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Knowledge evolution course discovery in a professional virtual community

Yuh-Jen Chen [a,*], Yuh-Min Chen [b]

[a] Department of Accounting and Information Systems, National Kaohsiung First University of Science and Technology, Kaohsiung, Taiwan, ROC
[b] Institute of Manufacturing Information and Systems, National Cheng Kung University, Tainan, Taiwan, ROC

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ABSTRACT

Capable of providing an interactive platform for enterprise experts to create and share empirical knowledge cooperatively, professional virtual communities have arisen from the pervasive use of the Internet. This circumstance incurs an overload of information and overflow of spam messages, accounting for high-volume low-quality knowledge in virtual communities. Therefore, providing valid knowledge decision support in order to assist community members to accurately predict and supply required empirical knowledge is of priority concern in implementing tacit knowledge management in an enterprise.

This work develops a technology for knowledge evolution course discovery in a professional virtual community as a decision support mechanism to discover effectively the empirical knowledge evolution course hidden inside of a professional virtual community, which can guide community members to retrieve required empirical knowledge quickly. This objective can be obtained by performing the following tasks: (i) design of an empirical knowledge management framework for professional virtual communities, (ii) definition of a knowledge evolution course model, (iii) design of a knowledge evolution course discovery process, (iv) development of techniques related to the technology for knowledge evolution course discovery, and (v) implementation and evaluation of a knowledge evolution course discovery mechanism for professional virtual communities. In developing techniques associated with the discovery of knowledge evolution course, which involves topic classification, domain dictionary construction, ontology-based topic empirical knowledge model construction, topic concept extraction and representation, and path establishment between topic concepts.

1. Introduction

As the 21st century has ushered in the knowledge economy era, which emphasizes the creation, distribution and application of knowledge, enterprises can utilize valuable knowledge broadly, thus promoting the enterprise value.

Professional virtual community is a frequently adopted interactive mechanism for enterprises to create, share, and apply knowledge collaboratively. The community provides an interactive space for individuals with the same knowledge expertise or professions. Therefore, personal professional knowledge, i.e. empirical knowledge, can be expressed freely in a professional virtual community to create and share tacit knowledge, thus achieving the goal of becoming an intelligent enterprise [7–9,17–19,22,28].

However, various professional virtual communities have arisen from the pervasive use of the Internet, leading to overload of information and overflow spam messages, and ultimately high-volume low-quality knowledge. Consequently, providing valid knowledge decision support in order to assist community members to accurately predict and supply required empirical knowledge is of priority concern in implementing tacit knowledge management in an enterprise [12].

As an effective means of retrieving and representing human knowledge, domain ontology can deal with scattered empirical knowledge in a professional virtual community in terms of classification, hierarchy, and relation to relieving information overloading, ultimately facilitating knowledge reasoning and problem solving. Ontology techniques have been increasingly adopted to define an entity, attribute and relationship among knowledge concepts within a specific domain using explicit descriptions and specifications that present an interoperable format understandable by both humans and machines, thereby realizing knowledge sharing and reuse. For instance, Lee and Jian [16] developed an ontology-based automatic summarization mechanism for web news, in which an agent mechanism formed by fuzzy theory and neural algorithm is used to automatically retrieve and summarize important sentences from web news and then transfer them into knowledge ontology. Quan et al. [20–21] proposed an ontology-based support platform for semantic inquiry, which can produce automatically an inquiry knowledge ontology from documents through the fuzzy formal concept analysis. Chen [4] designed a knowledge

* Corresponding author. Tel.: +886 7 6011000x4316; fax: +886 7 6011158.
E-mail address: yjchen@nkfust.edu.tw (Y.-J. Chen).

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construction mechanism for semantic searching, capable of utilizing Formal Concept Analysis (FCA) to construct a knowledge ontology for web documents and searching inquiries in order to provide required knowledge for knowledge demanders. However, these recent studies focus mainly on classifying and constructing domain knowledge concepts and a question-related searching instead of concentrating on knowledge evolution within empirical knowledge from dialogue among experts in a professional virtual community. Therefore, the inability to manage and reuse empirical knowledge in a professional virtual community effectively makes knowledge demanders impossible to retrieve required empirical knowledge.

