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An intelligent supplier management tool for benchmarking suppliers in outsource manufacturing

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Abstract

A global corporation's supply chain usually consists of enterprises and manufacturers that are graphically dispersed around the world, whereby each company is involved in a wide variety of supply chain activities such as order fulfillment, international procurement, acquisition of information technology, manufacturing, and customer service. However, selecting suppliers based on accumulated experience is not both effective and scientific due to subjective judgment and lack of systematic analysis. Therefore, continuously tracking and benchmarking performance of suppliers and forming an appropriate supplier selection mechanism is one of the crucial activities in supply chain management. This paper presents an intelligent supplier management tool (ISMT) using the case-based reasoning (CBR) and neural network (NN) techniques to select and benchmark suppliers. The development of ISMT and how the CBR and NN techniques are used in benchmarking suppliers during the process of new product development in Honeywell Consumer Products (Hong Kong) Limited are presented.

Keywords: Benchmarking; Outsource manufacturing; Case-based reasoning; Neural network; Supplier selection; Supply chain management

1. Introduction

The intense global competition among manufacturing industries to co-ordinate and respond quickly the industry value chain from suppliers to customers has made supplier management an important tool in new business design. It is because in the last decade, the role of manufacturing has shifted from a producer of goods and services to one that co-ordinates the whole industry value chain. Very few manufacturers now own all of the activities along the chain but integrate the supply network from various suppliers to the final customer. The possession of knowledge and information of the supplier networks and the ability to make fast and accurate decision often constitute a competitive advantage compared with his competitors or other networks. The rapid advance in information technology is now deployed not only to improve existing operational effectiveness of a business, but also to build the new capability to meet today's business environment and complexity. Among the many desirable capabilities, the ability to learn and adapt to changes is essential. Consequently, the core activity of manufacturing is no longer confined to making things but lies in the systematic processing of knowledge to create value for customers.

Manufacturing-related business services that capitalize on Internet and information technologies are expanding fast. As the manufacturing industry is gradually moving towards a borderless business environment, new models for manufacturing co-operation and collaboration through networks to meet the imminent challenge in the increasingly competitive marketplace is on the horizon.

Ferdows (1989) defined the international manufacturing system as a network of factories. Each factory plays different strategic roles in the network, e.g. off-shore, source, server, contributor, outpost and lead. The focus of Ferdows was on the relation between network and its factories. He tried to link the strategic motivations to the role of each factory in a network and emphasized new opportunities for learning in the network. However, this model perhaps put a little too much emphasis on strategic role of separate factories rather than functions of the integrated or coordinated network. Cohen, Fisher, and Jaikumar (1989) considered the network including vendors, plants and markets, but their international manufacturing strategy was mainly driven by the international financial factors, such as fluctuations of currency exchange rate. Moran and Riesenberger (1994) found that while globalization has intensified competition among enterprises, it has also fragmented production

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systems everywhere. There is a tendency for large firms to evolve into loosely tied and decentralized federations or business units, making products and seeking alliances both within and outside the 'consortium' to serve customers' demands to their best ability. Therefore, it can be summarized that the driving forces of the global market opportunity and new patterns of competition required a new generation of networks to be developed as manufacturing business is developed globally.

In recent years, a number of global manufacturing networks have been established, taking advantage of fast-growing networking and information technologies (Shi, Gregory, & Naylor, 1997). The networking characteristics of the new manufacturing system concern the involvement of manufacturers in a wide perspective covering geographic dispersed and interdependent parties in order to response rapidly to the demand of market. Therefore, an outsource manufacturing system consists of firms that are geographically dispersed and do not belong to the same Head Company. It is a system with central management capability, possessing the ability of central task decomposition/allocation, co-ordination and monitoring (Choy & Lee, 2000; Choy & Lee, 2001; Lee & Lau, 1999a; Lee, Lam, & Choy, 1998). In addition, to many companies, the Internet provides a global link to the company's customers and suppliers (Collet, 1999; Kalakota, 1997; Mill, 1998). With the rapid advances of electronic and communication technologies, an outsource manufacturing system that shares the information and resources among loosely connected manufacturing firms can be realized. The idea of forming an outsource manufacturing system is meant to establish a dynamic organization through the synergetic combination of dissimilar companies with different core competencies, thereby forming an organization to perform a given business project to achieve maximum degree of customer satisfaction (Gilman, Aparicio, & Barry, 1997; Goranson, 1999; Westkamper & Tutsch, 1998). Customers and suppliers can directly access the company almost at any place and at any time in the world for acquiring useful information (Lee, 1997; Lee & Lau, 1999a). In particular, the process of searching for the appropriate partners/suppliers and the continuous assessment of performance of these companies for a certain type of business task is of crucial importance to the successful running of an outsource manufacturing system. In this aspect, it is important that a certain level of decision support functionality should be created to enhance the overall performance of the system.

On the other hand, although it is a global trend to virtually integrate suppliers, manufacturers and end-customers in the supply chain basing on a certain type of virtual enterprise architecture (Ouzounis & Tschammer, 1999), the supply chain of products or services for a corporation can be very complex. A global corporation's supply chain now usually consists of multiple enterprises graphically dispersed around the world and each of these enterprises is involved in a wide variety of supply chain activities—order fulfillment, international procurement, acquisition of new information technology, and customer service. There are complex relationships such as multiple suppliers serving multiple customers, or a supplier who may be a customer or even a competitor in different parts of the chain (Christopher & Towill, 2000; Weber, 2000). According to Carter et al. (2000), the future of purchasing and supply strategic directions are that: (1) supplier assessment and evaluation will become more detailed and precise; (2) companies will create supply strategies to achieve cost and technology advantages; (3) dominant supply chain players will increase sourcing influence at the design and development stage. What manufacturers do is looking to establish dynamic trading relationships. It, however, needs a tool to select potential supplier(s) with the capability of continually monitoring and assessing the performance of their suppliers (Liu et al., 2000; Radjou, 2000). Manufacturers should use this extended supply chain visibility to identify and cut ties with low performance suppliers. Therefore, continuously tracking performance of supply chain partners and forming a supplier selection mechanism are expected as one of the crucial sessions in supply chain management.

Benchmarking, one the other hand, is the systematic comparison of elements of performance in a company against those best practices of relevant companies, obtaining information that will help the observing company to identify and implement improvement. Bhutta and Huq (1999) identified seven types of benchmarking based on what is compared, such as performance, process, and strategic benchmarking, and what the comparison is being made against, such as internal, competitive, functional and generic benchmarking. In fact, performance measurement in benchmarking is a trend measurement and comparison with another companies. In the past, researchers have conducted studies to identify the criteria for enterprise performance benchmarking (Rolstadås, 1998) in terms of people, customer, financial, learning and innovation. However, the results from these researches indicated that there is a lack of findings related to the implementation of a system, which is able to provide a reliable, and systematic benchmarking assessment approach to support supplier selection.

Burns (1997) and Meziane et al. (2000) proposed that artificial intelligence (AI) technique brings the efficiency and flexibility needed by manufacturing system. Mclvor and Humphreys (2000) prompted that it is effective in the decision making in make or buy methodology and practice with the use of AI techniques such as the case-based reasoning (CBR) technique, while other researchers have adopted fuzzy set, statistical model, expert systems and neural networks (NN) to aid in the process of supplier selection (Ng, Smith, & Skitmore, 1998; Nguyen, 1985; Vokurka, Choobineh, & Vadi, 1996). However, each of these systems has their own disadvantages such as the difficulties in defining the rules for expert system approach and the membership functions of the fuzzy set theory.