Chapter 2.1
A Multi–Agent Approach to Collaborative Knowledge Production

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ABSTRACT

Knowledge creation or production in a distributed knowledge management system is a collaborative task that needs to be coordinated. A multi-agent architecture for collaborative knowledge production tasks is introduced, where knowledge-producing agents are arranged into knowledge domains or marts, and where a distributed interaction protocol is used to consolidate knowledge that is produced in a mart. Knowledge consolidated in a given mart can, in turn, be negotiated in higher-level foreign marts. As an evaluation scenario, the proposed architecture and protocol are applied to coordinate the creation of learning objects by a distributed group of instructional designers.

INTRODUCTION

Knowledge management (KM) authors quote many verbs to describe the processes that transform the intellectual capital of an organization or group of people into value (Stewart, 1997)—creation, acquisition, distribution, application, sharing and reposition, among others—but they can be summarized in three categories, depending on the direction of the information flow, i.e., production, acquisition and transfer.

Knowledge is not frequently well-structured enough to be appropriately used and exploited, so acquisition and transfer techniques are needed to facilitate the sharing and re-use of the group-wide available knowledge. On the other hand, knowledge emerges from the social interaction

between actors, with production being the creative process of formulating information, which has to be validated as useful to the group before it becomes fully-fledged knowledge. According to empiric (Goldman, 1991) and organizational learning (Argyris, 1993) approaches, we consider knowledge as the subset of information that is applied in order to cause an impact in the influenced environment and which is subject to necessary validation tests that corroborate its applicability.

Recent works (Clases et al., 2002) advocate collaboration in support of knowledge production in socially distributed systems. Collaborative production stands out as a tool to mediate, but not eliminate, the differences between views of the design of a system. This chapter outlines a new approach for collaborative knowledge production based upon a multi-agent architecture. This approach organizes knowledge production in a distributed interaction environment to complete the distributed KM scenario. As a case study, our approach is applied to the collaborative development of learning objects by a distributed group of instructional designers.

In the rest of this section, we introduce the subject of collaborative knowledge production and our working thesis. The following section presents a structured and coordinated model of interaction between knowledge-producing agents. Next, the architecture is tested in an instructional design scenario devoted to the collaborative creation of learning objects. Finally, we present some conclusions and future work drawn from the application of the architecture.

Collaborative Knowledge Production

Several authors on the topic of KM cite production or generation of knowledge referring to the creation of new knowledge. When Davenport and Prusak (1998) tell about *knowledge generation*, they are referring both to externally acquired knowledge and knowledge developed within the bosom of an organization without distinguishing between acquisition and generation. In our study, we consider *generation* as distinct from *acquisition*. From our point of view, knowledge generation or production is the creation of new knowledge as the result of the social interaction between actors in a workgroup or organization, according to their interests and the regulations that apply. On the other side, knowledge is acquired when it comes from outside of an organization or workgroup — i.e., it is generated outside and thereafter adopted by the organization.

Coordination is a key pattern of interaction that is needed to obtain good-quality knowledge that has been validated by means of contrast and/or consensus in the group. Although KM research in distributed knowledge acquisition and sharing efforts are worth considering, knowledge production still lacks the interaction models and methods of coordinating a group of autonomous users in the collaborative generation of knowledge.

A Multi-Agent Approach

Multi-agent systems have been successful in the distributed implementation of KM processes. Knowledge acquisition agents have been one of the most successful applications of software agents, specifically in the Internet (Etzioni, 1995), where knowledge-collector agents operate within available information resources and validate them in accordance with the users' interests. On the other hand, knowledge transfer lies in an end-to-end routing of knowledge that is generated by some actor, and it is another typical task that has been realized by software agents (Genesereth & Tenenbaum, 1991). Therefore, it is reasonable to approach the multi-agent paradigm for knowledge production. Knowledge-producing agents need to do formulations in keeping with a validation scheme that supports the knowledge construction. Multi-agent systems can support the coordinated interaction needed to achieve an agreement on the knowledge that is eventually generated. They can also support the validation scheme.

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