

## **Developing an Information Model for Supply Chain Information Flow and its Management**

**A. M. M. Mukaddes, C. A. A. Rashed, A. B. M. A. Malek, M. J. Kaiser and S.M. S. Alam**  
**Department of Industrial and Production Engineering**  
**Shahjalal University of Science and Technology, Sylhet, Bangladesh**

### **Abstract**

In order to deal with the accompanying challenges, organization must embrace latest information technology, e-business and the internet that allow increasingly better opportunities for assisting with supply chain management and improving business performance. Supply chain management, a management method to optimize system-wide costs has evolved as an application of information technology (e-commerce, e-business). Information technology plays a vital role for increasing collaboration among supply chain members. From the information point of view the effective supply chain management must provide the right amount of relevant information to the right person at the right time. To develop an information model and to build an application database system are the current research emphasis of this paper. The information model deals with the integration of supply chain members and concentrates the flow of information among the chain members. A case study is performed to identify the data/information necessary to represent the communication for the production management of a supply chain. The data specification is used as the basis for developing the application software to support the supply chain integration and management. The application software is developed using the Java and SQL.

### **1. Introduction**

Supply chain management is a set of approach utilized to 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 costs while satisfying service level requirements [1]. Today, material suppliers, channel supply partners (wholesaler, distributors, retailers, transportation) and customers themselves are all key players in supply-chain management. In order to efficiently and effectively manage a supply chain, as well as to gain a competitive advantage, use of information technology is increasingly become extremely important. Information is the key to successful supply chain management because “no product flows until information flows”. For example the inventory manager needs direct access to the organization’s information system to properly administer materials flow into and within the organization. Accurate and timely information allows a firm to minimize inventories, improve routing and scheduling of transportation vehicles, and generally improve customer service levels. Different types of data are often used to control operations in an individual firm and are also used for negotiation among chain members that form a virtual organization to provide products and services to customers. Thus, modern information technology will offer opportunities for the fast and safe transmission and processing of extensive amounts of data, both internally for users within the company and externally for suppliers and customers. Paperless communication is coming to the forefront whereby routine tasks in order processing and scheduling will be decisively facilitated (figure1). As a result, new information technology offers great opportunities for linking the planning, control, and processing functions of inventory management. The proliferation of computerized information systems and databases, coupled with electronic data interchange (EDI), will make this facet of materials management even more significant in the future. The paper focuses the role of information technology in the supply chain management. Many conceptual papers [1, 2] have addressed the value of information technology/information sharing in supply chain management. The Wal-Mart & P&G experiences demonstrate how information sharing can be utilized for mutual advantage [3]. The major objectives of this paper are to develop a model for information flow and build an application data base system for supply chain management.

There are several information modeling methodologies and implementation method available to support the development of a communication mechanism to manage individual chain members. Data specification and an information model of supply chain simulation are overviewed in [4]. The configuration of the information model is based on the collected data by authors and a case study of U.S. power tool manufacturing company [3]. The developed model can be applied in various stages of supply chain effectively. The developed data base system can

store/distribute information about different chain members in a user friendly way. The scope of this research is to implement the model for the purpose of taking competitive advantages from the market place. The focus is limited to companies from different manufacturing sectors in Bangladesh including textiles, paints and cement industries.

## 2. Information and Technology: Importance in Supply Chain

In the developing country like Bangladesh the information flow between functional areas within an organization and between supply chain member organizations is paper based. The paper based transaction and communication is slow. In this way, information might be often over looked as a critical competitive resource because its value to supply chain members was not clearly understood. IT infrastructure capabilities provide a competitive positioning of business initiatives like cycle time reduction, proper utilization of resource, implementing redesigned cross-functional processes. Several worlds well known firms involved in supply chain relationship through information technology. Two factors have strongly impacted this change in the importance of information. First, satisfying in fact pleasing customer has become something of a corporate obsession. Second information is a crucial factor in the managers' abilities to reduce inventory and human resource requirement to a competitive level. Information flows plays a crucial role in strategic planning. Figure 1 shows the role of information technology in supply chain management. The present authors identify some benefits of information technology in supply chain management although the basic set up cost is high.

