“A STUDY OF INVENTORY ON SUPPLY CHAIN MANAGEMENT THROUGH LATERAL TRANSSHIPMENT WITH SPECIAL REFERENCE OF ABC COMPANY”

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Abstract:-Supply chain management addresses the management of materials and information across the entire chain from suppliers to producers, distributors, retailers, and customers. The purpose of this work is to examine the antecedents of retailer-retailer partnership and to explore its impact on the supply chain performance. In the past few decades, scholars gave ample attention about the impact of inventory on Supply Chain Management (SCM). We consider coordination among stocking locations through replenishment strategies that take explicitly into consideration transshipments, transfer of a product among locations at the same level. A continuous review inventory system has been adopted, in which lateral transshipments are allowed. In this research simple model is presented that enables us to characterize optimal inventory and transshipment policies for “n” locations. The research is based on a case study of a Four-wheeler Selling and Body Manufacturing Company in Central India by using its data and to strengthen its supply chain. This paper represents such an effort in that it integrates both inventory and transshipment components in the study of multi-location inventory systems. This work will done by the managers of ABC to overcome the uncertainties of demand and lead-time resulting into customer satisfaction and cost reduction.

Keywords: Transshipment, Product life cycle, inventory, supply chain management

INTRODUCTIONS

Supply chain management is the management of materials and information across the entire chain from suppliers to producers, distributors, retailers, and customers. Traditionally, each company performs purchasing, production and marketing activities independently, so that it is difficult to make an optimal plan for the whole chain. In recent years, it has been realized that actions taken by one member of the chain can influence all others in the chain. More and more companies have gradually recognized that each of them serves as part of a supply chain against other supply chains in terms of competition, rather than as a single firm against other individual firms. Since 1991, as the information technology has continuously developed, it is possible to coordinate all organizations and all functions involved in the whole chain. Consequently, supply chain management has been increasingly receiving attention from both academic researchers and practitioners. Roughly speaking, research on supply chain management has been mainly focused on three major issues. One is the behavior of information flow through a supply chain. The second issue deals with inventory management, which regards a supply chain as a multiechelon inventory system. The third issue is oriented to planning and operations management of a supply chain based on queuing systems. In this paper the second issue, namely inventory management will be discussed. There is a Chinese proverb saying, “if you want to defeat an army, frustrate the chief first.” It is also suitable for business fight. In the past few decades, scholars gave ample attention about the impact of inventory on Supply Chain Management (SCM). As a recently research shown, inventory cost account for 30% of the total capital cost. As matter of fact, successful inventory management is often the momentous symbol of competition victory and a well run organization. What happens when a supply chain is plagued with a bullwhip effect that distorts its demand information as it is transmitted up the chain? In the past, without being able to see the sales of its products at the distribution channel stage, HP had to rely on the sales orders from the resellers to make product forecasts, plan capacity, control inventory, and schedule production. Big variations in demand were a major problem for HP's management. The common symptoms of such variations could be excessive inventory, poor product forecasts, insufficient or excessive capacities, poor customer service due to unavailable products or long backlogs, uncertain production planning (i.e., excessive revisions), and high costs for corrections, such as for expedited shipments and overtime. HP's product division was a victim of order swings that were exaggerated by the resellers relative to their sales; it, in turn, created additional exaggerations of order swings to suppliers. A supply chain is a network consisting of suppliers, manufacturers, distributors, retailers, and customers. Supply chains perform two principal functions (Fisher, 1997): the physical function of transformation, storage and transportation, and the market mediation function of matching demand and supply in an uncertain and dynamic environment. While the physical function has been extensively studied within the production...
control and inventory management literature, innovative approaches have recently been emerging to the market mediation function. This paper goes beyond these approaches and introduces the strategy of transshipments to support both the physical and market mediation functions of the supply chain. Effective inventory management will optimize the supply chain, eliminate cash flow and reduce the possibility of occurrence on inventory shortage caused by variable orders. Consequently, it is of utmost importance to optimize inventory management to satisfy the company’s strategy goal. Describe a problem frequently encountered in supply chains, called the bullwhip effect: demand variability increases as one move up the supply chain. This distorted information throughout the supply chain can lead to inefficiencies: excessive inventory investment, poor customer service, lost revenues, misguided capacity plans, ineffective transportation and missed production schedules Transshipment or transshipment is the shipment of goods or containers to an intermediate destination, then to yet another destination. One possible reason is to change the means of transport during the journey (for example from ship transport to road transport), known as transloading.

