International Journal of Business, Human and Social Sciences
ISSN: 2517-9411
Vol:7, No:12, 2013

An Integrated Supply Chain Management to Manufacturing Industries

Kittipong Tissayakorn, Fumio Akagi, Yu Song

***Abstract*—**Manufacturers have been exploring innovative strategies to achieve and sustain competitive advantages as they face a new era of intensive global competition. Such strategy is known as Supply Chain Management (SCM), which has gained a tremendous amount of attention from both researchers and practitioners over the last decade. Supply chain management (SCM) is considered as the most popular operating strategy for improving organizational competitiveness in the twenty-first century. It has attracted a lot of attention recently due to its role involving all of the activities in industrial organizations, ranging from raw material procurement to final product delivery to customers. Well-designed supply chain systems can substantially improve efficiency and product quality, and eventually enhance customer satisfaction and profitability. In this paper, a manufacturing engineering perspective on supply chain integration is presented. Research issues discussed include the product and process design for the supply chain, design evaluation of manufacturing in the supply chain, agent-based techniques for supply chain integration, intelligent information for sharing across the supply chain, and a development of standards for product, process, and production data exchange to facilitate electronic commerce. The objective is to provide guidelines and references for manufacturing engineers and researchers interested in supply chain integration.

***Keywords*—**Supply Chain, Supply Chain Management, Supply Chain Integration, Manufacturing Industries.

I. Introduction

TRADITIONALLY, commercial innovations in products, processes and services typically were achieved within vertically integrated industrial corporations. During the 1990's, the global competitive environment shifted towards a horizontal or virtually integrated industry structure involving close interaction among suppliers, manufacturers, and customers. A supply chain is "an integrated process wherein a number of various business entities work together in an effort to acquire raw materials, convert these raw materials into specified final products and deliver these specified final products to retailers". From [1], the supply chain comprises the production and supply of materials and parts, and it serves both the manufacturing logistics chain and distribution logistics chain. The manufacturing logistics chain deals with the logistics business processes related to the production of the customer article, while the distribution logistics chain combines all logistic operations involved with the consumer with the after sales market, including maintenance and repair of the consumer product. Due to shortened product life cycles, rising manufacturing costs and the globalization of market economies, increasing attention has been placed on the supply chain.

Manufacturing can be defined as an activity that utilizes a variety of capabilities and adds value to a material, thereby making possible different uses of that material. Each step in the manufacturing process adds value. The first manufacturers were probably artisans who worked by themselves to design and create products. They served as both supplier and manufacturer, gathering and managing the resources and applying various processes to add value to the materials. Over time, manufacturing progressed to a series of specialists, each of whom supplied or added specific amounts and type of values. The benefits of this division of labor were that (1) more resources could be brought to bear on the task, adding value, and (2) specialization tended to reduce costs and increase the efficiency, consistency and quality of each operation.

A strategic supply chain focuses on long-term relationships with customers. It would identify suppliers whose strategic goal is compatible with those of the supply chain. This goal concludes direction of technical innovation for the supplier and focuses on quality, reduction of costs and reduction in response times. In recent years, the supply chain management has advanced to some extent. However, failing to conduct comprehensive planning and integration on the whole supply chain, most of the enterprises are unable to properly monitor their supply chain or improve their decision making services from their overall operation indices, and their production and organization methods remain at the state of making to stock. Facing such fierce market competition, enterprises should conduct management innovation so as to improve their core competitiveness. The supply chain management innovation offers an effective way [2].

The remainder of this paper is organized as follows: First we introduce some related literature in the next section. Supply chain management innovation in the manufacturing industry is described in Section III. In Section IV, we briefly evaluate the manufacturing perspective. Finally, Section V concludes the paper with remarks on the future.

II. Literature Review

A supply chain is an integrated system wherein members of various business entities work together to address issues of both materials flow and information flow. Reference [3] presented a survey of the literature pertaining to analytic approaches for global supply chain strategy analysis and planning. Two fundamental approaches, stochastic network optimization

K. Tissayakorn is with the Department of Management and Systems Engineering, Graduate School of Engineering, Fukuoka Institute of Technology, Fukuoka, Japan (e-mail: killua.benz@gmail.com).

F. Akagi and Y. Song are with the Department of System Management, Faculty of Information Engineering, Fukuoka Institute of Technology, Fukuoka, Japan (e-mail: akagi@fit.ac.jp, song@fit.ac.jp).

models and option pricing methods, were summarized to characterize the global supply chain network strategy planning model. The integrated supply chain network model is developed to capture the complexities of a multi-product, multi-period planning problem for the optimal choice of facility locations, capacity and technology used, as well as sourcing, production and distribution decisions contingent on future states-of-nature. Option pricing approaches focus primarily on the evaluation of operational flexibility to enhance the firm's shareholder value.

