

## Chapter 8.9

# A Multi-Agent Decision Support Architecture for Knowledge Representation and Exchange

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### **ABSTRACT**

Organizations rely on knowledge-driven systems for delivering problem-specific knowledge over Internet-based distributed platforms to decision-makers. Recent advances in systems support for problem solving have seen increased use of artificial intelligence (AI) techniques for knowledge representation in multiple forms. This article presents an Intelligent Knowledge-based Multi-agent Decision Support Architecture” (IKMDSA) to illustrate how to represent and exchange domain-specific knowledge in XML-format through intelligent agents to create, exchange and use knowledge in decision support. IKMDSA integrates knowledge discovery and machine learning techniques for the creation of knowledge from organizational data; and knowledge repositories (KR) for its storage management

and use by intelligent software agents in providing effective knowledge-driven decision support. Implementation details of the architecture, its business implications and directions for further research are discussed.

### **INTRODUCTION**

The importance of knowledge as an organizational asset that enables sustainable competitive advantage explains the increasing interest of organizations in KM. Many organizations are developing knowledge management systems (KMS) that are specifically designed to facilitate the sharing and integration of knowledge, as opposed to data or information, in decision support activities (Bolloju, Khalifa, & Turban, 2002). Decision support systems (DSS) are computer technology solutions

used to support complex decision-making and problem solving (Shim, Warkentin, Courtney, Power, Sharda, & Carlsson, 2002). Organizations are becoming increasingly complex with 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 data and knowledge to a decision maker anywhere, using Internet-based technologies. This trend necessitates enterprise DSS for effective decision-making with processes and facilities to support the use of knowledge management (KM).

Recent advances in systems support for problem solving and decision-making witness the increased use of artificial intelligence (AI) based techniques for knowledge representation (Goul, 2005; Whinston, 1997). 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 and Aha (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 & Aha, 2003). Ba, Lang and Whinston (1997) enumerate the KM principles necessary to achieve intra-organizational knowledge bases as: (1) the use of corporate data to derive and create higher-level information and knowledge, (2) 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:

1. apply knowledge discovery techniques (KDT) for knowledge externalization,
2. employ repositories for storing externalized knowledge, and
3. extend KDT for supporting various types of knowledge conversions.

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

This research 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 be 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 for storing externalized knowledge. It utilizes an intelligent multi-agent system with explanation facility to provide distributed decision support using Internet-based technologies. The imple-

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