SUGGESTIONS FOR ENHANCING RESPONSIVENESS IN SUPPLY CHAINS USING KNOWLEDGE MANAGEMENT

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ÖZET

İşletmeler, üretim maliyetlerini daha fazla düşüremedikleri durumlarda, rekabetle başedebilmek için değişik stratejiler geliştirmiş
üreticiye kadar uzanan yelpazede tedarik zincirinin tüm katmanlarının planlama sürecine katılabilmelerini sağlamaktır. Başarılı
bilgilerinin tüm tedarik zincirinde anında paylaşılması ve ortaklaşa planlama yapabilmektir. Bu makalede tedarik zincirinin da
önerilmektedir. Önce farklı üretim yerlerinde üretilen ve dağıtım ağının farklı yerlerinde depolanmış ürünlerin, müşteriye zamanın
üçgeninden oluşan bir sistemin karşılaştığı temel sorunlar tartışılmaktadır. Bu sistemin kavramsal alt yapısı sunulmakta, daha son
teknolojisi ve doğru bigiye ulaşabilmek için bilgi yönetimi ve veri madenciliği konularından söz edilmektedir.

ABSTRACT

This paper presents the salient details of an integrated system, which is under development for enhancing the responsiveness
information systems and is intended to be capable of dealing with various temporal and spatial decisions that are required for
system with better decision-making capability and ability to respond to customer needs faster, the concept of knowledge manag
as an integral part of the system.

Key Words: Supply chain, responsive, data mining, knowledge management.

INTRODUCTION

A supply chain is a network of facilities and distribution options that performs the functions of procurement of materials, transformation of materials into finished products and delivery of products to customers. Supply chains exist in both service and manufacturing organizations, although the complexity of the chain may vary greatly from industry to industry and from firm to firm.

In recent years it has become clear that many companies have reduced manufacturing costs as much as possible. The rules of the game in the world of trade, both within a country and across countries are quickly changing to the 'survival of the fittest and future for the agile organizations'. Many organizations have used various innovations to win the game. These days the power of information technology has become almost inseparable in every new technology and innovation. The study by Bradley [1], which covered a survey of more than 300 supply chain-related executives, found that 92% of those surveyed were planning to implement one or more supply chain initiatives. One of the commonly found approaches is to decentralize the value adding activities by outsourcing and developing a virtual enterprise. Since suppliers are located all over the world, it is essential to integrate the activities both inside and outside of an organization.

Supply chain management is defined as the integration of key business processes from end user through original suppliers that provides products, services, and information that add value for customers and other stakeholders [2]. According to Simchi-Levi et al. [3], supply chain management is a set of approaches utilized to effectively integrate suppliers, manufacturers, warehouses, and stores, so that merchandise is produced and distributed at the right quantities, to the right locations, and at the right time, in order to minimize system wide cost while satisfying service level requirements. This integration implies an information system for sharing information on various value adding activities along the supply chain.

This paper introduces an integrated system for managing supply chain, which has been designed as part of an ongoing research study. The system can help managing supply chains of organizations dealing with products that are made at different sources, stocked at a number of locations at different echelons of the distribution network and delivered to the end customers through the appointed dealers of the organization. This system is intended to provide different categories of management support to realize responsive supply chains.

RESPONSIVE SUPPLY CHAINS

Making the supply chain effective is increasingly regarded as very essential for enhancing the overall organizational competitiveness. When the supply chain management is made effective through increased responsiveness, a number of benefits will follow: (1) Increase in revenues, improvement in profitability, and a stable or increased market share will be observed. (2) Operating and administrative costs will be reduced. (3) Inventory turnover can be increased, which will reduce both inventory carrying costs and overall product cost base. (4) Products will be available easier due to reduction in stock-outs.

