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Global Distribution and Supply Chain Management- A Road to Success

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ABSTRACT

Even aspects of supply chain management itself have become increasingly specialized. Transportation management is becoming a specialty distinct from overall logistics management, whereas purchasing is specializing in applied topics like sourcing strategies, supplier quality methods, value engineering, and so on. The supply chain is treated as integrity which is composed of many operating elements realizing their own goals by means of taking part in the chain. From the point of view of each unit the integrity is subject to modeling and is the potential area for optimization. This depiction of the supply chain means that the chain is (in material meaning) a separate and independent organization with defined goals, defined internal structure and financial resources. In this way, supply chain becomes a separate economic unit (at least in theory) who is able to compete with other chains on the market and also may be a research subject of the organization and management theory. The present paper explores the following issues: Development of the concept of supply chain, The need for supply chain management., Type of supply chain management model(s), Framework of the supply chain management model(s). Supply chain performance measures, Issues in the design of supply chain management framework. Supply chain decisions. Quantitative methods and supply chain management (SCM).

1. INTRODUCTION

A supply chain is a network of facilities and distribution options that performs the functions of procurement of materials, transformation of these materials into intermediate and finished products, and the distribution of these finished 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 firm to firm. There seems to be a universal agreement on what a supply chain is. Jayashankar et al. defines supply chain to be -: "A network of autonomous or semi-autonomous business entities collectively responsible for procurement, manufacturing, and distribution activities associated with one or more families of related products. " Lee and Billington has a similar definition: "A supply chain is a network of facilities that procure raw materials, transform them into intermediate goods and then final products, and deliver the products to customers through a distribution system." Ganeshan and Harrison has yet another analogous definition:. "A supply chain is a network of facilities and distribution options that performs the functions of procurement of materials, transformation of these materials into intermediate and finished products, and the distribution of these finished products to customers. " In this paper we use the term *supply chain* as it is defined by the last of the quotes above.

2. DEVELOPMENT OF THE CONCEPT OF SUPPLY CHAIN

Developing of the logistics system leads to optimization of operations in every unit being a part of supply pipeline. However, aspiration to efficient operating of particular chain link does not guarantee success of the total chain. Competition of goals of each link, a lack of coordination and proper relations between particular parts of the chain are the main reasons of failure in operating.

The basic condition of success in business is to deliver the right product to customer. Companies have already understood that to make a product of high quality is not sufficient to be successful. The most important thing is to find a customer who will buy that product and in this way

will guarantee a profit. It is the reason why all actions undertaken in the chain, first of all, should be orientated to satisfy a customer of a final product. To achieve customer satisfaction, companies have to implement also total quality management systems. Such systems must concern not only all products and services but also all employees, all processes within the company and relationships with partners in whole supply chain, as well. Thanks to synergy effects of relationships between suppliers, haulers or others partners who offer different logistics services the chain is able to achieve quality advantage over the rivals. Unanimous co-operation in the chain needs, first of all, the integration of the particular goals of each part of supply pipeline into one main goal i.e. maximum of customer satisfaction. Up to now, the agreements between participants of the chain have concerned only costs minimizing and achieving short-term effects. However there was a lack of long lasting co-operation. Good co-operation needs efficient flow of information between links of the chain and liquidation of bottlenecks. The bottlenecks are formed in moments of direct contact between each part of the chain. These points very often are the places of confrontation of contradictory interests of two independent organizations. In order to overcome possible bottlenecks and to ensure proper flow of information between each part of integrated logistic chain the info partnering should be adapted.

Co-operation enables every company to take care of brand of offered products and image of manufacturer. Very important is also common care about the competitive advantage of not every separate company but of the whole supply chain in relation to other chains.

The supply chain is treated as integrity which is composed of many operating elements realizing their own goals by means of taking part in the chain. From the point of view of each unit the integrity is subject to modeling and is the potential area for optimization. This depiction of the supply chain means that the chain is (in material meaning) a separate and independent organization with defined goals, defined internal structure and financial resources. In this way, supply chain becomes a separate economic unit (at least in theory) who is able to compete with other chains on the market and also may be a research subject of the organization and management theory.

