Ontologies and the Dynamics of Organisational Environments:
An Example of a Group Memory System for the Management of Group Competencies

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Abstract*:* Knowledge Intensive Organisations (KIOs), that is organisations built on their use intellectual capital, need to create an environment that facilitates the effective deployment and reuse of existing organisational knowledge. As people transform data, information and experiences into shared knowledge, the management of individual competencies has become increasingly important to these organisations. Knowledge gained during the normal execution of daily tasks is easily lost in the dynamic environment of modern business. The ability to find versatile employees and to be able to leverage their knowledge to meet differing corporate needs, is a matter of vital importance for KIOs. This paper describes an ontological framework focused on competence elements that are modelled as knowledge assets in a group memory. A group memory is taken to be a specific example of an organisational memory. The dynamics of group competencies as a key organisational resource is emphasised and a model for a group memory system to manage corporate competencies in a KIO is presented.

1 Introduction

The central focus of this paper is the management of corporate competencies in knowledge intensive organisations (KIOs). The goal of corporate competence management is the improved use of human skills and knowledge in an organisation. In this paper, we describe an example of a system to help achieve this goal: a group memory system for managing corporate competencies. The system described focuses on internal competencies. Here competencies are taken to mean the characteristics of an individual or group that are required to produce an effective organisational performance. In particular, the system is concerned with the competencies of the

human knowledge sources in an organisation such as previous project experiences and their related heuristics. Thus, in this context a competency is closely related to the underlying knowledge and skills needed to perform a particular task or role in an organisation.

The remainder of this paper is organized in four sections: the first discusses KIOs by characterising their specific needs. The next section describes an approach to managing corporate competencies based on the ideas of Knowledge Management (KM). This is followed by a section that presents a discussion of ontologies and context in organisational memories. This is followed by a section that describes a framework for a group memory system focused on corporate competencies; finally, we close the paper with a section that presents our concluding remarks.

2 Knowledge Intensive Organisations

KIOs employ highly skilled staff, knowledge workers, whose role is essentially one of problem solving. Solving problems in such organisations involve complex, knowledge-intensive tasks such as dealing with abstraction and uncertainty or recognising patterns of organisational behaviour. Knowledge in KIOs is a product of the expertise, experience and skills of the individuals and workgroups that make up the organisation; it is stored in individual's minds, explicitly encoded and documented in corporate information systems and implicitly embedded in organisational culture, policy and procedures. To be effective workgroups must seek to exploit examples of best practice, improve their efficiency and contribute to overall organisational learning. Workgroups in KIOs need to manage their existing skills effectively, create mechanisms to elicit new ideas and innovations, and identify relevant sources of information.

3 A KM approach to competence management

In order to develop a better usage of human competencies, skills and knowledge, appropriate organisational models and tools must be developed. This might broadly be described as a KM approach to competence management. Most of the existing systems to manage organisational competencies can best be described as traditional information systems, complemented with features that allow competencies to be stored and retrieved [Lindgren and Wallstrom 2000]. What is missing are systems that allow an effective identification, storage and distribution of human competencies across the whole organisation.

3.1 Human competencies vs. human knowledge

An accepted definition of a competency is the underlying characteristic of a person that leads to, or causes, superior or effective work performance [Prahalad and Hamel 1990]. Employees' competencies, in the form of their technical and cognitive capabilities, are closely related to the ability of a company to exploit existing, and create new, knowledge. According to Nonaka (1994), the competencies of an organisation include both tacit and explicit knowledge and should be conceived as a mix of skills and technologies. When viewed in this way, the concepts of knowledge

and competence management are closely related [Lindgren and Wallstrom 2000]. In KIOs, most daily tasks require professional expertise and the management of large bodies of data, information and knowledge. Thus, in this sense a KIO is also a competency intensive organisation.