Such benefits will not accumulate easily though; the process of integrating different components in the supply chain is a complicated undertaking. There are several crucial supply chain management issues that affect the range of a firm's activities and its competitiveness in the market. One such issue is the design of a logistic distribution network. The network consists of suppliers, warehouses, distribution centres, retail outlets, and inventory of raw materials, work-in-process and finished goods. There are normally four stages in the design of a logistic distribution network [4]. The *arrangement stage* refers to the geographical arrangement or layout of the distribution network. At this stage the number, location and size of facilities and assignment of customers and suppliers to warehouses are determined. The second stage is the *deployment stage* that starts from the network arrangement and tries to find an optimal distribution of inventory and final assembly activities among the available facilities. Each product type is assigned to one or more locations where it should be kept in stock and, if applicable assembled. In the *flow stage* the required inventory levels, safety stocks, replenishment batch sizes and order frequencies are determined. This permits a thorough evaluation of the proposed supply chain. The *operations stage* is the final stage and covers issues involved in operating a supply chain. It requires determination of ordering procedures, detailed vehicle routing algorithms or customer delivery scheduling algorithms.

Another crucial issue in supply chain management is the variability of consumer demand information as one moves up the supply chain away from the retailer. If demand information is distorted, the chain may be subjected to undue pressure and may be forced to reduce its responsiveness over a period. Many researchers, under the topical interest called bullwhip effect, have discussed the issues associated with this problem [5].

The bullwhip effect refers to the phenomenon where orders to the supplier tend to have a larger variance than sales to the buyer (i.e. demand distortion) and this distortion magnifies upstream in the supply chain. The distorted information implies that different stages in the chain will have different demand estimates and this will lead to excess costs and reduced responsiveness.

Main factors contributing to the bullwhip effect are as follows [5]:

1. Demand Signal Processing. Demand distortion may arise when the retailers, manufacturers and suppliers forecast demand separately and do not share information. Because each stage in the chain makes its own forecast based on orders and not on real sales figures, a small change in customer demand becomes magnified as orders move up the chain. Different forecasting methods may contribute to further fluctuations in ordering and demand distortion.

2. Rationing Game. Information distortion can arise out of the practice of 'gaming' where the retailer orders more than the actual consumer demand thinking that the manufacturer will allocate less than what he requests. The net effect is a distorted demand. Distortion also arises during shortage periods when the retailer places large orders and goes back to standard orders when the shortage is over.

3. Batch Ordering. Firms may batch order at certain times of the month or the year in order to reduce fixed costs of ordering and transporting. However, ordering in large lots leads to an erratic order stream that adversely affects the manufacturer.

4. Price Variations. Pricing policies can also lead to the bullwhip effect. If prices fluctuate, retailers often attempt to buy in large quantities during the discounting or promotion periods.

Identification of the above forces aids the development of strategies to reduce or eliminate the damaging impact of the bullwhip effect. The problems caused by demand signal processing can be reduced by providing manufacturers with demand data at the retail stage, allowing a single stage of the supply chain to perform forecasting and ordering for other stages, and shortening the lead-time. The impact of rationing game can be diminished by allocating scarce products in proportion to the past sales records, sharing production and inventory information with each stage in the supply chain and using a contract that restricts the buyer's flexibility. The batch ordering problem can be reduced by using electronic data interchange based order transmission systems that help reduce ordering costs and lot sizes. Retailers can be entitled to order a variety of products to fill a truckload and offered the same volume discount. The problem due to price variations can be taken care of by eliminating promotions or by placing limits on the quantity that may be purchased during a promotion.

Another critical issue in effective supply chain management is managing the flow of information between the stages in the chain. Information provides managers with the facts to make decisions. It is essential to understand how information is gathered and analysed. Using information technology systems to collect and analyse information provides a firm a competitive advantage in the market. Information makes it possible to reduce the variability in the chain, to make better forecasts and promotional and market changes, to improve coordination of manufacturing and distribution, to enable retailers to offer better service to the customer by quickly reacting and adapting to supply problems, and to reduce lead times. It is important, however, that IT should be integrated with the components of the supply chain so that these benefits are realized.