- Higher visibility
- Immediate information
- Greater accuracy
- More economic
- Better customer service
- Higher productivity
- Reduced paper work
- Faster processing

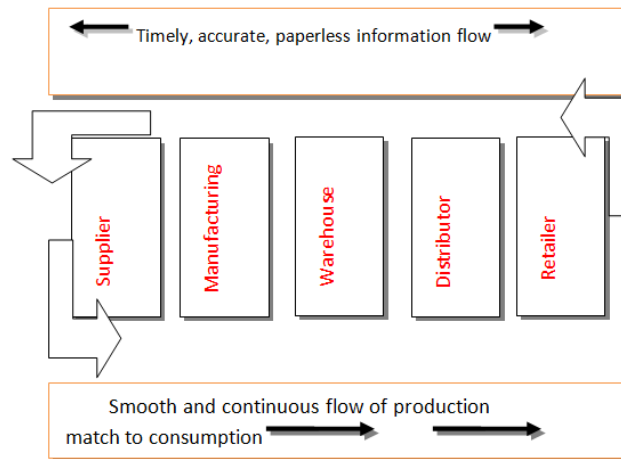


Figure 1: Role of Information Technology in Supply-Chain Integration

## 3. Data Specification for the Information Model

A requirement analysis has been performed for data specification. We perform several interviews with selected company, which plays a role of a prime contactor in their supply chain system. The material flows and information flows in the supply chain were our focus. A set of core processes of supply chain management is identified and then the input and output messages within the core processes are selected. Finally the information required for the integration of the supply chain system is identified. From the case studies we got the following information categories which are flow among the supply chain members:

1. Periodic Purchase order
2. Response to periodic purchase order
3. Urgent purchase order
4. Response to urgent purchase order
5. Distribution order
6. Demand information
7. Pre-estimation of delivery order
8. Response to delivery order
9. Delivering order
10. Manufacturing order
11. Urgent manufacturing order
12. Periodic response about manufacturing

- |                                      |   |
|--------------------------------------|---|
| 13. Shipment order                   | 19. Transport order from manufacturer                             |
| 14. Supplement stock order           | 20. Response of different transport order                         |
| 15. Safety stock order               | 21. Data for resource in manufacturing, warehousing               |
| 16. Transport order from supplier    | 22. Data for inventory in manufacturer, warehouse and distributor |
| 17. Transport order from distributor |   |
| 18. Transport order from warehouse   |   |

Each message/application object is an atomic element that embodies a unique application concept and contains attributes specifying the data elements of the object.

#### 4. Information Sharing

In recent years numerous studies have emphasized the importance of information sharing within the supply chain [12, 13]. An important strategy for managing integrated supply chains is to share information among supply chain partners. Lack of knowledge sharing between members of the supply chain has been shown to significantly affect overall performance [6-8]. One of the main benefits of sharing information is the reduced need for inventory. As a result, the supply chain achieves better performance in terms of financial returns, service level and time. With the information share among the manufacturer and the retailer, the manufacturer can use the information about the inventory level of the retailer to manage the frequency, quantity, and timing of the shipments-instead of waiting for the retailer to place orders. Following information should be shared among chain members for continuous flow of product.

From Retailer to Headquarter and vice versa: Urgent purchase order, Response to urgent purchase order and Conformation of urgent purchase order

From Distributor to Headquarter and vice versa: Demand information, Safety stock order, supplement stock order, Purchase order and conformation of product from manufacturer or warehouse

From Warehouse to Headquarter and vice versa: Safety stock order, supplement stock order and Ship order.

From Manufacturing to Headquarter and vice versa: Periodic manufacturing Order, Urgent manufacturing order, Response of manufacturer, Conformation of material from supplier and Stock available inventory.

From to Headquarter Transport administration and vice versa: Reason behind negative conformation.

From Supplier to Headquarter and vice versa: Pre estimation of order, Response of pre estimation and Delivery order

From Retailer to Distributor: Distribution order, Conformation of order.

From Manufacturing to distributor or retailer: Conformation of product

From Supplier to transport administration and vice versa: Component transport order to supplier, Response of order

From Distributor and Retailer to transport administration: Component transport order and its response.

