
- The sub-tasks are then further subdivided into more elemental issues.
- Subsequently, related examples and regulations are made available to the user for assisting in the approval processing for each of these elemental issues.

Additionally, the KBS platform could accept dynamic feedback from the users, which is used as a source of new and refined knowledge. The process is expected to maintain an up-to-date level of knowledge in the system. This is achieved by providing a section on knowledge capture, which enables users to enter comments. These comments are then saved *in context* of the task-in-hand. Subsequently, when the KBS is used for the same task, these new comments become available to the users. The new comments could be critiqued, revised and finally stored in the verified list of comments for this particular task.

Thus, over a period of usage, the KBS should be enhanced and thereby reflect the type of knowledge, which could provide useful assistance during approval work.

5. Challenges of Building a Knowledge-base System

The domain experts may initially be unaware of the potential capabilities of KBS and may not be able to assist the knowledge-engineer in identifying the areas of problem domain where the guidelines should be formulated. In such cases the knowledge engineer has to be pro-active to suggest possible scenarios where expertise could be elicited. These processes may lead to delays in the schedule of system deliverables.

As the heuristics are usually difficult to articulate, the true nature of knowledge may not be obvious and knowledge representation may be inaccurate (Durking, 1994). This could lead to the development of a system, which may appear to be simplistic to the KBS user.

Additionally, the domain expert may not fully trust the knowledge representation as the KBS developer does the coding.

The release of organisational expertise to the knowledge-engineer, who is usually from another organisation, could also pose as a sensitive issue during development.

6. Trends in Knowledge Management

The present trend in knowledge-system development is to minimise the role of the knowledge-engineer (Musen, 1999). The available tools e.g. Protégé from Stanford University (Musen, 1999), make knowledge capture much easier without involving a lot of manual programming. Therefore, in the future, one should expect more active involvement of domain experts in the actual development process. This will result in improved knowledge representation in a shorter time and with less painful knowledge elicitation. The domain experts will be able to claim ownership for the KBS developed and thus, user-confidence should be boosted.

Use of eXtensible Mark up Language (XML) is expected to support the structured information for knowledge management in the web environment.

The domain knowledge is likely to be categorised through development of domain ontologies. The ontologies are defined by Perez et al. (1999) as follows:

Ontologies aim at capturing domain knowledge in a generic way and provide commonly agreed understanding of a domain, which may be reused and shared across applications and groups. Ontologies provide a common vocabulary of an area and define...the meaning of the terms and the relations between them.

Ontologies will promote reuse in the development of future knowledge-base systems. The development of KBS would be through populating the domain ontologies with their day-to-day instances. Once these instances are available, libraries of problem solving methods (PSMs) would be made available (Swartout et al. 1999) which could operate on the instances to produce assistance for a given task.

Thus, for new KBS development, a major thrust would be to define domain ontologies and their inter-relationships, which will make various concepts and ideas transparent to different user groups, thereby promoting better business transactions.

Additionally, we would need to develop sets of problem-solving methods, which could query the instances and reason for our intended solutions.

7. Conclusion

In this paper I reviewed the traditional methods of KBS development based on my recent experience of building a KBS prototype for a maritime regulatory domain. Some of the common problems in the traditional approach were highlighted.

Development of shared ontologies and problem-solving methods will probably be the next thrust in knowledge management. Such processes would involve tedious work but should result in seamless knowledge transmissions among organisations in future and promote re-use of domain ontologies. This should result in faster and more informed decision-making and less time for KBS development.

8. References

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