Therefore, supply chain management does not refer to management of each part of the chain, but to management of the chain as integrity, the kind of complex "enterprise". The main tasks of the supply chain management process are reduction of costs and creation of the highest quality final products. Costs can be reduced by means of proper quantity control of inventories and their flows. There is no need to keep bigger safety stocks or make excessive purchases in very well organized chain. The right management of the supply chain influences also product price in the moment of its purchase by customer. Not only costs of production in each link of the chain have an influence on a price, but also relationships between links are very important. Good co-operation needs information. The managers must share information with each other. Up to now, information was perceived as unique resource of just only one company.

The managers jealously have held information and have not passed it to other participants of the chain. Information is a base for making decisions in the management process. This is the reason for creating of integrated information system which makes possible free data flows between companies. There is a different approach to risk in the integrated chain. A risk is shared evenly between all participants of the integrated chain. That is why stronger companies are forced to secure a proper level of turnovers for weaker companies, in order to avoid a risk of their bankruptcy. The management of

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the supply chain also requires planning. Common planning is connected with creation of relationships and alliances between the companies. Creating of close links with suppliers, haulers and logistics services providers leads to narrowing down of the group of co-operating companies what in result enables costs reductions and easier agreements as regards prices, lead times and quantity of provided services. Traditionally, marketing, distribution, planning, manufacturing, and the purchasing organizations along the supply chain operated independently. These organizations have their own objectives and these are often conflicting. Marketing's objective of high customer service and maximum sales dollars conflict with manufacturing and distribution goals. Many manufacturing operations are designed to maximize throughput and lower costs with little consideration for the impact on inventory levels and distribution capabilities. Purchasing contracts are often negotiated with very little information beyond historical buying patterns. The result of these factors is that there is not a single, integrated plan for the organization—there were as many plans as businesses. Clearly, there is a need for a mechanism through which these different functions can be integrated together. Supply chain management is a strategy through which such integration can be achieved.

Supply chain management is typically viewed to lie between fully vertically integrated firms, where the entire material flow is owned by a single firm, and those where each channel member operates independently. Therefore coordination between the various players in the chain is key in its effective management. Cooper and Ellram [1993] compare supply chain management to a well-balanced and well-practiced relay team. Such a team is more competitive when each player knows how to be positioned for the hand-off. The relationships are the strongest between players who directly pass the baton, but the entire team needs to make a coordinated effort to win the race.

3. SUPPLY CHAIN DECISIONS

The supply chain activities constitute a mega process and numerous decisions are involved in successful design and operation of supply chains. Supply chain decision making is a complex process. Some of the important reasons for the complexity of the decision making process are:

- Large scale nature of the supply chain networks
- Hierarchical structure of decisions
- Randomness of various inputs and operations
- Dynamic nature of interactions among supply chain elements

Supply chain decisions have been classified based on their temporal and functional consideration

Temporal Classification: Supply chain decisions can be broadly classified into three categories: strategic, tactical, and operational according to the time horizon of the decisions.

- **Strategic decisions** target long term objectives of a supply chain and guide the supply chain policies from a design and planning perspective. Typically these decisions are not reviewed before a time horizon of a few to several years expires but the time horizon depends on a variety of factors.
- **Tactical decisions** are the decisions that are required to effectively manage the supply chains configured according to strategic level decisions. The time intervals of tactical decisions could range from weeks to months.
- **Operational decisions** are short term decisions and are generally focused on the real-time activities of a supply chain.

Transportation Decisions: The mode choice aspect of these decisions is the more strategic ones. These are closely linked to the inventory decisions, since the best choice

of mode is often found by trading-off the cost of using the particular mode of transport with the indirect cost of inventory associated with that mode. While air shipments may be fast, reliable, and warrant lesser safety stocks, they are expensive. Meanwhile shipping by sea or rail may be much cheaper, but they necessitate holding relatively large amounts of inventory to buffer against the inherent uncertainty associated with them. Therefore customer service levels and geographic location play vital roles in such decisions. Since transportation is more than 30 percent of the logistics costs, operating efficiently makes good economic sense. Shipment sizes (consolidated bulk shipments versus Lot-for-Lot), routing and scheduling of equipment are key in effective management of the firm's transport strategy.

