Taxonomies of Knowledge

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INTRODUCTION

Knowledge management has become a major application of information technology (IT) and a major focus of IT research. Thus, it becomes increasingly important to understand the nature of the knowledge object and knowledge engineering processes. The assumption underlying this article is that in order for knowledge to be managed by technological means, it must first be represented in the relevant technology. As Sowa (1999) puts it:

Knowledge engineering can…be defined as the branch of engineering that analyzes knowledge about some subject and transforms it to a computable form for some purpose.

The purpose assumed here is the management of knowledge for organizational aims. The other key term is "analyzes knowledge"; to analyze an object, one must first describe it, and taxonomies are intended to facilitate description and analysis. A useful analogy is that of taxonomies of living creatures which employ multiple characteristics such as size, number of legs, blood temperature, and many more to assign specimens to categories.

As different kinds of knowledge require different modes of representation, taxonomy becomes the central link between knowledge engineering and knowledge management. For example, accounting data are represented as data records; routine manipulation of the data is performed employing accounting knowledge embedded in programs. Organizational use of accounting data may be mediated by expert systems, which are generally realized as a special form of rule-based programs. Thus, in order to effectively design a knowledge management system, one must first classify the types of knowledge to be embedded in it. Hence the importance of a taxonomy of knowledge. A definition of knowledge is itself knowledge; thus, this article deals essentially with knowledge about knowledge—that is, meta-knowledge.

Knowledge is a highly multidimensional phenomenon and can be studied from many points of view. Thus, Sowa's (1999) book titled *Knowledge Representation* is subtitled *Logical, Philosophical, and Computational Foundations*. The approach taken here is largely a computational one, since knowledge management is generally discussed, though not necessarily in the context of computer-based systems. Given a computerized knowledge management system, questions also arise of eliciting the knowledge to be embedded in the system; some of these are also addressed here.

BACKGROUND

Attempting to understand the nature of knowledge has been a major theme of philosophical enquiry for thousands of years. Thus, Aristotle (384-322 BC) argued that knowledge objects are made accessible to thought by assigning them to categories. This approach still underlies much of knowledge management in specific areas. It applies especially to library classification systems—for example, The Dewey Decimal Classification (Dewey et al., 2003) for organizing all published knowledge. The classic Yahoo search engine was based on the same principle.

However, not all knowledge management relates to knowledge by content area; many other classifications are possible, and it is the purpose of this article to elaborate those. Because of the multidimensionality of knowledge, many taxonomies are possible. A well-known attempt to survey taxonomies of knowledge in the context of knowledge management systems is that of Alavi and Leidner (2001); they present 10 categories of knowledge gleaned from the knowledge management literature; their summary is cited as Table 1. This article uses the Alavi and Leidner (2001) categories as a basis, while extending and rationalizing them.

In general, taxonomies of knowledge may be ordered by their degree of generality; one may deal with knowledge at the highest level of abstraction, as Sowa (2000) does, while at the other extreme there are taxonomies of knowledge within specific fields (i.e., subsets of the general scheme of classification by content). The approach taken here is something of an amalgam of these two extremes. As it is impossible within the confines of an encyclopedia article to cover the entire gamut of types of knowledge, the emphasis here is on some higher level categories that we consider most relevant to practical knowledge management.

Table 1. Knowledge taxonomies and examples (Alavi & Leidner, 2001)

Knowledge Types	Definitions	Examples
Tacit	Knowledge is rooted in actions, experience, and involvement in specific context	Best means of dealing with specific customer
Cognitive tacit:	Mental models	Individual's belief on cause-effect relationships
Technical tacit:	Know-how applicable to specific work	Surgery skills
Explicit	Articulated, generalized knowledge	Knowledge of major customers in a region
Individual	Created by and inherent in the individual	Insights gained from completed project
Social	Created by and inherent in collective actions of a group	Norms for inter-group communication
Declarative	Know-about	What drug is appropriate for an illness
Procedural	Know-how	How to administer a particular drug
Causal	Know-why	Understanding why the drug works
Conditional	Know-when	Understanding when to prescribe the drug
Relational	Know-with	Understanding how the drug interacts with other drugs
Pragmatic	Useful knowledge for an organization	Best practices, business frameworks, project experiences, engineering drawings, market reports

THE FOCUS: DIMENSIONS OF KNOWLEDGE

In discussing types of knowledge, one can think of the characteristics of knowledge items as unique points, each representing a class of knowledge. In this approach, for example, tacit and explicit knowledge are two different types. Most taxonomies to date have adopted this view. However, these two categories are also opposite poles of a single dimension along which there may well be types of knowledge that are combinations of the extreme points: for example, a given item of knowledge may be partly tacit and partly explicit. It therefore seems useful to think of the dimensions as having two extremes and to juxtapose those to depict characteristics of any given knowledge object.

The dimensions of knowledge discussed here are the tacit-explicit, individual-social, procedural-declarative, commonsense-expert, and task-contextual; three additional dimensions—true-false, certain-uncertain, and private-public are also briefly introduced. As the reader will note, there is considerable, but not complete, overlap with the Alavi and Leidner (2001) typology. The dimensions are also consistent with, but broader than, Nichols' (2000) identification of tacit, explicit, declarative, and procedural knowledge.

Given the multidimensional nature of knowledge, the ontology of an item of knowledge must refer to its location on all relevant dimensions in order to provide a complete specification. Such a specification should provide guidance in building systems to manage knowledge.

The Tacit-Explicit Knowledge Dimension

Tacit knowledge is knowledge that is possessed by an individual, but which he or she is unable to express verbally. At the other extreme of this dimension is explicit knowledge—knowledge that can be fully verbalized and so is available to any enquirer. An extreme statement of the tacit knowledge problem is that of Wittgenstein (1922): "The limits of my language are the limits of my mind. All