3.2 Corporate competence management

The aim of managing corporate competencies is to enhance the organisation's ability to develop and apply the knowledge, competencies and related skills of its workforce. According to Bahrami (1996), developing versatile employees and leveraging their capabilities is a matter of pivotal importance for KIOs as their employees' competencies, in the form of technical and cognitive capabilities, directly affect the company's knowledge creation ability. The main goal of corporate competence management is a better usage of human skills and knowledge. This also aims to assist the management of repeatable patterns of action [Chiesa and Manzini 1997], i.e. the preservation and future reuse of knowledge embedded in daily workgroup activities. The following sections of this paper describe how organisational knowledge in the form of competencies or other knowledge assets can be managed and preserved.

4 Ontologies and the dynamics of organisational memories

The ontological approach applied in this research follows the recent ontology-driven KM tendency within academic and business organisations [Staab et al. 2001]. This approach uses ontologies to represent and manage both organisational knowledge containers and contents. This technique allows the representation of organisational knowledge in a way that facilitates knowledge sharing and reuse between organisational agents. An Organisational Memory (OM) seeks to preserve and manage valuable knowledge assets at the corporate level. OM building is a current endeavour for many organisations, researchers and industrial practitioners.

4.1 Ontology-driven organisational memory

Following the ontology-driven KM approach, we use the ontological discipline as a methodology to define the organisational knowledge model of an OM. To structure and maintain large amounts of heterogeneous and distributed information in an organisation, appropriate meta-level descriptions are needed to represent the higher-level layer of the OM. In order to categorise and classify knowledge for future reuse, appropriate domain-independent and domain-dependent models must be conceived. In terms of data abstraction, Ontologies are used in the first conceptual layer of the system as the means of knowledge representation (see figure 1). The main objective of the Ontological discipline is the syntactic and semantic standardisation of knowledge structures. Ontologies are used to define a shared consensual structure for the elements that form the basis of the system. As a way of representing, sharing and reusing organisational knowledge, the Ontological discipline acts as both a knowledge modelling language and knowledge engineering technique.
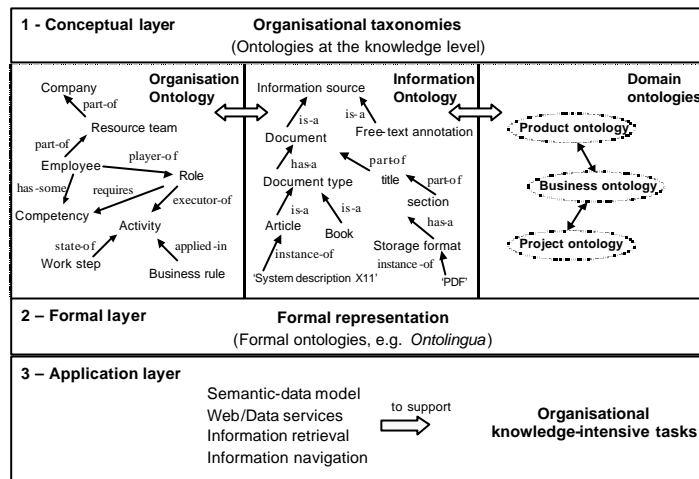
Figure 1: An example of an OM model using ontologies

Such high-level organisational knowledge description is seen as a set of definitions of context-specific knowledge representation primitives consisting of domain-dependent classes, relations, functions and objects. These primitives can be applied and represented differently in different organisational domains but should have the same meaning for human users and designers of the OM.

5 GMS Framework

People are what make organisations so complex: they have different and conflicting objectives and their perceptions and attitudes will shift and change over time. To build an effective group memory, it is necessary to address aspects of human behaviour within the organisation. The successful development of a group memory requires a careful analysis of the existing organisational work practices and the underlying information technology infrastructure.

5.1 Group Memories

To define a group memory we need to consider the work practices of the employees within the organization. A group memory (figure 2) stores the context of the personal and managerial aspects of work and encourages people to share their work practices to improve overall organisational performance.