Global Decisions:

- **Product and process selection**: What product quantities, by facility, by process, should be produced and stored in each period to support customer demands? What products to sell and to which customers to maximize profits? (tactical)
- **Planning under uncertainty**: What are the implications associated with seasonal or cyclical demand, capacity availability, cost fluctuations, or raw material availability? (tactical/operational)
- **Global optimization of operations**: What are the cost and service tradeoffs among procurement, manufacturing, distribution, and logistics alternative strategies? (strategic/tactical)
- **Real-time monitoring and control**: How can the orders be dynamically routed and scheduled through the supply chain in reaction to occurrence of real-time events? (operational)

4. FLEXIBILITY, INVENTORIES, AND CUSTOMER SERVICE

A satisfied customer is the desired end result of any supply chain management strategy, as illustrated by a quote from Lee and Billington: "HP management has recognized that its performance filling orders will cause it to win or lose the competitive battle." Let us look at three key terms within supply chain management:

Customer satisfaction says something about the level of satisfaction among a company's customers. It is in this sense a very vague term. Therefore customer service is often discussed in terms of the metrics which are used to measure it. Typical measures of customer service are a company's ability to fill orders within due date (fill rate), or its ability to deliver products to customers within the time quoted (on-time deliveries). Other metrics should be used to for example evaluate the delivery performance of orders that are *not* delivered on-time. A way to indicate this is to measure the average time from order to delivery.

Inventories: Manufacturing entities have inventories for raw products (RPI), products in the production process (WIP), and finished products (FGI). In addition there are often warehouses or distribution centers between the different levels of the supply chain. Inventories are costly. Binding capital in inventories prevents the company from investing this capital in projects of higher return. The holing cost inventories are therefore often set as high as 30 - 40% of the inventory value! In addition it is desirable to avoid so-called *dead inventory*, i.e. inventory that is left when a product is no longer on the market (often referred to as end of life (EOL) write-off). As we see it is in every company's interest to keep inventory levels at a minimum.

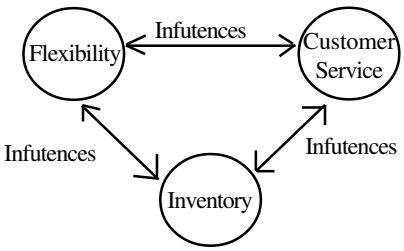

Figure (4) - Illustrating how fexibility, inventories, and customer service are interrelated.

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Much effort has been put into this, for example an entire manufacturing paradigm has come out of it. A main objective of the Just in Time (JIT) paradigm is to virtually abolish inventories. The efforts made have been more or less successful.

Figure (4) shows (very simply) how the three issues described above are interdependent. To put it bluntly; all depend on all. In the following this will be discussed.

Flexibility can be defined as the ability to respond to changes in the environment. In the case of a manufacturer, flexibility is the ability to change the output in response to changes in the demand. In a supply chain the flexibility of one entity is highly dependent on the flexibility of upstream entities (see Fig.1). The overall flexibility of a supply chain will therefore depend on the flexibility of all the entities in a supply chain, and their interrelations.

Inventory is a 'Flexibility Buffer': A manufacturer's flexibility is its ability to respond to changes in demand. Imagine a company that can receive customer orders, order and receive components, assemble these, fill the orders, and ship them to customers in one single day. This company would have a total flexibility. It would be able to respond to any unforeseen events on a daily basis, and could easily attain a hundred percent customer satisfaction without any inventory. But this is of course rarely the case. A supply chain may consist of many levels of production, transportation, and warehousing, each level adding to the lead time. The time from the first materials are ordered at the beginning of the supply chain till the finished products reach the customer may be long. In the US apparel industry this time is typically 58.5 weeks (from 1990, Flaherty) It is evident that customers will not wait this long from order to delivery. The manufacturer needs to plan ahead and therefore also to estimate future demand by making demand forecasts. If planning of production and inventories was perfect we would be able to implement a pure Just in Time strategy, with components arriving as they are needed, and finished goods being shipped as they leave the assembly line. But in a supply chain there are many events that can not be foreseen and uncertainties that need to be accounted for. These may be: late shipments from suppliers, defect incoming material, imperfect production yield, production process breakdown, or highly uncertain product demands.