SCOPe

Effective supply chain management (SCM) has become an important management paradigm. A great amount of studies have shown that substantial benefits can be obtained from SCM. Basically, SCM is a effective and systematic approach of managing the entire flow of information, material and services in fulfilling a customer demand (Chase, 1998). In this chapter we are mainly focused on material flow management in the supply chain system. At present many quantitative models have been proposed to provide decision support for the management of materials in supply chains (see, Tayur et al., 1998). Moreover, since the network of entities that constitute the entire supply chain is typically too complex to analyze and optimize globally, it is often desirable to focus on smaller parts of the system so as to gain an in-depth understanding of its characteristics, performance and tradeoffs involved. One such part that is attracting growing attention is the local distribution network, consisting of multiple retail outlets (stocking locations), which are supplied by one or more sources. The overall performance of the distribution network, whether evaluated in economic terms or in terms of customer service, can be substantially improved if the retailers collaborate in the occurrence of unexpectedly high demand, which may result in shortages in one or more retailing outlets. Collaboration usually takes the form of lateral inventory transshipment from a stock outlet with a surplus of on-hand inventory to another outlet that faces a stock out. Since the cost of transshipment in practice is generally lower than both the shortage cost and the cost of an emergency delivery from the designated warehouse and the transshipment time is shorter than the regular replenishment lead time, lateral transshipment simultaneously reduces the total system cost and increases the fill rates at the retailers. A group of stocking locations that share their inventory in this manner is to form a pooling group, since they effectively share their stock to reduce the risk of shortages and provide better service at lower cost.

METHODOLOGY

Scientific Perspectives Positives

Positivism is based on an objectivist epistemology. For a positivist, reality is Objective – things are true or actual in fact, and that truth is not influenced by factors such as society, culture, or interaction with human cognition. There is “a conviction that scientific knowledge is both accurate and certain.” There is also the conviction that objective science is the only way of “interacting with the world cognitively, i.e. in terms of knowing and explaining and hence understanding it and how it works – and this is science.” Positivist studies are primarily quantitative in nature (although qualitative positivist case studies are possible). Empirical science exemplifies the positivist methods, and knowledge is built through a process of inductive logic – hypotheses are developed and tested with experiments; as more and more facts accumulate, they can be used to construct general explanatory theory. Findings are validated when experiments are replicated and yield consistent results. Ideally, this testing involves testing under original conditions and also testing with variations – under different conditions, within different cultures, etc. Positivist investigations deal with observables – things that can be perceived with the human senses (aided by scientific instruments). Culture, society, and inborn cognitive structures would therefore not be legitimate topics for positivist investigation. It is possible for a phenomenon to be reduced to its component parts for study in a positivist framework; the findings for the parts will be valid when applied back to the whole.

Researchers conducting this type of study are expected to remain aloof from the experiment – they are observers only, and should not influence the course of the experiment or the results by their interaction with their subjects. These researchers proclaim their objectivity, the fact that their findings are not colored by their individual perspectives or prejudices. This point of view is becoming somewhat modified; some scientists remain within the positivist camp but temper very significantly the status they ascribe to their findings, the claims they make about them. It is not possible, they have come to recognize, to find some Archimedean point from which realities in the world can be viewed free from any influence of
the observer’s standpoint. They may claim a higher level of objectivity and certitude for scientific findings than for other opinions and beliefs, but the absoluteness has gone and claims to validity are tentative and qualified. The positivist very much dwells within a world backed by centuries of scientific tradition. Although this position was born in the natural sciences, it has become an important theoretical perspective for social research as well. Although some would question whether the same research approach can be used in two such different disciplines, many, such as Amos report, still feel it the only route to knowledge.

