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ROLE OF KNOWLEDGE ENGINEERING IN AN ORGANIZATION

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ABSTRACT

This article deals with the concept of knowledge engineering, knowledge systems, the need for a knowledge engineering methodology, the common KADS suite of models and roles of knowledge-engineering projects. It has been pin-pointed that knowledge engineering provides the methods to obtain a thorough understanding of the structures and processes used by knowledge workers- even where much of their knowledge is tacit-leading to a better integration of information technology in support of knowledge work.

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INTRODUCTION

The Industrial Revolution revolutionized manual labour. In the process, it brought about numerous new disciplines into being, such as mechatronics, petrochemical and electrical vehicle engineering, Machin learning and Data Analysis, Artificial Intelligence which laid the scientific foundation for this revolution. Likewise, the Information Society is currently revolutionizing intellectual labour. More and more people are becoming knowledge workers, while at the same time this work is undergoing a major transformation. New disciplines are emerging to provide the scientific underpinnings for this process. One of these new disciplines is knowledge engineering. Just as mechanical and electrical engineering offer theories, methods, and techniques for building cars, knowledge engineering equips us with scientific methodology for analyzing and engineering knowledge. Knowledge engineering has evolved since the late 1970s onwards, from the art of building expert systems, knowledge-based systems, and knowledge intensive information systems. These words are used interchangeably and these terminologies are also called knowledge systems. Knowledge systems are the single-most important industrial and commercial offspring of the discipline called artificial intelligence. They are now in everyday use all around the world. They are used in human problem-solving ranging from detecting the credit card fraud, speeding up ship design, aiding medical diagnosis, making scientific software more intelligent, delivering front-office financial services, assessing and advising on product quality, and supporting electrical net-work service recovery. Thus knowledge engineering enables one to spot the opportunities and bottlenecks in how organization develop, distribute and apply their knowledge resources, and so gives tools for corporate knowledge management. Knowledge engineering also helps, as a result, to build better knowledge systems: systems that are easier to use, have a well-structured architecture, and are simpler to maintain. Martin *et al*. (1996) made an empirical study in which two basic questions were addressed: (i) What are the benefits expected from the use of knowledge systems? and (ii) Are the expected benefits from an investment in knowledge systems actually realized? To answer these questions, survey data were collected from persons in industry and business, and on this basis the variables linked to knowledge system benefits were explored from the viewpoint of those working with them. The three benefits from knowledge systems were confirmed: (i) Faster-decision making, (ii) increased productivity and (iii) increased quality of decision making.

Faster-decision-making is more often felt to be a result of knowledge-system utilization than an increase either in decision quality or productivity. Thus, knowledge systems indeed appear to enhance organizational effectiveness. Although they are employed for a range of purposes, they seem to contribute particularly to the timeliness of knowledge delivery; enabling shorter time-to- market and faster customer response times. However, Martin *et al*. caution both managers and developers to carefully examine the organizational environment in which knowledge systems are to be developed and used. Indeed, the CommonKADS methodology provides special techniques for investigating this aspect.

Needs for Knowledge-engineering Methodology: The Common KADS enterprise originates from the need to build industry-quality knowledge systems on a large scale in a structured, controllable, and repeatable way. When the CommonKADS work started back in 1983, there was a little interest in such methodological issues. At that time, the prevailing paradigm for knowledge systems was rapid prototyping of one-shot applications, using special- purpose hardware and software such as LISP machines, expert system sells, and so on. Common KADS or any other software-development approach consists of a number of elements. These elements can be depicted graphically in the form of a pyramid. The methodological pyramid has five layers, where each consecutive layer is built on top of the previous one (Fig.1). But the lower layer e. g. 'world-view' of methodology is very significant in Common KADS. The Common KADS can be formulated as a number of principles that form the base-line and rationale of the approach.

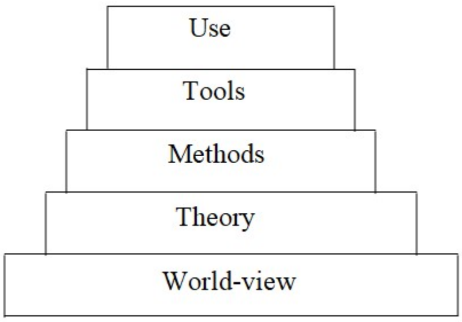

Fig. 1. Elements of CommonKADS

Thus, the CommoKADS methodology offers a structured approach. It is based on a few basic thoughts or principles that have grown out of experience over the years. Some of the fundamental principles underlying modern knowledge engineering are as under:

(i) Knowledge engineering is not some kind of "mining from the expert head", but consists of constructing different aspect models of human knowledge.

Traditionally, knowledge engineering was viewed as a process of 'extracting' or 'mining' from the expert head and transporting it in computational form to a machine. This has turned out to be a crude and rather a naïve view. Today, knowledge engineering is approached as a modeling activity. A model is a purposeful abstraction of some part of reality. Modeling is constructing a good description of only a few aspects of knowledge and leaving out the rest. Models in this sense are useful because all details of expert knowledge are neither sufficiently accessible to get a complete grip on, nor necessary for the knowledge goals of most projects.

(ii) The knowledge-level principle: in knowledge modeling, first concentrate on the conceptual structure of knowledge, and leave the programming details for later.

The knowledge-level principle, first put by Allan Newell (1982), states that knowledge is to be modeled at a conceptual level, in a way independent of specific computational constructs and software implementations. The concepts used in the modeling of knowledge refer to and reflect the real-world domain and are expressed in a vocabulary understandable to the people involved. In the CommonKADS view, the artifact design of knowledge system is called structure-preserving design, since it follows and preserves the analyzed conceptual structure of knowledge.

