Developing and Optimizing Distribution Model of Electronic Supply Chain Management System in Indian Context

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ABSTRACT
The proposed study will develop a framework to assess the electronic supply chain management model based on the existing literature and the impact of information technology (IT) and electronic commerce (EC) on supply chain management (SCM). The framework will result in recognizing the structure, operations, and performance indicators of electronic supply chain in Indian context and optimizing the various variables considered. It will provide an interdisciplinary view of electronic commerce and supply chain modeling.

1. INTRODUCTION
Firms are facing intense competition in today’s global business environment. They have to produce quality products at competitive prices with uncertain demand. To be competitive, a firm has to quickly respond to demand fluctuations, competition, and new market opportunities. Lagging the competition even slightly can be a threat to the viability of the business. In addition, businesses need to be increasingly customer-driven and more efficient both in the operations and in interaction with suppliers and partners. All these require a very efficient supply chain management.

1.1 Impact of IT and EC on SCM
Information technology is a critical enabler of effective supply chain management. Indeed, much of the current interest in supply chain management is motivated by the opportunities that appeared due to abundance of data and the savings that can be achieved by sophisticated analysis. Moreover, Internet is emerging as the most efficient way of sharing information across the supply chain. This has changed the nature of competition and firms’ operations. Electronic commerce is transforming the marketplace by changing the rules of the game. Firms can now sell directly to end consumers. It also provides them with the opportunity to reach new markets, increase sales, and reduce the cost of doing business.

Electronic commerce is transforming the marketplace by changing firms’ business model, by transforming relations among market actors, and by contributing to changes in market structure. It provides the opportunities for economic growth created by organizational change. It also creates the possibility of new models for organizing production and transacting business, by offering complementary products/services in business models.

One of the major effects of electronic commerce on supply chain management system is the emergence of Internet enabled distribution channel. The two of the most prominent sales channel on the Internet are the direct sales via Company Web sites and sales via Electronic Marketplaces [Keskinocak and Tayur, 2001]. These distribution channels may require a different supply chain structure (number of echelon levels, location of warehouses, etc.) and policy (inventory and transportation policy).

1.2 Context
Online information sharing between the supply partners includes information related to orders, stock position, transportation details, etc. Theoretically, the electronic supply chain will lead to operate the functions of supply chain in more efficient and cost effective manner. The broader issue the firms are facing is how they can extract the benefits of electronic supply chain, what should be their supply chain structure, which operations should they automate, etc.

2. LITERATURE REVIEW
The theoretical foundation of the proposed study will be based on supply chain optimization, impact of information technology and information sharing on supply chain management, and Internet enabled distribution channel.

2.1 Supply Chain Optimization
The two major elements of supply chain optimization i.e. inventory and distribution models have attracted much attention from academics and practitioners.

At the discrete level, inventory model is designed to address two fundamental issues: when to replenish and how much to order. The problem is to minimize the cost of distributing products located at a central facility to geographically dispersed facilities with different objectives to meet such as, minimizing variable distribution cost, optimization of fleet size, and minimization of delivery time. Much of the interest now lies in integrated distribution-inventory models.

One of the first papers that consider an integrated distribution-inventory model has been done by Burns et al. (1985). They derived formulas for transportation and inventory costs, and determined the trade-off between these costs. Further, they analyzed and compared the two distribution strategies; direct shipping and peddling. Anily and Federgruen (1990) discussed a similar problem with a depot and many dispersed retailers to determine feasible replenishment strategies to minimize long run average transportation and inventory costs.

2.2 Information flow in Supply Chain
One of the important components of SCM is to manage the information flow between the partners in multi-stage production-distribution networks. Identifying and managing information requirements in the supply chain for decision-making process are becoming critical. Many authors have even argued that information flow within the chain can be a substitute to the inventory. Chen (1999) have shown that the information lead-time plays the similar role as the production / transportation lead-time in the determination of the optimal replenishment strategies; information lead-time being less costly.

Lee and Whang (2000) have discussed various types of information to be shared as inventory, sales, demand forecast, order status, and production schedule. Cachon and Fisher (2000) studied the value of sharing demand and inventory data. Chen et al. (2000) quantified the bullwhip effect and Lee et al. (2000) quantified the information sharing in a supply chain.
3. RESEARCH QUESTIONS

The research objective is “to develop and optimize the distribution model of electronic supply chain in Indian context”. The proposed study will be addressing following research questions:

- How the distribution model of electronic supply chain is different from the traditional supply chain in terms of structure, lead-time, inventory policy, cost elements, pricing structure, etc.?
- How the distribution model of electronic supply chain can be optimized?

