

Chapter III

Virtual Enterprise Formation Supported by Agents and Web Services

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ABSTRACT

This chapter describes the use of software agents and Web services to support the formation of virtual enterprises. The partners of a virtual enterprise are represented as software agents. The AGORA multi-agent architecture is used. The focus of this chapter is on the description of the services provided by each partner and the partner selection process. The concept of agent interaction protocols is used to manage the interactions during the formation of the virtual enterprise. An implementation of the ideas and examples from industrial case studies are used for the validation of the approach and discussions. The use of semantic Web technology and Web services with multi-agent systems is discussed as the future directions for this work.

INTRODUCTION

Recent advances in communication and distributed information technology has changed the way business is conducted. Enabled by technologies such as software agents and electronic commerce, enterprises have gone beyond the geographical and sociocultural boundaries and have become entities

that not only compete in the global market, but also draw their resources from an international market. The trend of outsourcing seems to be replaced by strategic alliances, where enterprises or individuals work together towards a common goal and share their responsibilities as well as their profits. The concept of a virtual enterprise (VE) has emerged as a means of dealing with this.

Interest in VEs have grown in the recent years and efforts have been made in several research domains to understand, design, facilitate and support VEs in any possible way. Some of this work is reviewed in the following section. As a result of this focus, the need for technological support of VEs has risen. This chapter describes an agent-based approach to support VEs and a model to describe them. The focus of our work is to support, in particular, the formation phase of the lifecycle of a VE. The formation of a VE is considered within the context of an electronic market place where several parties compete to become partners of a VE. Software agents and Web services are used as solution technologies. Our approach is based on understanding a VE from an organizational perspective and using these ideas to provide technological support. Emphasis has been made to ensure that the work is not technology driven, rather a combination of organizational design ideas as well as an appropriate technology.

The objective of this work is to provide an agent-based model of the VE and a solution technology that meets the needs and challenges of the industry. The work was motivated by the fact that technological solutions will save the industry resources by supporting the automation of some generic operations and processing of information. The aim is not to automate the complete process, rather to support effective decision-making by providing appropriate information to the decision makers. The work described in this chapter has been validated using industrial case studies.

The rest of this chapter is organized as follows: Section 2 provides an overview of related work; Section 3 describes the agent-based model of the VE; Section 4 describes the VE formation process; Section 5 describes the implementation of the approach and the model using a multi-agent architecture; Section 6 presents a validation of the work using industrial case studies; Section 7 discusses the future directions for this work and Section 8 concludes the chapter.

BACKGROUND

This section provides an overview of the literature that is related to this work. The research areas that have been addressed are VEs, intelligent agents, multi-agent systems and Web services and agents and Web services for modelling VEs.

Virtual Enterprises

VEs have received increasing attention during the last decade (e.g., VOSTER, 2003). Due to the advancement of distributed information technology and the changing needs of the business community, enterprises are expected to be more agile and responsive. The concept of a VE is a means of meeting these new expectations. Although a universally accepted definition of the term is still missing, there have been several attempts at defining VEs from different areas of application, for example, from manufacturing (Jagdev & Brown, 1998), organizational design (Davidow & Malone, 1992) and enterprise modelling and integration (Vernadat, 1996). While the definitions address their particular areas of interest, there are some common aspects in these definitions. We have reviewed several definitions of VEs to come up with our working definition of a VE, which is as follows: *A VE is a group of enterprises that collaborate to achieve a specific goal.* The main characteristics of VEs are that it is a temporary network of enterprises, (Jagdev & Brown, 1998), with a limited lifetime, (Fischer et al., 1996), where the partners are distributed geographically and they collaborate (Oliveira & Rocha, 2000); it is goal-oriented, (Petersen, Divitini & Matskin, 2001), and commitment-based (Jain, Aparicio, & Singh, 1999); it is supported by communication and information flow, (Garita & Afsarmanesh, 2001) and the partners share their skills, costs and profits (Byrne, Brandt, & Port, 1993).

The goal-oriented and distributed nature of VEs implies that there is no central control; rather, the control is decentralized. The goals are achieved

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