15. Flexible Decision Support in a Dynamic Business Network

John Collins¹, Wolfgang Ketter² and Maria Gini³

¹Computer Science and Engineering, University of Minnesota, United States of America, jcollins@cs.umn.edu
²Decision and Information Sciences, RSM Erasmus University, The Netherlands, wketter@rsm.nl
³Computer Science and Engineering, University of Minnesota, United States of America, gini@cs.umn.edu

Abstract

We present the design of a service oriented architecture which facilitates flexible managerial decision making in dynamic business networks. We have implemented and tested this architecture in the MinneTAC trading agent, which is designed to compete in the Supply Chain Trading Agent Competition (Collins et al., 1998). Our design enables managers to break out decision behaviors into separate, configurable components, and allows dynamic construction of analysis and modeling tools from small, single-purpose “evaluator” services. The result of our design is that the network can easily be configured to test a new theory and analyze the impact of various approaches to different aspects of the agent’s decision processes, such as procurement, sales, production, and inventory management. Additionally we describe visualizers that allow managers to see and manipulate the configuration of the network, and to construct economic dashboards that can display the current and historical state of any node in the network.

Introduction

Organizations in business networks have a growing need for intelligent software that can assist managers by gathering and analyzing information, making recommendations, and supporting business decisions. Advanced decision support systems and autonomous software agents promise to address this need by acting rationally on behalf of humans in numerous application domains. Examples include procurement (Sandholm, 2007; CombineNet, 2006), scheduling and resource management (I2, 2006; Collins, Bilot, Gini, & Mobasher, 2001), and personal information management (Berry et al., 2006). The recent advent of Smart Business Networks (SBN) (Vervest, Preiss, Heck, Pau, 2004; Vervest, van Heck, Preiss, & Pau, 2005; van Heck, & Vervest, 2007) extends the area of traditional business processes and gives rise to new challenges, especially in the area of dynamic and modular
business process management, by enabling integration of legacy systems and by providing advanced tools to facilitate human managerial decision making.

We make four major contributions to the SBN literature. One of the major theoretical tenets of SBNs is the ability of actors to quickly connect to other actors to achieve specific business objectives and then disconnect when a task is finished. Our first contribution in this paper extends the SBN literature through the design and implementation of a highly configurable and flexible decision support system that dynamically connects to different nodes of a business network and disconnects them when no longer needed. Our second contribution is the vision of goal directed service composition. This allows business services with formal semantic descriptions to be composed and validated. Thirdly, we are developing a tool to enable managers to visualize, understand, and validate the theoretically designed decision chain with a graphical representation of the actual network chain. Finally, we have developed a flexible economic dashboard architecture that can be dynamically connected to selected nodes to visualize their real-time status, current parts and finished goods inventory positions, risk and reward management, and the like. This architecture can greatly empower business network managers in their understanding of the overall business network structure and facilitate real-time managerial decision making. Currently, we are working on an even more interactive version of this dash-board which allows the human decision maker to interact with the business network to make structural changes.

Since operating on real world business networks has high risks, and might cause serious business problems when not done properly, we tested our architecture and algorithms on a supply-chain testbed, the Trading Agent Competition for Supply Chain Management (Collins et al., 2005) (TAC SCM). We describe the implementation of our flexible decision support system and demonstrate its value using as an example MinneTAC (Collins, Ketter, & Gini, 2008), an autonomous agent that performs coordinated buying, selling, production scheduling, and inventory management in the context of TAC SCM. In addition, we present results of our network visualizer toolbox, where a manager is able to see the current configuration of the network as well as the state of the different nodes. We review the relevant related literature, and finish with conclusions and future work. In the future work section we describe the Dutch flower auction network as an example of a complex, strategic, and uncertain business network on which we are currently working to integrate our architecture and algorithms.

A Business Network Testbed: The Trading Agent Competition for Supply Chain Management

Traditionally, supply chains have been created and maintained through the interactions of human representatives of the various enterprises (component suppliers, manufactures, wholesalers/distributors, retailer, and customers) involved. However, the recent advent of autonomous trading agents opens new possibilities for automating and coordinating the decision making processes between the various parties