HERMENEUTICS

Hermeneutic interpretation proceeds by what is known as the “hermeneutic circle.” Central to this idea is the impossibility of understanding a whole without understanding the parts, and vice versa. The process of inquiry thus moves in a circle—first examining the parts to inform interpretations about the whole, then examining the newly illuminated whole to better understand the parts: As soon as we initially discover some elements that can be understood, we sketch out the meaning of the whole text. We cast forward or (forecast) a preliminary project, which is progressively corrected as the process of understanding advances. Interpretation brings with it anticipation, albeit vague and informal, of the meaning of the whole; And the light of this anticipation plays back to illuminate the parts. Within this system, there is never a final “answer.” Understanding moves around the circle, deepening with each revolution. It is also possible that the understanding reached will exceed that of the original author of the text: “This aim derives from the view that in large measure authors’ meanings and intentions remains implicit and goes unrecognized by the authors themselves.

Interpreters may end up with an explicit awareness of meanings, and especially assumptions, that the authors themselves would have been unable to articulate.” Hermeneutic interpretation is influenced by the situation of the individual researcher. That person’s history, culture, and prejudices cannot be transcended; they will color the nature of his or her interpretation. Because different investigators will bring different perspectives to their inquiry, there is the possibility (or probability) of different “truths” emerging from the same phenomena. These “truths” will also change over time, as researchers of the next age bring their particular situations to bear on the problems. As with phenomenology and other primarily qualitative disciplines, validity is a difficult question. Only the accumulation of consistent, supporting understanding can confer eventually validity to a hermeneutic study. Hermeneutics can provide a valuable perspective for the historical researcher, who must routinely deal with texts of various sorts, direct access to the historical players being of course impossible.

EMPIRICAL FINDINGS

Case study

Automobile sector is one of the emerging markets in India and presently lateral transshipment is being less exercised at retailers’ level in their supply chain structure. As inventory management and customers’ satisfaction are the key areas in modern industrial sector, the same problems are also being faced by the supply chain managers.

We consider a company ABC that Sales and Manufacturer of Vehicle body for Four -wheelers in M.P.

Logistics systems

ABC Company does not have any critical margins because if the company went out of stock would the whole retailer and customer will not get good vehicle body’s. When there is time for budget proposition, the company looks if the stock of raw material is enough for the planned activity. If the stock is not enough then they have to order raw material and the ordering of raw material is a long procedure because the time of delivery is very long for the thick steel plate. For the thick steel plate that is used in the making of vehicle body. The welding rod is ordered on Thursdays and the first arrival will come on Sundays. That is the welding rod is used for the coming week. So in one week the ordered welding rod should be used. In the company the most important consumable material is welding rod. Steel plates and welding rod come from the steel plant and it takes about two to three week for the supply to the company. The time that the customer required many types of vehicles body’s in different design.

Procurement

ABC Company use many supplier when it comes to steel plate, welding rod and nut bolt deliveries, and the most important selection criteria they use are the cheapest suppliers gets the delivery. ABC Company use this criterion mainly because the difference in materials only depends on the cost and quality, which ABC Company have an independent controller to check every delivery that arrives to the company. Suppliers get paid according to the quality level of the steel plate and welding rod. Therefore they have to use the system with order once a week, as we all know it is even difficult to foresee the weather so it always have to be a smaller safety stock. When it comes to other material suppliers it is more economic to buy bigger amount so ABC Company to get a lower price. To secure the delivery to ABC Company they use suppliers from different supplier they also have a system where the spread the contract period for all the suppliers so they don’t need to negotiate
with all the suppliers at the same time. With this system the always have contracted suppliers that are committed to deliver raw material. The contract time is usual between 5 years and they use retailer price index when contract is written.

