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Supply Chain Management, Optimization and Forecasting Techniques

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Abstract:

Supply chain management is one of the biggest challenges of today when it is crucial to remain active in the market and competitive without compromising the processes within the company itself. The costs of production and living in general are increasing day by day and it is up to the management of the company to reduce costs to the lowest possible level in order to maintain profitability in the market. In this paper we address the issue of the supply chain and forecasting method. The impact of supply chain management extends beyond reducing costs (Farris II & Hutchison, 2002). Forecasting methods are very important for company plan, production plan, sales and similar segments of a company. The study introduce and find prediction method brings better planning for the production or sale of other parts of the supply chain within the company. Each optimization brings a new loss reduction and increase in profit, so firms need to choose the right method to predict the needs of the company. The Q model introduced by the study is one of the most used methods within supply chain optimization

Keywords: *Supply Chain, Forecasting, Production, Supply Chain Management*

1. Introduction

Managing supply chain managing is the process of planning, implementing and controlling all activities in the supply chain in the most efficient way possible. According to Bahree (2006) the supply chain includes all transfers of physical suppliers and services required to produce and value the goods and bring them to final consumer. Given the transfer of market's power to customers, meeting customer's demands not only involves producers but also the whole supply chain (SC) (Gunasekaran and Ngai, 2004). Agility in supply chain management (SCM), namely, quick, high-quality and low-cost responding to demands, reducing the product life cycle, increasing products variety, etc. is essential to the survival and development of SC members (Hanafizadeh and Sherkat, 2009).

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Excellence in managing supply chains is directly linked to superior organizational performance
(Christopher M., 2005). There exists a contradiction among experts on differences in supply chain management and logistics. Few expetrs say both are synonymous terms, while others claim that these are two different terms. The objective of supply chains can be broken down into: end-user satisfaction, chain efficiency and supplier chain flexibility. Successful supply chain management must result in improvements in business areas. Supply chain management is focused on: increasing profits, better exploiting resources and reducing costs. Primarily the focus of supply chain is end-user satisfaction (Sharp et al., 2006). The end customer is the only one who injects "existing" money that drives the activity chain across all partners. The money is divided into chain members in proportion to its added value (Bartling, B., 2003). Supply chains are related associations of individual businesses. The concept of the network indicates the introduction of coordination in processes and relationships. An uplink means that it goes “in the opposite direction” and refers to the link between the company and its suppliers, as well as sub-suppliers with suppliers. Downstream links, or "in the direction of movement", refer to the business-to-consumer relationship (Epstein, 2006). Combined upstream and downstream connections may occur, as in the case with businesses that have return containers, pallets or internal exchange products. The flow strategy of materials, information and value streams includes: reducing the level of production breakdown (ideally just one installation step), increasing the flexibility of production assets capacity, increasing the degree of flexibility human resources capacity, greater involvement of suppliers in the production process, designing simple and short flows of information and materials, introduction of efficient information systems. Planning goals for inland transport within a part of the supply chain in production. Figure 1 presents Fixed order-quantity Model, where Optimal use: minimal transport costs, minimal idle times, high functionality and time utilization. High level of service: short waiting time, short transportation time. High flexibility: wide range of cargo for transportation, easy adaptability to the work environment. High transparency: information on the current situation, calculation of costs, establishment of indicators. Under such circumstances, in order to ensure growth, the retail supply chain must be adaptive and responsive (Ramesh, Banwet, & Shankar, 2008). Trends in production structure: production according to market needs, very limited number of products, customization to customer needs and requirements, acceptance of how fast development in new products and to quickly adapt the product range. Organizing cost-effective production also includes outsourcing capabilities, simpler means of production can be combined more easily Close (2006). In addition to the customers’ orders which, generally speaking, draw a final product out of the supply chain network (pull factors), supply chain networks are often subject to push factors which are caused by the feeding of raw material into the supply chain by suppliers (push factors) (Hinkelman, 2005).

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2. Review of Literature

Supply chain optimization aims to successfully control the various elements within the chain. By elements we mean participants, their external contacts, but also the way of organizing some internal activities. The essence of the optimization process is the elimination of those elements that do not create or support value, but which still exist as participants or activities within the chain. Optimization is the management of complicated supply chains in their entirety by synchronizing all value-added elements within production or distribution, while eliminating all other elements Rabbinob et al. (2004). In van der Vorst et al. (2000), a DES facilitates the evaluation of supply chain scenarios of a food supplier. The results obtained from the simulations suggest ways to improve the supply chain by changing inventory strategies.