#### 5. Proposed Information Model

The information model which is given focuses on the minimal set of the data that need to be exchanged between members of supply chain. A communication data flow analysis of the supply chain was performed. As a result of data requirements used to communicate among the supply chain members have been identified these data requirements are a set of objects; they are grouped into seven units of functionality: headquarter, supplier, manufacturing plant, distributors, warehouse, transportation administration and retailers. The manufacturing plants manufactures product by using the raw materials provided by the suppliers. The distributors stores inventories and supply the products to customers through retailer. The headquarter; manufacturing plant and warehouse might belong to the same company. The warehouse meets the uncertainty of demand. The can share management information at any time by a common data base system. The transportation administration gives smooth flow of materials to customer demand. The information are basically stored in the headquarter data base. By using this information the headquarter can evaluate the efficiencies and effectiveness of each chain members. Using the central data base system, an individual member exchanges data with other members to synchronize their business operations. These exchanged data discussed in section 3. These data are often used to control operations in an individual firm and are used for negotiation among chain members that form a virtual organization to provide product and services to customers.

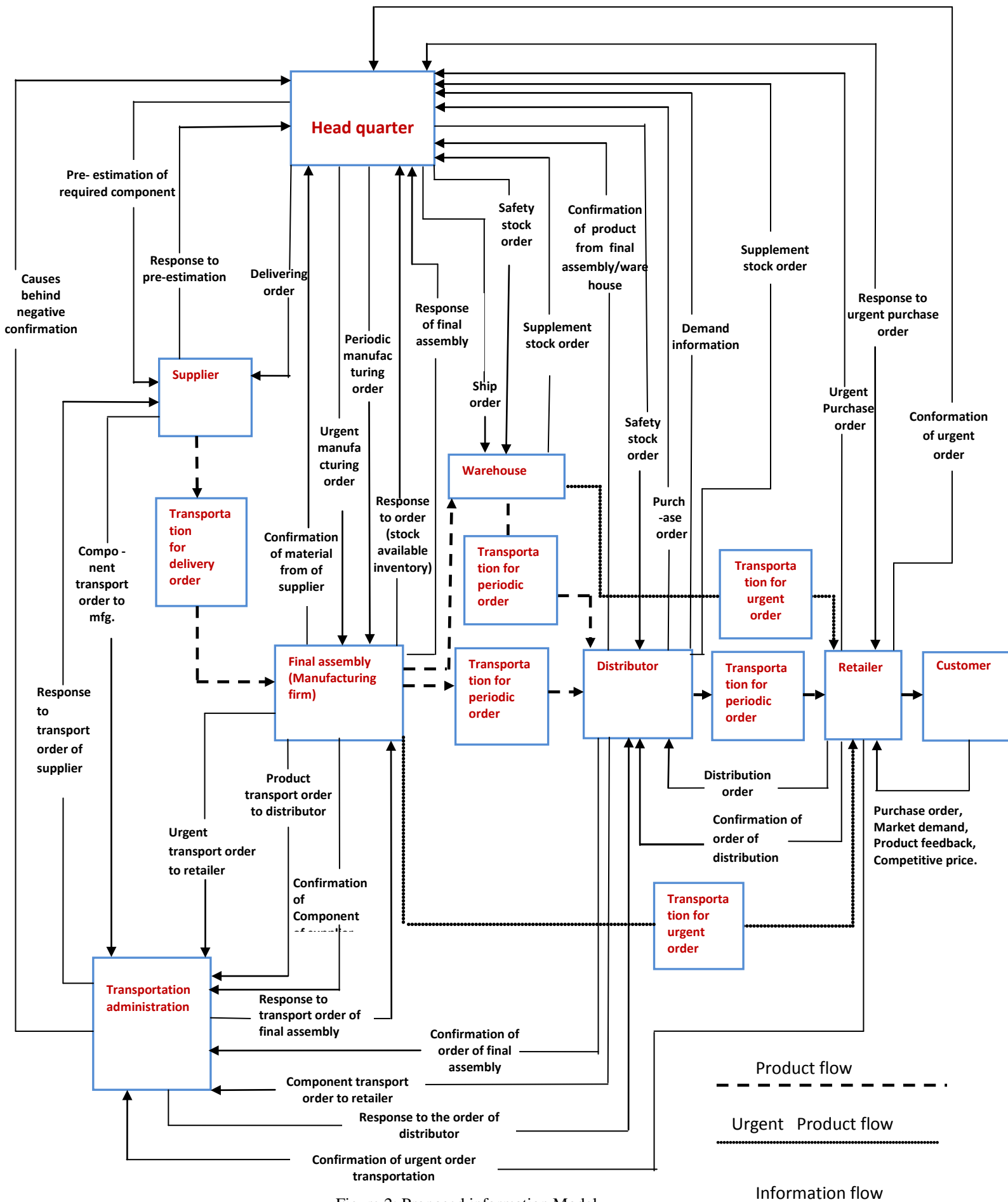


Figure 2: Proposed information Model

## 6. Data Communication Mechanism

The immediate connection between a headquarter and a supplier, headquarter and a distributor increases cooperation and efficiency between firms. The success of worldwide retail chain Wal-Mart frequently has been attributed to the electronic data interchange (EDI) system installed among its pool of suppliers. Also, the ubiquity of the Internet allows more companies to operate on a common platform without heavy investment in closed information networks such as EDI. The more those companies conduct trades online, the more profitable Internet-based supply chain management will become. Wigand [9] also emphasized the importance of optimal