**ANALYSIS**

**Classifying inventory**

Multiple product lines and inventory control require companies to focus upon more important inventory items and to utilize more sophisticated and effective approaches to inventory management. Inventory classification is usually a first step toward efficient inventory management demonstrates ABC analysis as it applies to inventory management. The diagram indicates that only 20 percent of the items in the product line account for 80 percent of total sales. The items that make up this 20 percent are referred to as A items, due to the significant portion of sales for which they are responsible. The items in the B category account for approximately 50 percent of the items in the product line, yet make up only an additional 15 percent of total sales. Finally, the C items are represented by the remaining 30 percent of the items, which account only for approximately 5 percent of sales. In many ABC analyses, a common mistake is to think of the B and C items as being far less important than the A items, and subsequently to focus most or all of management’s attention on the A items. For example, decision might be made to assure very high in stock levels for the A items and little or no availability for the B and C items. There are a number of additional reasons not to overlook the importance of the B and C items. Sometimes, the use of B and C items may be complementary to the use of A items. Performing a Pareto analysis on these products is somewhat hard since almost all types of Vehicle are necessary. LPT 407 (tipper) is expensive and bad for the Inventory cost, but on the other hand it has a high Profit and is easy to Sale. Therefore is LPT 407 (tipper) good as other product. The other product is less expensive to buy, but only stocking one type of vehicle would decrease the selling of vehicle and profit of the Company.

<table>
<thead>
<tr>
<th>Item</th>
<th>Percentage of annual sales</th>
<th>Customer service</th>
<th>Classification Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>LPT 909</td>
<td>30%</td>
<td>97.8%</td>
<td>A</td>
</tr>
<tr>
<td>LPT 1109</td>
<td>25%</td>
<td>97.9%</td>
<td>A</td>
</tr>
<tr>
<td>LPT 407</td>
<td>20%</td>
<td>96.6%</td>
<td>B</td>
</tr>
<tr>
<td>LPT 407 (pick up)</td>
<td>18%</td>
<td>94.0%</td>
<td>B</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Item</th>
<th>Percentage of annual sales</th>
<th>Customer service</th>
<th>Classification Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>LPT 407 (tipper)</td>
<td>7%</td>
<td>99.9%</td>
<td>C</td>
</tr>
</tbody>
</table>

**Table 5-1 ABC analysis for inventory of Vehicles**

Hence a combination is necessary. LPT 909 is the main product of these companies since it has a high selling value compared to its price. We notice that only item of LPT 407 (tipper) achieve the level of Company goal about customer service. That’s why the company is inclined to combine the items when delivery them to the retailers. According to the survey of Head office executives of ABC Company, they can easily increase the percentage of customer service by combining the Products. Thus, it is crucial to optimize the percentage of the inventory.

**Identify cost factors**

Inventory cost can be divided into carrying cost and order cost. In order to give a holistic view of the factors and elements of carrying cost, a Cause Effect diagram is used as following:

![Cause Effect Diagram](image-url)
5.3 Assess cost components

For the identified cost elements, the next step involved calculation and assessment of each item.

5.3.1 Ordering cost factor

Transportation cost: Obviously, this factor refers to costs for external transportation from supplier to company. As we known, raw materials the company used is truck chassis steel plate and welding rod. The company has no special large truck for transport this kind of material. It is therefore that all transportation for raw material is included in the raw material price. No deliver terms are stated in the purchasing order. Thus, there is no cost for transportation to consider.