Reference [4] explored the basics of supply chain management from a conceptual perspective by tracing the roots of the stream of literature. In their paper, supply chain management is also characterized as evolving over the years from materials management, physical distribution and integrated logistics.

Coordination of production planning among multiple plants in a vertically integrated firm was described in [5]. It is identified that production and inventory decisions could be determined for all plants in a manner optimal for the organization as a whole. Several issues that arise in coordinating the multi-plant structure including nervousness issues, lot sizing issues and safety stock issues are reviewed.

Reference [6] introduced optimal centralized and decentralized control policies for a two market stochastic inventory system concerning the Newsvendor problem. First, optimality of decentralized production control policies is demonstrated, with the production centers and a constant transfer price used to coordinate production. A decentralized production control structure with a nonlinear pricing scheme for production coordination among centers administrated through an intermediate organizational unit is also proposed. There are also other approaches proposed to achieve supply chain management.

III. Supply Chain Management Innovation the Manufacturing Industry

In a supply chain, the flow of information moves upstream, whereas the flow of material moves downstream. Information flows from customers to retailers, manufacturing companies, logistics, and raw material providers. It is the way the production systems have been working for decades. The difference in a supply chain is that all the partners should be informed simultaneously. The idea of introducing a common information system that sends the customer's information simultaneously to all the partners according to their needs is a major characteristic of the next generation of supply chains. Material flows downstream from suppliers of raw material or components to customers. As with information, the flow of material should be coordinated among all partners. This implies that activities should be coordinated upstream and downstream. The products in the manufacturing industry are mostly put into batch production in the form of making to stock by labor-intensive enterprises. The following features characterize the supply chain innovation of manufacturing industries:

A. Customer Satisfaction Approach

There is a range of products with different features to satisfy the needs of different types of customers. Typically, there are many manufacturers in the market that can supply comparable products with similar features and quality; the products are viewed by customers as commodities. Customers do not wait for the product to become available and will easily substitute a product for one that a competitor offers at a lower price for the same product features and quality. Thus it is important that the product be available at the time, in the right quantity and at the price the customer wants. To better satisfy the end-customers is the common goal of supply chain members. Manufacturing industries should change their traditional make to stock production and take the requirements and satisfaction of customers as their tenet [7]. The most important piece of information is what the customer wants. In this case, manufacturers have to have a strong knowledge of the technology and the capability to deliver in order to get the upper hand. The customer is willing to wait and pay a premium for quality, reliability and customized products.

B. Concept of New Cooperative Competition

Different from traditional business management models, the supply chain management system is cooperative, comprehensive and harmonious, including the inner management of nucleus enterprises, the utilization and cooperation of resources among all enterprises at every stage and requires all enterprises to participate in cooperative games so as to reach a win-win situation in the end. The manufacturing industry should establish the supply chain management concept of cooperative competition, regarding the supply chain as a branch system so as to set up dynamic alliances in which member enterprises can trust each other, cooperatively open up markets, realize maximum economic returns and share all costs they save and profits they create in the end.

C. Replying on Modern Network Information Technology

Supply chain management is the product of modern network information technology and the idea of strategic alliance. The highly integrated network information system serves as the technical foundation; in particular, Enterprise Resource Planning (ERP) is widely applied in the supply chain management [8]. ERP system created a revolution with their capacity to integrate different functional areas of an enterprise. They also looked at how companies overcome their inertia and reengineer their business process. Though managing the following of information, material and capital, it closely combines all manufacturing sites, marketing systems and finance systems of all enterprises to transform the traditional supplier-driven production model. It fully embodies the concept of manufacturing completely according to customer's requirements and realizes the strategy of talking customer satisfaction as the core through information and resources sharing.

IV. Manufacturing Perspective

As can be seen from the literature review provided in Section II, the supply chain has a strong business management and operations research emphasis. The role of manufacturing engineering in supply chain integration is presented. Research issues discussed include; product and process design for supply chain, design and evaluation of manufacturing supply chain, agent based techniques for supply chain integration, intelligent information sharing across the supply chain and development of standards for product, process and production data exchange to facilitate electronic commerce.

A. Product and Process Design for Supply Chain

Within a manufacturing supply chain, each entity will increasingly need to improve coordination not only in the area of demand replenishment, but also in the area of demand generation through joint development of new products. Design for a supply chain can result in major improvements of a company's profitability.