THE SYSTEM FOR MANAGING SUPPLY CHAINS

This paper proposes an integrated system shown in Figure 1 to enhance the responsiveness of the supply chain. The system, using the power of modern information systems, is capable of supporting an organization dealing with multiple products, which include both in-house and subcontracted products sold under the brand name of the company.

The distribution network in the system spans different geographical areas. Each regional office (RO) coordinates with the branch offices (BO) in the respective regions. Dispatches are made directly to branches, which in turn supply products to dealers. Only in case of emergency, the RO's stock goods. There are two policy groups, namely the Policy Analysis Centre (PAC) and the Policy Implementation Centre (PIC). These function as the central nerve centres for planning, implementing and controlling the entire system.

Customer orders are received and fulfilled by the dealers, who in turn are served by the respective branches. Dealers and branches are responsible for managing the information, material and cash flows. A regional office coordinates all the commercial activities of the branches and the dealers in the region with the help of a divisional marketing office. The central policy groups (CPG) PAC and PIC control all these constituents. While making supply chain related decisions, the CPG considers the availability of finished goods and work-in-process inventory of both in-house and factored products, and the actual production at all sources. The PAC determines policies on production scheduling, allocation, replenishment, stocking, returning and transportation of the in-house and factored products. The PIC is responsible for implementing these policies. Both groups are connected to all the other physical locations of the system through the company intranet whereas the customers are linked to the dealers through the Internet.

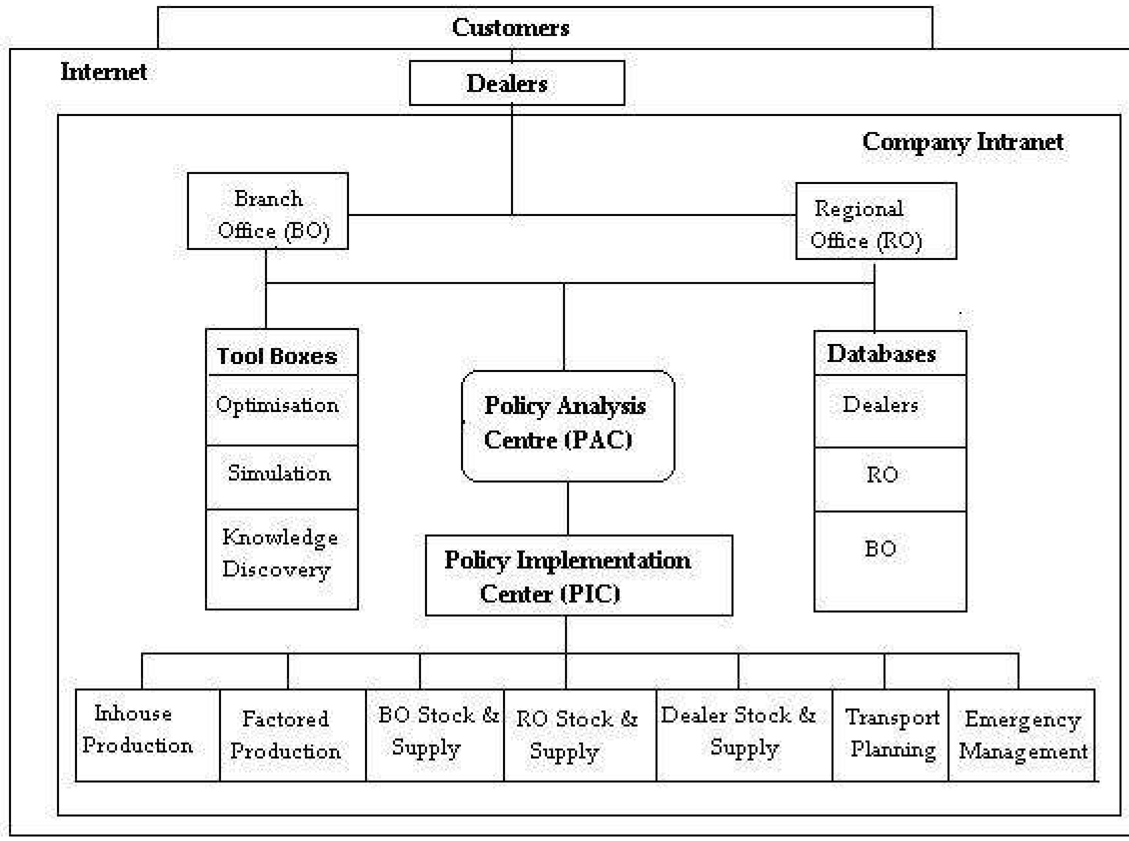

Figure 1.