This work presents a technology for knowledge evolution course discovery in a professional virtual community as a decision support mechanism to discover effectively the empirical knowledge evolution course hidden inside of a professional virtual community, which can guide community members to retrieve quickly required empirical knowledge. To achieve this objective, the developmental path is described as follows. Firstly, an empirical knowledge management framework is designed based on the empirical knowledge communication model and the knowledge management method. Subsequently, the conversation structure for community members is initially identified by performing conversation analysis. The developmental track among discussion topics is then defined through exploring interactive information and sharing process from participants. The defined developmental track is represented using the ontology method for facilitating empirical knowledge sharing in a professional virtual community. Finally, the formal concept analysis, the probabilistic latent semantic analysis, and the Dijkstra's shortest path algorithm are adopted to develop the techniques associated with the discovery of knowledge evolution course.

The remainder of this paper is organized as follows. Section 2 designs the empirical knowledge management framework for professional virtual communities. Section 3 designs the knowledge course evolution discovery procedure for professional virtual communities. Section 4 develops the techniques involved in discovery of empirical knowledge evolution course. Section 5 shows results of a prototype knowledge evolution course discovery mechanism implementation and an application example. Section 6 concludes the paper with some perspectives.

2. Design of empirical knowledge management framework for professional virtual communities

Knowledge experts in a professional virtual community capture required information and knowledge of each other through dialogue to accumulate self-empirical knowledge. Such dialogue contents become important sources for accumulating empirical knowledge.

To effectively manage unorganized but already expressed knowledge contents among experts through a systematic means of managing tacit knowledge, this section introduces an empirical knowledge management framework for professional virtual communities, as shown in Fig. 1. Effectiveness of the proposed framework is illustrated by a knowledge management life cycle, capable of extracting, verifying, constructing, and reasoning empirical knowledge. Each element is discussed as follows.

(1) *Extracting empirical knowledge:* Empirical knowledge from a professional virtual community is scattered all over the dialogue process among community members. Hence, empirical knowledge contents generated from a professional virtual community are first analyzed and constructed to be an empirical knowledge evolution course model in order to comprehend the distribution of empirical knowledge in the community. Speech act analysis is subsequently performed for empirical knowledge under topic classification of empirical knowledge evolution course model, to identify various characters inside the virtual community and discover the propagation tendency of empirical knowledge. Ultimately, domain empirical knowledge is extracted based on the empirical knowledge evolution course model and the speech act analysis results. Different the extracted empirical knowledge contents are then represented using ontology techniques to enable the knowledge model and the empirical rules to possess reasoning capability, thus facilitating the updating and maintenance of empirical knowledge.
(2) *Verifying empirical knowledge:* Based on the ontology representation of the extracted empirical knowledge from the above element, the logical conflict problem from the extracted empirical knowledge model is verified via the empirical knowledge difference for professional virtual communities. Moreover, domain experts must modify error logics to ensure the accuracy and consistency of the empirical knowledge model.
(3) *Constructing empirical knowledge:* After verifying empirical knowledge, the ontology-based empirical knowledge model is archived into the empirical knowledge repository according to the different categories of empirical knowledge, including know-what, know-why, know-how, and know-with. Such ontology-based empirical knowledge models in the empirical knowledge repository can be treated as standards for verifying empirical knowledge or identifying knowledge sources for empirical knowledge reasoning in the future.
(4) *Reasoning empirical knowledge:* While involved in a certain topic discussion, members in a professional virtual community can describe and inquire regarding their problems. These problems are analyzed through the empirical knowledge reasoning system, followed by matching and retrieving empirical knowledge to obtain required empirical knowledge in order to satisfy the tacit knowledge requirements from professional virtual community members.

This study focuses mainly on discovering knowledge evolution course, as displayed in the shaded portion of Fig. 1.

3. Design of knowledge evolution course discovery scenario for professional virtual communities

This section first analyzes the structure of a discussion topic for professional virtual communities as well as defines relations between topics by using the conversation analysis to establish a model for an ontology-based empirical knowledge evolution course. Based on the established model, the process of knowledge evolution course discovery is then conducted.

3.1. Definition of knowledge evolution course model

This section primarily defines an empirical knowledge evolution course model, which involves analyzing the knowledge evolution course structure, defining knowledge evolution course relations, and designing the knowledge evolution course concept schema, as described in the following subsections.

3.1.1. Analysis of knowledge evolution course structure

Communication forms the basis of a professional virtual community. Therefore, the virtual community must continuously strive to stimulate its members to dialogue and interact with each other,