Procurement: As mentioned in theory part, production should be ensured with continuous material supply. The company uses 5 suppliers when it comes to steel rod, nut bolts and rivets deliveries; hence, the supplier resources never short. They sign contract with supplier for a period of 5 years. The personnel at ABC company spend 3 hours each week on this aspect, and each hour costs approximately 2000. Production is performed 50 weeks yearly. This gives a total procurement cost of 30,000 (= 2000*50*3)

Material handing: It takes approximately 20 minutes to move 3 trucks of raw material from the loading dock to the storage space. Each hour cost 2000. And we can conclude the material handing cost is 83,330.

Payment: The personnel at ABC company devote about 2 hours each week for raw material payment, and each hour costs approximately 2000. Production is running 50 weeks yearly as well. This gives a total payment cost of 2,00,000. (= 2*2000*50)

Total ordering: hence, we can easily come to the total ordering cost, namely 133,330. The company order times are 617. Consequently, each ordering costs 21000.

Carrying cost factor:

Capital cost: The company had a mean inventory value of 8,00,000 in raw material, 100,000 tied up in storage stands and 160,000 tied up in ware house truck. The raw material is charged for 70% of the use of storage stands and warehouse trucks. This means a total capital cost of 8,182,00 (= 10,000*70% + 160,00*70% + 8,000).

5.4 Distribution method

The company keeps inventory of items at a distribution centre (DC) located in central India. It has a sales network of 16 outlets, and provides maintenance support to customers at 10 workshops. Beside this company has 6 rural outlets in towns with population of 200000 and below. As shown in Figure 5.1 the company out puts supply chain strategies at different echelons but not on the lower side i.e. at retailers end. Retailers are not grouped with each other through any type of transshipment. In the pull type of inventory management system that is proposed in this work, where a demand is being generated by the retailer when having zero inventories, lateral transshipment between the retailers may be allowed. Also in the present distribution structure the retailers are apart by moderate distances, so transshipment may done by road and by the vehicle itself and it can be delivered on the same day.
This data collection has been made for the months of March, 2012 to August, 2012 by the authors. The data is collected for one brand for 180 demand periods (18 each) for 10 retailers. Collected data represents the day wise demand faced by the retailers, daily opening stock at retailers’ end and following cost parameters. Holding cost per Truck is Rs. 120/- per day, backorder cost is Rs. 9000/- per Truck and transportation cost per Truck per kilometer is Rs. 8.00/-. Distance between retailers varies from 50 to 120 kilometers. Since retail outlets have variable demand and lead time, they face shortage or surplus. However with lateral transshipment both holding and shortage quantity decreases thereby reducing the total expected cost. If the retail outlets do not consider for lateral transshipment, they have to pay the holding cost for surplus inventory once the individual demand is satisfied and have to pay for shortage cost, if stock-out take place. Figure 2 represents the proposed structure in which retailers are grouped together for the sharing of information and material by adopting lateral transshipment. For each retailer constant holding cost, shortage cost and variable transshipment costs have been considered. The variability in transshipment cost is due to the differences of distances between retailers. Transshipment between retailers is made in such a way that if a retailer faces backorders he does transshipment from nearest retailer and onwards. Ordering strategies and lead times are also taken into account. The developed programme is run on actual data of the Four-wheeler manufacturing company and the outcome has been compared with existing one.

**Discuss the effect of inventory on supply chain**

Quite a few factors in the supply chain, namely procurement, transportation, warehousing and storage level will be identified under the circumstance of inventory optimization.

**Procurement**

By optimizing inventory management, the following advantages of procurement will achieve:

- Increase customer satisfaction
- Reduce stock out
- Scheduling production more efficiently
- Managing shipping better
- Improving pricing and promotion management
- Making more informed pricing decisions

ABC Company does not have any critical margins because if the company went out of stock would the whole state not get any heat. Thus, increasing customer level is the essential item to the company. Decreasing the ordering times and enhancing the quantities of each time will dramatically reduce stock out. And it also can make scheduling production more efficiently and accurately. Meanwhile, the company helps the suppliers decrease the transportation cost. This will give the company more margin space.