B. Design and Evaluation of Management Supply Chain

To improve productivity, reduce costs and shorten product time to market, manufacturing companies need to establish an appropriate supply chain. This calls for a formal methodology for the design and evaluation of the manufacturing supply chain. A two phased approach for the optimal design of a supply chain. First, a mathematical programming formulation and heuristic solution approach was used to minimize the distinct number of product types held at various points in the supply chain. Then a spreadsheet inventory model was used to estimate the safety stock needed to absorb random fluctuations in both demand and lead time throughout the system [9]. Reference [10] developed a deterministic model for determining economic levels for the base stock and lead time for production and transportation in integrated production, inventories and distribution system. Operation research models and techniques are well suited for analyzing the local performance of logistic sub chains and processes. However, the operation research approach, in which the OR model is the starting point of analysis and data structure is derived from the model, is insufficient to support the analysis of the performance of an integrated logistic chain; an experimental environment is needed, including a set of OR models and having the capability to easily and quickly build these logistic models [11].

C. Agent Based Techniques for Supply Chain Integration

Information capabilities can accomplish similar results whether operating from a highly centralized or decentralized direction, and a decentralized application calls for a new paradigm in supply chain integration. One promising approach is the agent based distributed artificial intelligence approach. One can see an agent as an autonomous, goal directed, computational process capable of robust and flexible interaction with its environment. While conventional systems rely on sequential operation, the agent architecture facilitates distributed and concurrent decision making. Agents are able to communicate with each other in order to collaboratively solve a challenging problem. Multi agent systems offer a new dimension for supply chain integration.

In [12] some preliminary results were reported from an agent based model of a simple supply network, together with some validating analyses of operating data from supply chains in automotive and electronics assembly. Then, the author discussed the benefits of agent based models in comparison with more traditional differential equation models of system behavior at the enterprise level. Although agent based techniques hold great promise to achieve supply chain integration, there are a number of issues in agent application that need serious consideration. An important issue is the potential chaotic behavior of an agent based system, which has been demonstrated based on mathematical theory and examples [13]. Therefore, researchers should explore approaches that can minimize, if not eliminate, the potential chaotic behavior of agent based systems.

D. Intelligent Information Sharing Across Supply Chain

Unfortunately, information distortion is common in a supply chain. One such distortion is the bullwhip effect. The variability of an upstream site is always greater than those of the downstream site. The bullwhip effect was described using a stochastic analytical model [14]. The authors highlighted strategies that can be used to counteract the bullwhip effect. These strategies include information sharing, channel alignment and operational efficiency. Reference [15] discussed the effect of demand distortion and control surges in a number of enterprises and presents ways of solving the problems occurring. In the communication between all entities with the supply chain, delays and distortions may substantially affect how the industrial enterprises operate and lead to near chaos As many researchers have suggested, the keys to success in supply chain management should be focused on integration of activities, cooperation, coordination and information sharing throughout the entire supply chain. With information sharing, demand information at a downstream site is transmitted upstream in a timely fashion and thus, facilitates decision making. In order to achieve efficient information sharing, companies are beginning to introduce new types of intelligent decision support systems. A key success factor for intelligent information sharing is the availability of useful information. This means that there is a large amount of data available, but useful information has yet to be extracted from it. Therefore, researchers should explore the application of data mining techniques in information extraction for supply chain integration.

E. Development of Data Exchange Standard

Data exchange, specifically electronic data interchange (EDI), was identified as an important factor in contributing to partnership satisfaction. Reference [16] examined effects generated by the implementation of EDI technology on supply chain management through a case study. EDI was initially used to support business transactions between suppliers and their customers including invoicing, purchase orders, purchase order acknowledgement, dispatch notifications, stock reports, etc.

Recently, EDI is beginning to be used to exchange technological data, more specifically, product data. In order to advance electronic commerce, manufacturing engineering should first focus on computer-aided design (CAD) and computer-aided manufacturing (CAM) data exchange. CAD/CAM systems are commonly used to provide a seamless interface between design and manufacture of products. Using CAD/CAM systems, the geometry and processes of a product can be defined and validated digitally. This enables a manufacturing company and its partners and suppliers to work concurrently and collaboratively. A supply chain consists of different corporations. Hence, product data exchange becomes a critical issue.

V. Conclusion

Supply chains are problem systems that consider production from horizontal standpoints instead of vertical ones. Since manufacturing is an important aspect of a supply chain, manufacturing engineers should not be left out of supply chain research. This paper presents a manufacturing engineering perspective on supply chain integration. Facing a competitive situation, the manufacturing industry is required to conduct supply chain management innovation so as to constantly improve the core competitiveness of all related enterprises. The strategic supply chain management is an integrated management that involves a wide range of areas, mainly including four large areas of supply, production planning, logistics and demands, and enterprises are required to be cooperative both in intra-enterprise and inter-enterprise operation. A unified planning with due consideration must be done to ensure the promptness and effectiveness of the supply chain and enable the manufacturing industry to remain invincible amid fierce market competition. Putting undue emphasis on one aspect should not be done. The emergence of supply chain integration will have a profound impact on engineering practices. Manufacturing organizations are now establishing partnerships with suppliers. They need to incorporate these suppliers into their product development process from the early phases by applying concurrent engineering and integrated logistics support concepts. Suppliers will then have more opportunities to participate in product specifications and anticipate future problems and responsibilities to propose new ideas for product development and to plan, produce maintain and carry out traceability throughout the total product life cycle. This paper discusses technical aspects of the collaboration between manufacturing companies and their suppliers. While solving technical problems is necessary, it is not sufficient to ensure successful collaboration to achieve supply chain integration. The success of supply chain integration also requires research to be conducted on social aspects of multi-organization collaboration. As a result, manufacturing engineering would benefit from a multi-disciplinary team when conducting research on supply chain integration.

