Chapter 41
An Agent-Based Operational Virtual Enterprise Framework Enabled by RFID

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ABSTRACT

The Virtual Enterprise (VE) is a collaboration model between multiple business partners in a value chain that aims to cope with turbulent business environments, mainly characterized by demand unpredictability, shortening product lifecycles, and intense cost pressures. The VE model is particularly viable and applicable for Small and Medium Enterprises (SME) and industry parks containing multiple SMEs that have different vertical competencies. As small firms collaborate effectively under VE model, it will be only possible to emerge products by joining their diverse competencies and mitigate the effects of market turbulence by minimizing their investment. A typical VE model has four phases; opportunity capture, formation, operation, and dissolution. The goal of this chapter is to present a conceptual Virtual Enterprise framework, focusing on operation phase. The framework incorporates two key technologies Multi Agent Systems (MAS) and Radio Frequency Identification Systems (RFID) which are emerging from research to industry with a great momentum. First, state of the art for Virtual Enterprises and the two key enabling technologies are covered in detail. After presenting conceptual view of the framework, an Information and Communication Technology (ICT) view is also given to enhance technical integration with available industry standards and solutions. Finally, process views of how a virtual enterprise can operate utilizing agent based and RFID systems in order to fulfill operational requirements, are presented.

INTRODUCTION TO VIRTUAL ENTERPRISE

In 21st century, continued competitiveness by enterprises in the flat economic world depends on their ability to employ the principles of agility. Agile manufacturing is not flexible manufacturing or lean manufacturing or computer integrated manufacturing, rather it is a combination of such useful techniques, methods, and philosophies, those companies can employ to bring unprecedented improvements in quality, productivity, and services. Agile companies aggressively embrace change. For agile competitors, change and uncertainty are self-renewing sources of opportunities from which to fashion sustained success. An agile organization is one whose organizational structures and processes enable fast and fluid transitions of an initiative, to respond changes in customer enriching business activities. Agility is dynamic, context-specific; aggressively change embracing and growth oriented. Agility is about winning, about succeeding in emerging competitive arenas, and about winning profits, market share, and customers in the very centre of the competitive storms many companies are in (Goldman et al. 1995).

Many scholars and authors cite Virtual Enterprises (VEs) as a key enabler of Agility (Goldman et al. 1995; Gunesekeran et al. 2001). Among other enablers such as concurrent engineering, e-commerce, integrated product/production information systems, VE is special interest because it places the greatest demands on a company to co-operate in achieving collaborative production. If a company is so staffed, equipped, organized and motivated that it can create a virtual structure to meet a demand, then all of the other elements of agility are likely to be present in this organization. A VE is a temporary consortium formed by real autonomous companies on the basis of strong collaboration to respond temporary demands, which a single company with limited core competencies and production capacity, is unable to respond.

Indeed, a VE can accomplish tasks that could be not done by each of the competitors working sequentially or in tandem. It is analogous to synergy created by members of an all-star team. In addition to sharing core competencies, there are other strategic reasons for using the virtual organization model. By sharing facilities and resources in order to increase the size or geographic coverage, a VE can reach the critical mass to be a world-class competitor. Further, total cost and risk will be shared, which would reduce the barriers of entry in many industries, where small and medium sized enterprises (SMEs) may not afford alone. In production, VEs can generate a wide range of output volumes. They can be formed to perform a one-of-a-kind production, such as building a plant which outputs very low volumes, and high customization. Alternatively, they can also be formed to perform manufacturing of a product line in batch size volumes, with more advanced process techniques (Ouzounis 2002). While a VE is opportunistic, the solution it provides, its customization level and volume, are dictated by the market. A consumer need must evolve, and so will a VE's resource requirements. Some participants may leave because they no longer can provide value for the solution, or new partners can join for required new core competencies.

VEs which are competing on basis of agility, must deal with rapidly opening and closing windows of opportunity for products and services. In agile competition, a company may use VEs not because it could make a product, that it could not do alone, but because it could not make it fast enough to exploit the high-opportunity window. Goldman further suggests that first half of an opportunity window, is far more profitable than second half of an opportunity window, hence it is unlikely that any firm that missed the first half of the window could capture even a majority of the profits in the second half of the window. Therefore time-to-market is a major maximization objective for VEs, as well as minimizing and sharing costs and risks. These objectives can be only enabled by

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