**Transportation**

By shipping in carloads or truckload quantities rather than less than car loads or less than truck load quantities, a company may experience lower per unit transportation rates. As long as the transportation cost savings exceed any expenses associated with warehousing the additional volumes of product, it will be advantageous to ship in the larger quantities.
Also, shipments in large volumes may experience better service, such as faster transit times and more reliable and consistent service. It is of a main element as to the company. These results will help to reduce other costs such as in transit inventory carrying cost and potential costs of lost sales due to product unavailability at point of sale or use.

**Warehousing and storage**

If the company uses the method of reducing the ordering times, it will affect the warehousing and storage somewhat. But the trend of the number of customers increases obviously. Customer service polices, such as a 24 hour delivery standard, may require a number of field warehouses in order to minimize total costs while achieving the standard. By keeping some

**RESULTS AND DISCUSSIONS**

Emergency lateral transshipment technique, in considered supply chain structure is evaluated by making a comparison between the ABS Company’s existing results and those which are obtained after the programme implementation. Figure 3 shows the comparison of surplus inventory at retailers’ end without transshipment and with transshipment. It has been found that surplus stock without transshipment for 180 (Mar. 12 to Aug. 12) demand periods is 300, 276, 284, 321, 296 and 312 while with transshipment the stock is reduced to 151, 138, 145, 201, 202 and 144 respectively.

Backorder quantities are also calculated in both the cases as shown in Figure 4 and it has been observed that with the use of lateral transshipment not even a single customer was backordered during the six months duration and without transshipment the numbers’ of undelivered customers were 104 which reflects that by the use of lateral transshipment more customers are satisfied even with lesser inventories in hand. As shown in Figure 6.1 similar effects have been obtained in regards to the holding and backorder costs. By using lateral transshipment holding cost has been reduced up to Rs. 73932/- and zero backorder cost as all the demands are fully satisfied. On the other hand these costs were found to be Rs. 126784/- and Rs. 103600/- when there is no lateral transshipment. Further total cost has been reduced to Rs. 76892/- from Rs. 190484/- even with the addition of transshipment cost of 94 Four wheelers. Also with lateral transshipment demand service level and period service level has been enhanced from 0.8 and 0.74 to 1.0 and 1.0 respectively. Based on the results, this work has examined, from a cost-parametric perspective, the relative effectiveness of a transshipment approach in supply chain network, characterized by a single supply source at the higher echelon and multiple retail locations at the lower.
CONCLUSIONS

Due to the effective inventory management, procurement goal can be achieve quickly. In this work, a multi-location inventory system is considered where transshipments are allowed as recourse actions in order to reduce the costs of surplus or shortage inventory after demands are realized. Based on the results, this work has examined, from a cost-parametric perspective, the relative effectiveness of a transshipment approach in supply chain network, characterized by a single supply source at the higher echelon and multiple retail locations at the lower. Our transportation network formulation has enabled us to gain analytical insight into problems of higher dimensions than has been achieved earlier. Furthermore, a number of simplifying assumptions such as zero lateral shipment lead-times, infinite supplier inventories, etc. are made here. In this paper a model has been formulated for one central warehouse serving to ‘n’ retailers. Emergency lateral transshipment technique is used for controlling inventories and associated costs for all the retailers and finally it has been found that surplus quantities and stock-out quantities are less in case of lateral transshipment, so holding cost and back order cost are decreased. For comparative purpose, a case study is solved by using their methodology and by implementing the collected data in the programme developed. Our results indicate that, from a managerial standpoint, the notion of lateral transshipments appears to have substantial appeal. If the benefits of avoiding retail level shortages outweigh the additional delivery costs resulting from transshipments, customer service may be enhanced significantly, without the burden of additional safety stocks. Finally, we suggest that the issue of emergency shipments from one or more other supply sources be examined in future work in this area.

REFERENCES


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