At a general level, group memory holds data on communication patterns, information sources and the detail of shared work. The main role of a group memory is to act as a shared conceptualisation to facilitate communication between group members and to function as a common schema for software applications. Thus, a group memory supports both structurally and dynamically, a shared representation of knowledge that allows a consensual understanding of shared purposes, roles and competencies.
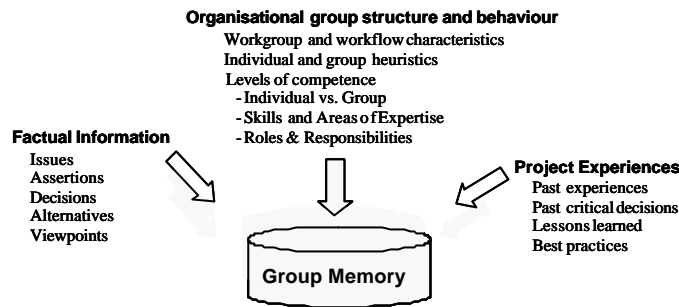
Figure 2: An example of a Group Memory

5.2 Representing group competencies

Specific competencies may differ in fine but significant detail. The construction of reliable descriptors of competencies (see table 1), i.e. the creation of a consensual model for workplace competencies, is both an organisational and design challenge.

Title	**Competence Ontology**		
Domain	Workgroup competency taxonomy and a model for expert annotations		
Creation Date	February 2001		
Modified in	June 2001		
Ontology Engineer	JBV		
Main goal	Represent a consensual workgroup structure of competencies to assist business process activities		
Scope	Portfolio Engineering - a process-oriented company workgroup		
Knowledge sources	• Domain experts • Interviews results • Questionnaire focusing in competence management • Active participation – communication patterns within the workgroup • Technical documentation		
Applications	GMS Prototype		
Users	• Corporate managers • Industrial practitioners • KM & OM researchers		
Usage Scenarios	• Profiling people • Dynamic creation of competencies within a company workgroup • Routing information needs to the right experts • Project teambuilding analysis • Expert annotation systems		
Reused ontologies	• Enterprise Ontology [Uschold et. al 1997] • Agent Ontology (*Ontolingua* Library) • Ontology of capabilities [Stader and Macintosh 1999]		
Reusable ontologies	Product Ontology		
Domain questions (some examples)	Question What competencies are needed to install a TN-16XE optical interface?	Concepts Competency, Install, Optical Interface	Relation Has-skill-of (Install, Optical Interface)
Classes specified	- 7 Classes		
Relations	- 12 Relations		
Functions	- 17 Functions		
Instances	- 23 Instances		
Logic Axioms	No axioms defined		

Table 1: A knowledge description of the Competence Ontology

At the organisational level, an employee's competency can have different levels of granularity depending on the business activity or problem-solving task. For example, a *technical* competency can be described in terms of different competencies,

such as *analysis*, *modelling* and *engineering*. In addition, each of them can be further defined by competencies such as *test*, *review*, *assess* and *analysis*. Competence granularity means a hierarchy of competencies and their areas of application that can be defined for a specific workgroup. Depending on the domain under investigation, different levels of competence granularity can be defined in a consensual manner.

6 Conclusions and Future Research

The competence management approach in this paper sees personal and group competencies of employees a key organisational knowledge asset. These may include the formal and informal communications and work conventions that come about when people work together in a co-located or geographically distributed organisation.

The initial research work focused on a specific domain concerning the telecom industry. Future research aims to define a domain-independent model to represent corporate competence elements: an ontology-driven organisational memory to manage group competencies. The idea is to define a competence model that could be tailored for KIO-based organisations. As further research development in order to test and validate this approach, the group memory system as a theoretical concept will have a more coherent result from other studies within organisational settings. It is expected that knowledge-intensive activities, such as problem-solving tasks, involving different people from different departments, geographical locations, and technical background, would benefit from access to such a group memory system.

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