Organizational fit and alignment in the deployment of information technology. Fig3 shows Information Technology Infrastructure for our model given in fig3. Following are the few ICT network scheme: Public Network, Private Network, Virtual private Network(VPN) . A virtual private network combines the advantage of private and public networks by allowing a company with multiple sites to use a public network to carry traffic between sites. We will choose a VPN model for implementing our model. The model will use telephone line for data transmission. Intelligent application of information technology also can eliminate duplicative data entry, provide real-time status information [10].

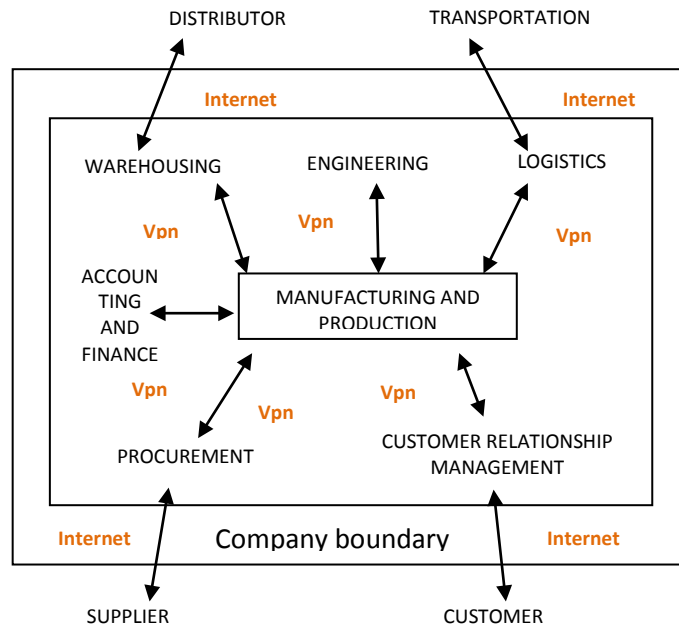


Figure 3: Networking connection among supply chain members

The information infrastructure of an organization is extremely important and is even considered a key success factor in any SCM transformation exercise. In fact, the information infrastructure refers to the physical facilities, services, and management that support all shared computing resources in an organization [11].

## 7. Application Software Overview

To implement supply chain information-flow management we develop application software and a database system. A database plays an important role for information storage. An important task for the purpose of information flow and storage information is to create database. One thing should be kept in mind during software development is that software should be flexible in use and to be simple to suit existing communication system. In figure 4 we shows layout of software. Due to the page limitation details software could not be described. The software is developed with the help of JAVA and it is linked with SQL+ for the purpose of data storage. So, any one can create database with little knowledge of SQL+ with the help of this software. The button SHOW INFORMATION gives all information which is storage in the database system. After clicking any particular type of information, the headquarter can see all information available for that database. The headquarter can print all information or any particular information with respect to that database and also can add, remove or update the database. The supply chain members directly access the headquarters database if they are connecting with company network.