The longer the planning horizon, the less accurate the plans will be. A typical US apparel manufacturer must see more than a year into the future! For it to maintain a high level of customer service, all uncertainty of the year must be accounted for (see Pitfall 5 below). The long lead times make the manufacturer inflexible, and vulnerable to unforeseen changes and inaccurate demand forecasts. A manufacturer will account for the uncertainties and unforeseen events by keeping *safety stocks*. The safety stocks assure the necessary flexibility; or rather they act as buffers for the *lack* of flexibility in the supply chain.

As we decrease lead times in the supply chain, we decrease the planning horizon, and thereby increase the flexibility. The need for a buffer in the form of inventory will also diminish. In other words; higher flexibility allows fewer inventories to maintain the same level of customer service.

Inventory vs. Customer Service: A Trade-Off : If we assume lead times to be constant, the ability to fill orders is directly dependent on the inventory levels in a supply chain. As long as there are products in the finished goods inventory (FGI), from which products are taken, orders can be satisfied. Other inventories, such as raw product inventories will have a more indirect effect on customer satisfaction. Stock-outs in any of these will obstruct production and may eventually lead to stock-out in the FGI. For

this reason, it is common in supply chain management to keep exaggerated inventory levels. But as mentioned above inventory holding costs are often calculated as high as 30-40% of inventory values. While oversized inventories are a costly inventory management strategy, low fill rates are also costly. Business may be lost through cancelled orders, and the company's reputation may be severely damaged. It is therefore in a company's interest to balance inventory holding cost and the cost of imperfect customer satisfaction. The trade-off inventory vs. customer satisfaction is one of the classic issues of logistics and supply chain management.

Globalization: Through the past decades we have seen an increasing rate of globalization of the economy and thereby also of supply chains. Products are no longer produced and consumed within the same geographical area. Even the different parts of a product may, and often do, come from all over the world. This creates longer and more complex supply chains, and therefore it also changes the requirements within supply chain management. This again affects the effectiveness of computer systems employed in the supply chain. A longer supply chain will often involve longer order to delivery lead times. Flaherty states, in accordance with the discussion in Section that the consequences of longer lead times will often be;

- less dependable forecasts as these have to be made earlier,
- reduced production flexibility, i.e. greater difficulties to adjust to order changes,
- Higher levels of inventory.

The evident answer to the problem of longer lead times is to speed up the supply chain. But a limit is often reached beyond which further effort to shorten lead times are futile, especially in international supply chains. Another approach is to restructure the supply chain. This simply means to reconsider the strategic level decisions priory made. A third approach identified by Flaherty is changing *coordination*: The order, forecasting, procurement, and information sharing procedures among the members of the supply chain. We will dwell on the issue of coordination in the next section. Globalization also brings foreign competition into markets that traditionally were local. Local companies are thereby forced to respond by improving their manufacturing practices and supply chain management. Bhatnagar et al. states that attempts have focused, among others, on reduction of inventory levels, and increased flexibility through reduced lead times. Yet again we see how industry focuses on the issues of inventory management and flexibility to maintain high levels of customer satisfaction.

5. IMPROVING SUPPLY CHAIN MANAGEMENT

The above sections describe issues and challenges of supply chain management. It is time to approach solutions. A key to improved supply chain management lies in *integration and coordination*, look to Section for a discussion. Section introduces important tools of supply chain managers, modeling and simulation.

Integration and Coordination Definitions: The Webster's dictionary defines to integrate as: *To make into a whole by bringing all parts together; unify.* In an enterprise, integration can simply mean that each unit of the organization will have access to information relevant to its task and will understand how its actions will impact other parts of the organization thereby enabling it to choose alternatives that optimize the organization's goals. The key to integration is coordination. To *coordinate* is to manage dependencies among activities so as to achieve coherent operation of the entire system in question.