4. RESEARCH METHODOLOGY

The proposed research will be an exploratory study to develop and optimize the distribution model of electronic supply chain in Indian context. The research will be using multiple methodologies to answer the research questions.

4.1 Conceptual Model

The concept model formulated from the theoretical inputs, requires a thorough verification for completeness of all the variables in the conceptual model. For this we adopted the case methodology approach. We have done comprehensive case studies with the three manufacturing organizations, which has implemented Web application for doing business, and studied their supply chain operations related to distribution. The profile of the studied organizations varies from Industrial Product to Fast Moving Consumer Goods with varied supply chain structure and operations. This has captured the issues involved in the distribution of electronic supply chain in Indian context.

4.2 Research Approach

The broad approach of this research is appended in the following steps:

- The case studies with the organizations verified the variables considered in the conceptual model and provided the cost elements. We are in a process to formulate and optimize the generic model of the electronic supply chain for the specific industry taking the issues and cost elements from the case-studies. The model will address the worthiness of performing different operations through online computer applications. For example: the FMCG firm is dealing with a single inventory product. The majority of the plant production is consumed in a nearby metropolitan city. Now, through modeling approach (Refer-Appendix A) we will try to find out whether the online stock information at these retail outlets will be beneficial for the company. The approach will be to find out the total expected contribution with and without perfect stock information. The difference between the two cases and the total cost for the online information sharing and processing will allow deciding whether the online information sharing will help the firm.

5. SIGNIFICANCE OF THE STUDY

The aim of the study is to address the issues involved in the distribution model of electronic supply chain in Indian context, where currently limited knowledge exists. This study will address some current questions facing the Indian organizations to efficiently manage their logistics in electronic commerce era. It will result in recognizing the structure and operations of electronic supply chain and a framework for optimizing the various variables considered. It will provide an interdisciplinary view of electronic commerce and supply chain modeling.

REFERENCES


APPENDIX - A

Model Formulation

Sets

- \( r \): Retailer
- \( p \): Product

Information Technology and Organizations 1155

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v: Vehicle

**Parameters**
- \( X_{rp} \): Quantity of product 'p' demanded at retail outlet 'r' (litres)
- \( F_{rp}(X) \): The probability density-function of demand at retail outlet 'r' for product 'p'.
- \( US_p \): Understocking cost of product 'p' (Rs. per litre)
- \( OS_p \): Overstocking cost of product 'p' (Rs. per litre)
- \( N \): Number of vehicles in the transportation system (number)
- \( VL \): Vehicle capacity load (crates)
- \( Cap_r \): Storage capacity at retail outlet 'r' (crates)
- \( Sup_p \): Available supply of product 'p' (crates)
- \( Stk_{rp} \): Stock of product 'p' available at retail outlet 'r' (litres)
- \( Qty_{rp} \): Total quantity of product 'p' available at retail outlet 'r' for meeting the demand (litres)

**Variables**
- \( Q_{v rp} \): Quantity of product 'p' to be delivered at retail outlet 'r' by vehicle 'v' (crates)
- \( Y_v \): Is 1 if the vehicle 'v' is used for delivery purposes, otherwise 0 (binary decision variable)
- \( D_{vr} \): Is 1 if the vehicle 'v' is used to deliver at retail outlet 'r', otherwise 0 (binary decision variable)

**Note:**
- A crate is a plastic container, which can hold 10 litres of milk.

\[
\text{Qty}_{rp} = 10 \times (\sum_v Q_{v rp} + Stk_{rp})
\]

**Objective function**
The objective is to minimize the total expected understocking and overstocking cost at each retail outlet for each product.

\[
E(z) = \sum_p \sum_r Q_{v rp} X_{rp} F_p(X) \, dx \cdot OS_p + \sum_r \sum_p \int_{0}^{\infty} (X_{rp} - Q_{v rp} X_{rp} F_p(X) \, dx) \cdot US_p
\]

**Constraints set**
- \( \sum_v \sum_p Q_{v rp} \leq Cap_r \)
- \( \sum_r \sum_p Q_{v rp} \leq Y_v \cdot VL \)
- \( \sum_v \sum_r Q_{v rp} \leq Sup_p \)
- \( \sum_r Y_v \leq N \)
- \( \sum_p Q_{v rp} \leq D_{vr} \cdot VL \)
- Non-negativity constraint.