Chapter 2.15

Multi–Agent Architecture for Knowledge–Driven Decision Support

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ABSTRACT

Organizations use knowledge-driven systems to deliver problem-specific knowledge over Internet-based distributed platforms to decision-makers. Increasingly, artificial intelligence (AI) techniques for knowledge representation are being used to deliver knowledge-driven decision support in multiple forms. In this chapter, we present an Architecture for knowledge-based decision support, delivered through a Multi-Agent Architecture. We illustrate how to represent and exchange domain-specific knowledge in XML-format through intelligent agents to create exchange and use knowledge to provide intelligent decision support. We show the integration of knowledge discovery techniques to create knowledge from organizational data; and knowledge repositories (KR) to store, manage and use data by intelligent software agents for effective knowledge-driven decision support. Implementation details of the architecture, its business implications and directions for further research are discussed.

INTRODUCTION

Knowledge is an organizational asset that contributes to sustainable competitive advantage. This explains the increasing interest organizations take in knowledge management (KM). Many organizations are developing knowledge management systems (KMS), specifically designed to share and integrate knowledge, as opposed to data or information, in decision support activities (Bolloju et al., 2002). Decision support systems (DSS) are computer technology solutions used to support complex decision-making and problem solving

(Shim et al., 2002). Organizations are increasingly complex with increased emphasis on decentralized decision-making. Such changes create the need for DSS that focus on supporting problem solving activities on distributed platforms by providing problem specific knowledge, and supporting information, to a decision maker using Internet-based technologies. This trend requires enterprise DSS for effective decision-making with processes and facilities to support the use of knowledge management.

Recent advances in systems support for problem solving and decision-making witness the increased use of artificial intelligence (AI) based techniques for knowledge representation (Whinston, 1997; Goul 2005). Knowledge representation takes multiple forms including the incorporation of business rules, decision analytical models and models generated from the application of machine learning algorithms. Intelligent decision support systems (IDSS) incorporate intelligence in the form of knowledge about the problem domain, with knowledge representation to inform the decision process, facilitate problem solving and reduce the cognitive load of the decision maker. Weber *et. al*. (2003) identified requirements for organizational KMS where the central unit is a repository of knowledge artifacts collected from internal or external organizational sources. These KMS can vary based on the type of knowledge artifact stored, the scope and nature of the topic described and the orientation (Weber et al., 2003). Ba *et. al.* (1997) enumerate the KM principles necessary to achieve intra-organizational knowledge bases as: (i) the use of corporate data to derive and create higher-level information and knowledge, (ii) provision of tools to transform scattered data into meaningful business information. Knowledge repositories play a central and critical role in the storage, distribution and management of knowledge in an organization. Interestingly, Bolloju *et. al.,* (2002) proposed an approach for integrating decision support and KM that facilitates knowledge conversion through suitable automated techniques to:

- Apply knowledge discovery techniques (KDT) for knowledge externalization
- Employ repositories for storing externalized knowledge
- Extend KDT for supporting various types of knowledge conversions

This chapter is motivated by these principles. We present an intelligent knowledge-based multi-agent architecture for knowledge-based decision support using eXtensible Markup Language (XML) related technologies for knowledge representation. This allows for knowledge exchange over distributed and heterogeneous platforms. The proposed architecture integrates DSS and KMS using XML-based technologies as the medium for the representation and exchange of domain specific knowledge. Intelligent agents to facilitate the creation, exchanges and use of the knowledge in decision support activities. This is the primary contribution of this chapter to the existing body of knowledge in DSS, KMS and multi-agent research.

This chapter builds on existing bodies of knowledge in intelligent agents, KM, DSS and XML technology standards. Our research focuses on achieving a transparent translation between XML and Decision Trees through software agents. This creates the foundation for knowledge representation and exchange, through intelligent agents, to support decision-making activity for users of the system. We use a knowledge repository to store knowledge, captured in XML documents, that can used and shared by software agents within the multi-agent architecture. We call this architecture "*an Intelligent Knowledge-based Multi-agent Decision Support Architecture*" (IKMDSA) IKMDSA integrates KDT and knowledge repositories to store externalized knowledge. It uses an intelligent multi-agent system with explanation facility to provide distributed decision support using Internet-based technologies.

The implementation incorporates XML related technologies for knowledge representation, storage and knowledge exchange among participating

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