(iii) Knowledge has a stable internal structure that is analyzable by distinguishing specific knowledge types and roles.

Although knowledge may be complex in nature, it is not chaotic. Knowledge appears to have a rather stable internal structure, in which we see similar patterns over and over again. Conceptually, the knowledge-level models helps us understand the universe of human problem-solving by elaborate knowledge typing. An important result of modern knowledge engineering is that human expertise can be sensibly analyzed in terms of stable and generic categories, patterns, and structured functional whole, the parts of which play different, restricted, and specialized roles in human problem solving.

(iv) A knowledge project must be managed by learning your experiences in a controlled 'spiral' way.

The development of simple or very well-known types of information usually proceeds along a fixed management route. This is especially clear in the so-called waterfall model of systems development. This consists of a number of pre-defined stages in a pre-defined sequence: prepare and plan the project; find out about the customer requirements; specify and design the system; program, test, and deliver it-and in this order only. Knowledge project management follow a spiral approach that enables structured learning, whereby intermediate results or 'states' of the CommonKADS models act as signposts to what steps to take next. In the determination of these steps, the notions of objectives and risks play crucial role.

The CommonKADS suite of Models

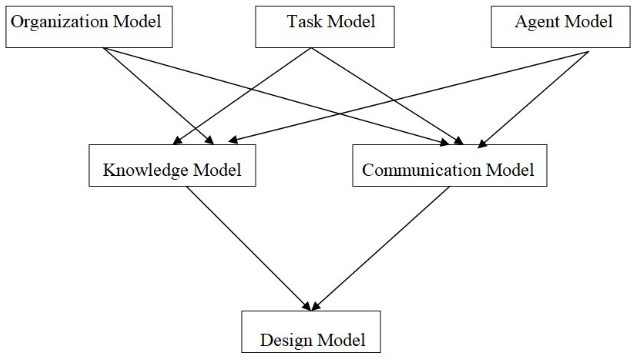

Fig. 2. CommonKADS Model Suite

Fig. 2 presents the CommonKADS model suite that is the practical expression of the above principles. It constitutes the core of the CommonKADS knowledge-engineering methodology. The figure also shows three groups of models, because there are essentially three types of questions of why, what and how to be addressed. Although CommonKADS has a pre-defined set of models, each of them focuses on limited aspects which together provide a comprehensive view:

(i) *Organization Model:* Tasks are the relevant supports of a business process. The task model analyzes the global task layout, its inputs and outputs, pre-conditions and performance criteria, as well as needed resources and competencies.

(ii) Agent Model: Agents are executors of a task. An agent can be human, an information system, or any other entity capable of carrying out a task. The agent model describes the characteristics of agents, in particular their competencies, authority to act, and constraints in this respect. Furthermore, it lists the communication links between agents in carrying out a task.

Knowledge Model: The purpose of this model is to explicate in detail the types and structures of knowledge used in performing a task. It provides an implementation-independent description of the role that different knowledge components play in problem solving, in a way that is understandable for humans.

Communication Model: Since several agents may be involved in a task, it is important to model the communicative transactions between the agents involved. This is done by this model, in a conceptual and implementation-independent way, just as with the knowledge model.

Design Model: The above models together can be as constituting the requirements specification for the knowledge-system, broken down in different aspects. Based on these requirements, the design model gives the technical system specification in terms of architecture implementation platform, software modules, representational constructs, and computational mechanisms needed to implement the functions laid down in the knowledge and communication models.

Roles in Knowledge-engineering Projects: It is important to identify a number of roles that humans play in knowledge management and engineering processes. In particular, six roles can be distinguished which significantly contribute to the success of knowledge-engineering in an organization:

(i) ***Knowledge Provider/Specialist:*** An important role in the process is played by the human 'owner' of knowledge. This is traditionally an 'expert' in the application domain, but could also be other people in the organization that do not have the 'expert' status. Bogus experts are always harmful to the organization. So, it is important for an organization to find 'real' experts.

(ii) ***Knowledge Engineering/Analyst:*** Knowledge analysis, right from the beginning, has been perceived as the major bottle-neck in the knowledge-system development. CommonKADS offers the knowledge engineer a range of methods and tools that make the analysis of a standard knowledge intensive task such assessment relatively straight forward.

(iii) ***Knowledge-system developer:*** The knowledge-system developer is responsible for design and implementation. So, the developer needs to have a basic background in the analysis methods, so that he/she can understand the requirements formulated by the knowledge analyst.

(iv) ***Knowledge User:*** A knowledge user makes use directly or indirectly of a knowledge system. Involving knowledge users from beginning is even more important than in regular software engineering projects. Automation of knowledge-intensive tasks invariably affects the work of the people involved. For designed implementation it is, therefore, important to ensure that they interact with the system with their own interface representations. Knowledge engineer also needs to be able to present the analysis results to the potential knowledge users, because the success of the implementation of CommonKADS largely depends on the understanding of the knowledge-analysis by the knowledge-users.

(v) ***Project Manager:*** The knowledge-project manager is always an in-charge of running of a knowledge-system developed project. The project manager is likely to benefit from a structured approach such as CommonKADS. The model-suite gives a powerful and flexible instrument for project planning and control.

(vi) ***Knowledge Manager:*** Knowledge manager is not directly involved in knowledge development projects. The knowledge manager formulates a strategy at the business level. He/She also initiates a knowledge development and knowledge distribution activities.

Concluding Remarks: From the above discussions and terminologies, it is obvious that for the successful knowledge management in a system, the right kind of knowledge engineering is required to be put in place. For the service of the purpose, the intensive knowledge of knowledge-systems, principles of knowledge-engineering, CommonKADS suite of models and process roles must be there with those humans which matter in the organization.

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