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training workers to become effective members of teams and to be innovative. This is where the concept of knowledge management appears in the picture. The capability of the integrated system can be enhanced to the level of a knowledge management system for realizing responsive supply chains.

KNOWLEDGE MANAGEMENT SYSTEMS FOR ENHANCING RESPONSIVENESS

Knowledge management is concerned with recognizing and managing an organization's intellectual assets to meet its business objectives. As Duffy states [7], knowledge management is a business process and a professional discipline and describes a set of business practices and technologies used to assist an organization to obtain maximum advantage from one of its most important assets - knowledge. It is concerned with effective utilization of an organization's knowledge resource in a systematic way. Organizations are redesigning their internal structure and their external relationships, creating knowledge networks to facilitate improved communication of data, information, and knowledge, while improving co-ordination, decision making, and planning [8]. Knowledge networks allow their participants to create, share, and use strategic knowledge to improve operational and strategic efficiency and effectiveness. Partnership is critical to the creation and spread of knowledge, and creation and diffusion of innovation [9]. An integrated system proposed above may provide a good base for partnership.

A supply chain is an integration of various business processes to deliver what is of value to the customers. Enterprises that work sufficiently long time generate considerable knowledge in terms of expertise that are virtues of an organization. This repository of expertise can be stored, retrieved and deployed as desired with the help of what is called as knowledge management systems. Especially in an integrated system such as supply chain, the essence of capturing knowledge is more critical considering the scope and the spread of this system covering a number of business processes at various stages. Knowledge discovery tools like data mining can be used along with decision support systems to improve the responsiveness of the system. In the proposed framework, it is envisaged to use data mining tools for knowledge discovery.

Data mining has become a vital tool in trying to analyse markets, and to predict supply and demand uncertainties in supply chain systems. It can be used along with the decision support systems to improve the overall results of the system. The major stages for the data mining process for knowledge discovery include goal definition, data selection, data preparation, data exploration, pattern discovery, pattern deployment, and pattern validity monitoring [10]. The commonly used data mining tools are artificial neural networks, decision trees, and genetic algorithms, nearest neighbor method, rule induction, and data visualization [11].

The fundamental goals of data mining are prediction and description. Prediction makes use of existing variables in the database in order to predict unknown or future values of interest. Description focuses on finding patterns describing the data and making them available for user interpretation. There are several data mining algorithms, which are used to solve specific problems or objectives [10]. These are categorized as associations, classifications, sequential patterns and clustering. The basic idea behind associations is to find all associations such that the presence of one set of items in a transaction implies other items. Classification generation develops profiles of different groups. The method of sequential patterns identifies sequential patterns subject to a user-specified minimum constraint. Clustering segments a database into subsets or clusters. There is evidence in the published literature that data mining rules can be effectively integrated with applications built using relational data base systems [12].

CONCLUSION

Managing supply chains spread over different geographical areas is a complex issue especially when demand is uncertain. Effective information support can help mitigate the problems associated with the bullwhip effect and poor customer service. If the decision-making hub is properly integrated with the various constituents of the supply chain, and made available with dynamic information, the supply chain can be managed more effectively with the use of appropriate decision-making tools. The applications developed on relational database systems, if properly integrated with data discovery tools such as data mining, can significantly enhance the responsiveness of the supply chain. This paper proposes a conceptual framework, which makes use of information support, knowledge management and data mining to manage a supply chain.

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