Based on the above definition, it can be said that there are a number of goals that firms want to achieve by optimizing the supply chain: synchronization of all elements (participants and activities) that add value in production or distribution and elimination of elements do not create or support value. In addition to the above two basic, there are some other secondary goals of supply chain optimization: providing the highest quality customer service and retaining them. Top performers have a clear supply chain strategy aligned with overall business objectives and customer requirements (Geary and Zonnenberg, 2000). The overall productivity of the supply chain can be expressed through a simple relationship between total outputs and total inputs. Globalization, market instability, reducing product life-cycles and ever increasing competition are few of the major convincing factors which are compelling companies to focus on their core competencies and outsource an increasing amount of their other non-value-adding activities (Prahalad & Krishnan, 2008)

As mentioned earlier that performance measures in a supply chain are required "to streamline the flow of material, information, and cash, simplify the decision-making procedures, and eliminate non-value adding activities" (Gunasekaran, Patel, & Tirtiroglu, 2001). According to Bozon (2006). most of the activities in the chain are about 95% represented by non-value elements. According to them all time-related non-value activities can be classified into the following categories: queues (time until material is processed), production overhauls (bug fixes), managerial incompetence (failure to make decisions on time) and inventory costs in the supply chain.

2.1. Supply Chain Optimization Factors

New information technologies, increasing pressure from customers on responsiveness and reliability and the globalization of operations and markets, supply chain management has become a challenge and an opportunity (Bowersox and Closs, 1996). Optimization as a process does not happen by itself. Reviewing the literature in this field, the following factors have been identified as the most important. Bento (2003) highlights three major sources of supply-chain uncertainty: suppliers' failure to deliver on promises, manufacturing plant failures and computer errors, uncertainty

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about order quantities and the appearance of a whiplash effect. All the factors mentioned increase the volume of inventories (Miller. 2004). The very purpose of stock existence is precisely to insure against supply uncertainty. Lai, Ngai, & Cheng, (2002) distinguish three dimensions of supply chain performance in transport logistics: first, service effectiveness for shippers; second, Operational efficiency; and third, service effectiveness for consignees.

Collaboration and integration of participants in the chain. Optimization is most likely to be achieved through a collaborative exchange of information between cross-functional teams within and outside the organization (Gold, 2006). Comparison with best practice. Boyles and Melvin (2005) points out that this is a thorough analysis of the success and dissemination of learning across an organization. The desire to optimize the supply chain and achieve world-class MLS must be conceptualized or have the support of top management of the company. This requires the existence of two-way communication between the management and senior managers in charge of integrating the supply chain, as well as the functions and processes within it (Frank, R. H, 2006).

3. Methodology

A set of variables that signify the impact of real working of the supply chains based on the profitability of the entire system are used to measure supply chain performance (Ramdas & Spekman, 2000). Time series methods are based on a series of data that are equally spaced in time - daily, weekly, monthly, etc. data. Predicting a time series of data assumes that future values are predicted solely on historical data (Shahid & Sattar, 2017) and that other variables, no matter how potentially important data may be overlooked. By decomposing historical data, four major components of the time series can be identified Chu (2004):

- Trend
- Seasonal oscillations
- Cycles
- A random factor

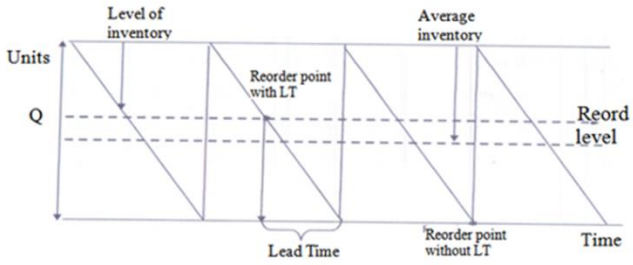

Figure 1: Fixed order-quantity Model

The figure 1 presents Fixed order-quantity Model, the decision rule, in a system of continuous inventory control with predetermined and fixed quantities of Q, is: Continuously monitor inventories (available and ordered). When supplies fall to the reorder point R, a fixed quantity of Q is ordered. If Q is fixed and demand is variable, the time between two orders will also be variable. The fixed order quantity model is also called the Q model. The fixed ordering model, in a continuous inventory control system, is fully determined by two parameters: R and Q. The order quantity Q can be approximated by the EOQ model with acceptable accuracy provided that demand variability is within acceptable limits (Demand Variability Coefficient is less than 0.2). Average demand is used to calculate Q over the EOQ formula. The

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reorder point (R) can be determined either on the basis of inventory cost (if known) or on the level of service. According to the basic assumptions of the EOQ model, demand and delivery times are known and constant and inventory is not exhausted.

If the demand or delivery time is stochastic, then stocks may be depleted:

- In cases where demand is higher than expected.
- In cases where the delivery time is longer than expected.