Acknowledgment

We would like to express our deepest appreciation to those people who helped in even the smallest way in making the completion of this paper entitled “An Integrated Supply Chain Management to Manufacturing Industries” possible.

References

[1] Beamon, B. M., “Supply Chain Design and Analysis: Models and Methods”, International Journal of Production Economics, Vol. 55, 281-294, 1998.
[2] Zhang H., “Utilizing Supply Chain Management to Promote Enterprise Competency”. Market Modernization, Vol. 7, pp. 95- 96, 2008.
[3] Cohen, M. A., and Huchzermeier, A., “Global Supply Chain Management: A Survey of Research and Applications, Quantitative models for Supply Chain Management”. Article, 1998.
[4] Ganeshan, R., Stephens, P., Jack, E., and Magazine, M., “A Taxonomic Review of Supply Chain Management Research, Quantitative models for Supply Chain Management”, The Netherlands: Kluwer Academic Publishers, pp. 839 – 879, 1999.
[5] Bhatnagar, R., Chandra, P. and Goyal, S. K., “Models for Multi-Plant Coordination”, European Journal of Operation Research, Vol. 67, pp. 141 – 160, 1993.
[6] Kouvelis, P., and Gutierrea, G., “The Newsvendor Problem in a Global Market: Optimal Centralized Control Policies for a Two-Market Stochastic Inventory System”, Management Science, Vol. 43, No. 5, pp. 571 – 585, 1997.
[7] Sui Y., “Logistics Management Innovation ender the Environment of the Supply Chain Management”. Pioneering with Science & Technology Monthly, Vol. 3, pp. 52 – 53, 2008.
[8] Luo M., Ma W., “Analysis on SCMIS Structure Oriented Equipment Manufacturing Industry”. Logistics Technology, Vol. 2, pp. 108 – 110, 2008.
[9] Newhart, D. D., Stoott, K. L., and Vasko, F.J., “Consolidating Product Sizes to Minimize Inventory Levels for a Multi-stage Production and Distribution System”, Journal of the Operational Research Society, Vol. 44, No. 7, pp. 637 – 644, 1993.
[10] Ishii, K., Takahashi, K., Muramatsu, R., “Integrated Production, Inventory and Distribution Systems”, International Journal of Production Research, Vol. 26, No.3, pp. 474 – 482, 1988.
[11] Slats, P. A., Bhola, B., Evers, J. J. M., and Dijkhuizen, G., “Logistic Chain Modeling”, European Journal of Operational Research, Vol. 87, pp. 1 – 20, 1995.
[12] Parunak, V., and Vanderbok, R., “Modeling the Extended Supply Network”, Industrial Technology Institute, working paper, 1998.
[13] Sarri, D. G., “A Chaotic Exploration of Aggregation Paradoxes”, SIAM Review, No. 1, pp. 37 – 52, 1995.
[14] Lee, H. L., Padmanabhan, V., and Whang, S., “Information Distortion in a Supply Chain: The Bullwhip Effect”, Management Science, Vol. 43, No. 4, pp. 546 – 558, 1997.
[15] Holmstrom, J., Hameri, A. P., Nielsen, N. H., Pankakoshi, J. and Slotte, J., “Example of Production Dynamics Control for Cost Efficiency”, International Journal of Production Economics, Vol. 48, pp. 109 – 119, 1997.
[16] Calza, F., and Passaro, R., “Case Study: EDI Network and Logistics Management at Unilever-Sagit”, Supply Chain Management, Vol. 2, pp. 150 – 170, 1997.

Kittipong Tissayakorn was born in Sukhothai, Thailand. He earned his bachelor degree at King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand. Currently, he is a master’s degree student at the Graduate School of Engineering, Fukuoka Institute of Technology, Fukuoka, Japan.

Fumio Akagi was born in Japan. He earned his Ph.D. at Osaka City University, Japan in 1985. Currently he is a professor at Fukuoka Institute of Technology, Fukuoka, Japan.

Yu Song was born in China. He earned his Ph.D. at Tohoku University, Japan. He is a professor at Fukuoka Institute of Technology, Fukuoka, Japan.