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A knowledge engineering approach to knowledge management

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Abstract

Knowledge management facilitates the capture, storage, and dissemination of knowledge using information technology. Methods for managing knowledge have become an important issue in the past few decades, and the KM community has developed a wide range of technologies and applications for both academic research and practical applications. In this paper, we propose a knowledge engineering approach (KMKE) to knowledge management. First, a knowledge modeling approach is used to organize and express various types of knowledge in a unified knowledge representation. Second, a verification mechanism is used to verify knowledge models based on the formal semantics of the knowledge representation. Third, knowledge models are classified and stored in a hierarchical ontology system. Fourth, a knowledge query language is designed to enhance the dissemination of knowledge. Finally, a knowledge update process is applied to modify the knowledge storage with respect to users' needs. A knowledge management system for computer repair is used as an illustrative example.

Keywords: Knowledge management; Knowledge engineering; Conceptual graphs

1. Introduction

Knowledge management (KM) facilitates the capture, storage, and dissemination of knowledge using information technology. Methods for managing knowledge have become an important issue in the past few decades, and the KM community has developed a wide range of technologies and applications for both academic research and practical applications [13,20,27,32,38,44]. The scope of knowledge is broad and knowledge may exist in various forms such as declarative/procedural, explicit/tacit, and general/specific. Therefore, knowledge cannot be dealt with using only a few general principles. Most current KM activities rely on database systems and Internet techniques. However, to manage various types of knowledge, a systematic knowledge engineering approach that includes knowledge analysis, knowledge formalization, and knowledge reasoning is desirable.

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Many researchers have attempted to address KM activities from various perspectives, including a design perspective [13], an information technology perspective [38,47], a management perspective [20,32], an artificial intelligence (AI) perspective [28,39], and an ontology perspective [5,10,29,30,43]. These studies have pointed out several major problems that KM activities may encounter.

- The lack of a systematic approach makes it difficult to pursue and integrate KM activities.
- Both declarative knowledge and procedural knowledge must be captured, stored, and analyzed to solve problems.
- KM activities must support the continuous change of knowledge.
- A common understanding of knowledge is required among knowledge workers for sharing and interoperating knowledge.
- In times of increasing information overload, finding information relevant to the task at hand is becoming increasingly critical.

To alleviate these problems, we propose a knowledge engineering approach, called Knowledge Management through Knowledge Engineering (KMKE), to knowledge management. In KMKE, KM activities are integrated in a systematic framework consisting of knowledge modeling, knowledge verification, knowledge storage, and knowledge querying. First, knowledge models are used to organize and express various types of knowledge in a unified knowledge representation. The formal knowledge representation helps in capturing the semantics of knowledge and offering the ability to reason about knowledge. Second, we propose a verification mechanism to verify knowledge models based on the formal semantics of the knowledge representation. When knowledge models are created or changed, the verification mechanism is applied to ensure their consistency. Third, knowledge models can be classified and stored in a hierarchical ontology system. Ontologies serve as the common understanding of knowledge and facilitate the finding of specific knowledge relevant to a given domain. Fourth, a knowledge query language is designed to enhance the dissemination of knowledge. Knowledge can be reused by matching, retrieving, and inferring from knowledge models. Finally, a knowledge update process is applied to modify the knowledge storage with respect to users' needs. The domain hierarchy is reorganized according to the usage frequencies and the correlations of nodes. The efficiency of knowledge querying can thus be improved.

2. Related work

As described above, recent studies have adopted a variety of perspectives to deal with KM activities: (1) a design perspective that focuses on the creation and the evolution of knowledge [13]; (2) an information technology perspective that discusses how KM and IT relate to each other [38,47]; (3) a management perspective that investigates critical factors and challenges in KM [20,32]; (4) an artificial intelligence perspective that emphasizes the role of artificial intelligence in KM [28,39]; and (5) an ontology perspective that focuses on developing common formalisms to enable knowledge sharing [5,10,29,30,43].

Traditional KM treats knowledge workers as passive recipients of information and its goal is to store information from the past so that lessons will not be forgotten. Fischer and Ostwald [13] recognized that future information needs will be different from past needs and proposed a design perspective approach for KM. In this framework, KM is a cyclic process involving three related activities: creation, integration, and dissemination. The design perspective shares three essential viewpoints: (1) KM relates to working, learning, and knowledge creation; (2) workers, not managers, create knowledge at the time of use; and (3) knowledge is a side effect of work. Several barriers to implementing a design-oriented KM approach are pointed out. First, a common understanding of knowledge is required among knowledge workers for sharing and interoperating knowledge. Second, KM must support the continuous change of knowledge. Third, to address information overload, finding information relevant to the task at hand is becoming increasingly critical.

Wilson and Snyder [47] considered that successful KM has three dimensions: information technology, people, and processes. Their research focuses on the IT aspect of KM. Two types of knowledge are classified: support information and guidance. The support information includes descriptive explanations that serve as a basis for understanding (who, what, when, where, with what, and why). The guidance strengthens the ability