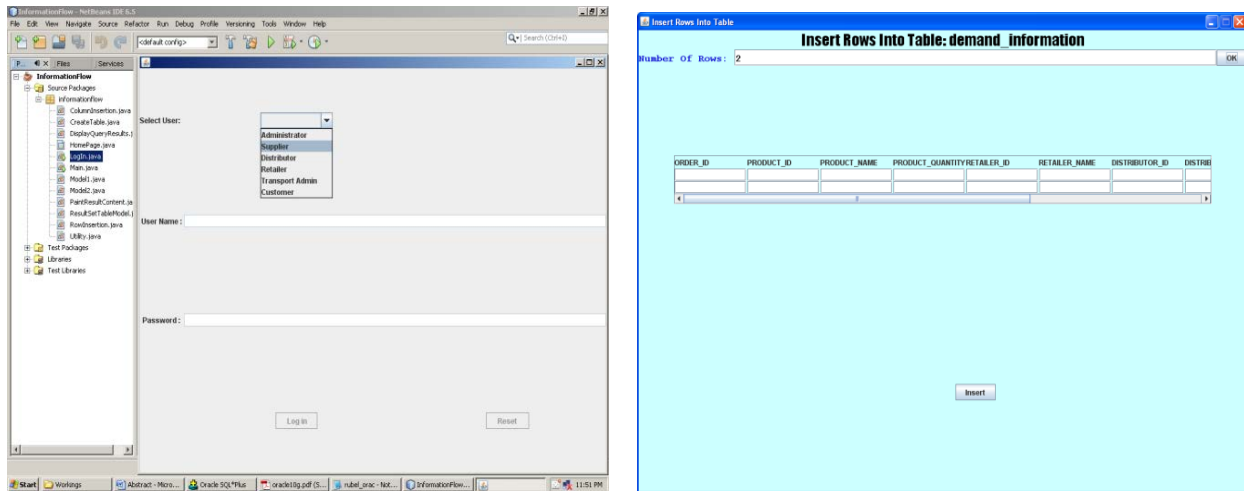


Figure 4: Application software

## 8. Conclusion

Information is the key to successful supply chain management because without information sharing product flow is impossible. Paper based information flow is time consuming. This paper proposed an information model for information sharing among the supply chain members. The information that must be exchanged is specified. The proposed model provides the accurate and timely information to the right person minimizing inventories, improving scheduling of transportation and customer service leveling. Application database software is developed based on the proposed model. The data base might substitute the conventional paper based system in the developing countries.

## References

- 1 Levary, R. R., (2000) Better supply chains through information technology, *Industrial Management*, 42(3), pp. 24-33.
- 2 Zhao, X., XIE, J., and Zhang, W.J. (2002), "The impact of information sharing and ordering coordination on supply chain performance", *Supply Chain Management*, vol. 7, no 1, pp. 24-40.
- 3 Graen, M., and Shaw, M.J., (2002), *Supply-Chain Integration through Information Sharing: Channel Partnership between Wal-Mart and Procter & Gamble*, Research note of Center for IT and e-Business Management, University of Illinois, Urbana-Champaign, IL, available at: <http://citebm.cba.uiuc.edu/IT-cases/Graen-Shaw-PG.pdf>.
- 4 Simchi-Levi, D., Kaminsky, P., and Simchi-Levi, E., (2000) *Designing and managing the supply chain: concepts, strategies and case studies*. Irwin McGraw-Hill.
- 5 Lee, Y. T., *Information Modeling: From Design to Implementation*, Proceedings of the second world manufacturing congress, International computer sciences conventions, Canada/Switzerland.
- 6 Armistead and Mapes, (1993), "The Impact of Supply Chain Integration on Operating Performance," *Logistics Information Management*, vol. 6, pp. 9-14.
- 7 Anderson, E., and Fine, C., (1999), "Business Cycles a Productivity in Capital Equipment Chains", in *Quantitative Models for Supply Chain Management*, ed. S. Tayur, et al, (Kluwer Academic Publishers, Boston).
- 8 Bhaskaran, S., (1998), Simulation analysis of a manufacturing supply chain, *Decision Sciences*, vol. 29 (3), pp. 663- 657.
- 9 Wigand, R. T., (1997), *Electronic commerce: Definition, theory, and context*. The Information Society, vol. 13(1), pp. 1-16.
- 10 *Integrated Supply Chain Management Optimizing Logistics Support*, A concept paper from *the Learning Source* at the OSD Comptroller iCenter, <http://www.dtic.mil/comptroller/>
- 11 Turban, E., (2004) *Electronic commerce*. Upper Saddle River, Prentice Hall.
- 12 Barrat, M., (2004). Understanding the meaning of collaboration in the supply chain. *Supply Chain Management: An International Journal*, vol. 9(1), pp. 30-42.
- 13 Lambert, D. M., and Cooper, M. C., (2000). Issues in supply chain management. *Industrial Marketing Management*, vol. 29(1), pp. 65-83.