General and Multi-Plant Coordination: Much research effort has been put into optimizing the performance of supply chains. The major part of the early work tends to focus on very limited segments, e.g. only material procurement, manufacturing, or

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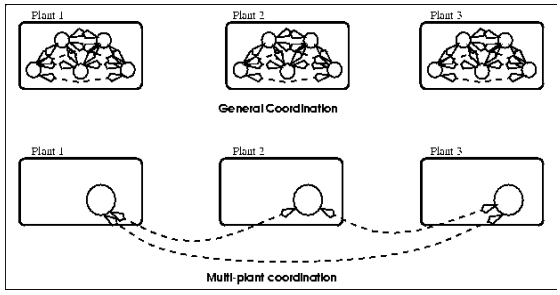
distribution, and treat these as separate systems. Though this might lead to improved performance in the segment in question, the complex interaction among supply chain segments is ignored. Thereby potential gains from coordination are lost.

In later years we have seen an increasing focus on the integration of different segments of the supply chain. As for example Cohen and Lee and Chandra and Fisher who treat integration and coordination of production and distribution functions. These efforts are what Bhatnagar et al. who have reviewed the existing works on coordination, refer to as *general coordination*. Bhatnagar et al. distinguish between two broad levels of coordination. General coordination is the integration of different functions, e.g. inventory and production planning, sales, and distribution.

The other level of coordination identified, is that on which production decisions are coordinated among the plants of an internal supply chain. This is referred to as *multi-plant coordination*. The objective of multi-plant coordination is to coordinate the production plans of several plants in a vertically integrated manufacturing company so that the overall performance of the company is improved. Still according to Bhatnagar et al., in order for such coordination to be efficient, the effects of uncertainty of final demand, uncertainties in production process at each plant, and capacity constraints at each plant must be taken into consideration.

Figure (5) illustrates, in a very schematic way, the principles of these two levels of coordination. Bathnagar et al. conclude that there is much overlap and interaction between the two coordination levels, but there is today (1992) no unified body of literature on the issue. Research effort is required.

Information Technology: An Unrealized



Potential : The rapid development within the information technology and software engineering gives unprecedented opportunities for integration and coordination. The modern computer networks have the ability to rapidly distribute information to all concerned entities of an enterprise. The networks also present an infrastructure for coordination of planning and operational processes, not only within organizations, but also among them. Chee et al., states that there is an unrealized potential for using information technology in support of network coordination (1996). A survey was done of more than forty computer manufacturers. It was found that only about 15% of the partners were communicating through EDI. It was also found that much of the coordination activity occurs above the operational level.

6. SUPPLY CHAIN PERFORMANCE MEASURES

Supply chain performance measures can be classified broadly into two categories-:

a) Qualitative measures (such as customer satisfaction and product quality)
b) Quantitative measures (such as order-to-delivery lead time, supply chain response time, flexibility, resource utilization, delivery performance, etc.). Improving supply chain performance requires a multi-dimensional strategy that addresses how the organization will service diverse customer needs. While the performance measurements may be similar, the specific performance goals of each segment may be quite different.

Quantitative metrics of supply chain performance can be classified into two broad categories: Non-financial and financial.

Non-Financial Performance Measures: Cycle time, customer service level, inventory levels, resource utilization, per formability, flexibility, and quality. We will focus here on the first four measures.