Determining the optimal point R, or optimal preventive (safety) stocks is possible if the unit cost of holding the stock and the unit cost of stock shortage are known. The preventative amount of inventories depends on the costs incurred in the event of inventory depletion and the cost of holding excess inventories (Hoffman, 2004). The procedure to calculate the cost is;

- For different levels of security stocks, the additional cost of holding inventory and the cost of inventory shortage are calculated.
- The amount of security stock that results in the minimum total cost is the optimal amount.

The cost of holding additional inventories can be calculated as follows:

Supplemental Inventory Cost = Security Inventory x Unit Annual Inventory Cost……...**equation-1**

The cost of inventory depletion can be calculated as follows:

Cost of non-availability of product in stock (Quantity of product whose demand cannot be met) x (probability of demand te = quantity of product) x (unit cost of product shortage) x (number of orders per year) …….....
.....**equation-1**

4. Findings

Brown & Dant (2008) supply chain management is in fact vital for retail success. The eyewear retailer has decided that the order point of a particular type of frame should be 50 pieces. The annual cost of holding the stock apiece is $ 5, and the lost profit in the event of inventory depletion is $ 40 per box. The store manager has experience on the likelihood of demand for frames at the time of delivery. The optimum number of orders in a year is 6.
How much preventative amount should be kept in stock?

	NUMBERS	POSIBILLITY
	30	0,2
	40	0,2
ROP →	50	0,3
	60	0,2
	70	0,1
		$\sum = 1$

The goal is to find a preventative amount that will minimize the sum of the cost of keeping an extra amount of product in stock and the cost of product shortage. The annual cost of inventory preventive supplies is equal to the cost of storing the product unit times the product number. If the preventative quantity is 20 frames and the order point is 50 frames, taking the preventive amount into account the new

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order point is 50 + 20 = 70 frames and this results in an increase in storage costs by 20 x $ 5 = $ 100. Depletion losses on inventories can be calculated for each preventive amount (based on a formula already known). For example, if the preventative quantity equals zero and the demand for frames during the waiting period of delivery equals 60 pieces, then the sale of 10 frames is lost since ROP = 50. In case of demand of 70, the lost sales will be 20 frames. Thus, the costs due to zero amount of preventative supplies are:

Cost of non-existent product on stock = (10) (0.2) ($ 40) (6) + (20) (0.1) ($ 40) (6) = $ 960

5. Conclusion

Each prediction method brings better planning for the production or sale of other parts of the supply chain within the company. No part of the SCM can be ideally optimized if the previous one is not in this state, so every part of the supply chain, from the initial part to the end customer needs to be optimized. Each optimization brings a new loss reduction and profit increase, so you need to choose the right method to predict the needs of the company. The Q model is one of the most used methods within supply chain optimization that is why we introduced it in the study.

5.1. Research Implications

This study has the following practical implication

- The findings of the study can be used to improve the service levels to customers while reducing overall supply chain costs." Put another way, supply chain management (SCM) involves the production, shipment and distribution of products.
- The findings of the study has the power to boost customer service, reduce operating costs and improve the financial standing of a company. Organizations increasingly find that they must rely on effective supply chains, or networks, to compete in the global market and networked economy.
- Supply-chain optimization addresses the general supply-chain problem of delivering products to customers at the lowest total cost and highest profit, trading off the costs of inventory, transportation, distributing and manufacturing.
- The finding of this study contributes to the existing body of knowledge about Supply-chain optimization, it effects on operational performance and measures to improve the lead-times.
- The study finding will help the top management of firms to formulate efficient Supply-chain strategy that can enhance the organizational operational efficiency as well as industry outcomes.
- The industry can get a competitive advantage over its competitors by lowering down the overall industry lead-time.
- The findings of the study also help in efficient inventory management system, smooth information flow, and timely availability of required raw materials and optimization of the whole supply chain, which can increase operational performance.

5.2. Research Limitation

This study has the following Limitations

- The study is limited to the supplier's lead time and product characteristics
- The study has not explained behavioral factors related to employees and manager's personality, attitudes, and experience levels.
- Organizational composition, size, and business nature of the firm is also excluded from this research study.
- There is also limited amount of field research due to time constraints.
- Marketing, sales and other stakeholders which plays an important role in speed-to-market of a product or service are not considered in this study.

5.3. Future Recommendation

This study has the following Recommendations for Future Research

- The further study should focus on the suppliers' lead time and product characteristics.
- The further investigation should take into account the behavioral factors related to employees and manager's personality, attitudes and experience levels.
- The future study should investigate Organizational composition, size, and business nature of the firm.
- The future research should be discussed on limited amount of field research due to time constraints.
- The additional study must be focused on the Marketing, sales and other stakeholders which plays an important role in speed-to-market of a product or service which are eliminated from this study.

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