Cycle time: Cycle time or lead time is the end-to-end delay in a business process. For supply chains, the business processes of interest are the supply chain process and the order-to-delivery process. Correspondingly, we need to consider two types of lead times: supply chain lead time and order-to-delivery lead time. The order-to-delivery lead time is the time elapsed between the placement of order by a customer and the delivery of products to the customer. If the items are in stock, then it would be equal to the distribution lead time and order management time. If the items are made to order, then this would be the sum of supplier lead time, manufacturing lead time, distribution lead time, and order management time. The supply chain process lead time is the time spent by the supply chain to convert the raw materials into final products plus the time needed to reach the products to the customer. It thus includes supplier lead time, manufacturing lead time, distribution lead time, and the logistics lead time for transport of raw materials from suppliers to plants and for transport of semi-finished/finished products in and out of intermediate storage points. Lead time in supply chains is dominated by the interface delays due to the interfaces between suppliers and manufacturing plants; between plants and warehouses; between distributors and retailers; etc. Lead time compression is an extremely important topic because of time based competition and the correlation of lead time with inventory levels, costs, and customer service levels.

Customer Service Level : Customer service level in a supply chain is a function of several different performance indices. The first one is the order fill rate, which is the fraction of customer demands that are met from stock. For this fraction of customer orders, there is no need to consider the supplier lead times and the manufacturing lead times. The order fill rate could be with respect to a central warehouse or a field warehouse or stock at any level in the system. Stock out rate is the complement of fill rate and represents the fraction of orders lost due to a stock out. Another measure is the backorder level, which is the number of orders waiting to be filled. To maximize customer service level, one needs to maximize order fill rate, minimize stock out rate, and minimize backorder levels. Another measure is the probability of on-time delivery, which is the fraction of customer orders that are fulfilled on-time, i.e. within the agreed-upon due date.

Inventory Levels : Since inventory carrying costs can contribute significantly to total costs, there is a need to carry just about enough inventories to satisfy the customer demands. Inventories held in a supply chain belong to four categories, Raw materials, work-in-process (unfinished and semi-finished parts), finished goods inventory, and spare parts. Each type of inventory is held for different reasons and there is a need to keep optimal levels of each type of inventory. Thus measuring the actual inventory levels will provide a useful picture of system efficiency.

Resource utilization : A supply chain network uses resources of various kinds: manufacturing resources (machines, material handlers, tools, etc.); storage resources (warehouses, automated storage and retrieval systems); logistics resources (trucks, rail transport, air-cargo carriers, etc.); human resources (labor, scientific and technical personnel); and financial (working capital, stocks, etc.). The objective is to utilize these assets or resources efficiently so as to maximize customer service levels, minimize lead times, and optimize inventory levels.

Financial Measures: There are several fixed and operational costs associated with a supply chain. Ultimately, the aim is to

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maximize the revenue by keeping the supply chain costs low. Costs arise due to inventories, transportation, facilities, operations, technology, materials, and labor. The financial performance of a supply chain can be evaluated by looking into the following items: Cost of raw material; Revenue from goods sold; Activity-based costs such as material handling, manufacturing, assembling, etc.; Inventory holding costs; Transportation costs; Cost of expired perishable goods; Penalties for incorrectly filled or late orders delivered to customers; Credits for incorrectly filled or late deliveries from suppliers; Cost of goods returned by customers; Credits for goods returned to suppliers.

Typically, the financial performance indices can be put together using the following major modules: activity based costing, inventory costing, transportation costing and inter-company financial transactions.

8. CONCLUSION

The preceding sections are a selective overview of the key concepts in the supply chain and management of a supply chain using a decision support system. After going through all the literature, and analyzing each of them it can be concluded that efficient management of supply chain requires an efficient system for managing it, and an efficient computerized decision support system can only manage the complex supply chain .Despite that management of supply chain carries a huge importance in today's world ,in India this fact has still not been recognized by many and there is a need to work in this area if we have to survive in the globalize market. Also there is a need to give socio technical factors affecting a supply chain a due consideration while designing a new Decision Support System.

- more collaborative, timely product development through enhanced communication between functional departments, suppliers, customers and even regulatory agencies;
- reduction of channel inventory and product obsolescence owing to closer linkage across the supply chain and better insight into the demand signals to drive product schedules and ultimately achieve build-to order capability;
- reduction in communication costs and customer support costs with more interactive, tailored support capability inherent with internet technologies;
- new channel capabilities to reach different customer segments and further exploit current markets; and
- Ability to enhance traditional products and customer relationships through customizations driven by internet connectivity and interactivity.

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