Improvement of SCM in a Branded Eyewear Industry Using Theory of Constraints

Mallikarjun Hallikeri Math
(PGDM No.: 12026)
Student, SDMIMD, Mysore
malikarjun12026@sdmimd.ac.in

R Jagadeesh
Professor - Operations Management and Quantitative Techniques
SDMIMD, Mysore
jagadeeshraj@sdmimd.ac.in

Comments by the Faculty

Typically a supply chain is analyzed for a variety of purposes and lead time analysis is one such important exercise carried out to ascertain the availability of stock at the retailers' place. In fact the supply chain efficiency and responsiveness, both hinge around the lead times as maintained by the vendors. It is imperative that reducing the lead time ensures timely availability of the items at the retailers' end thereby ensuring customers' satisfaction.

In this project, for the purpose of the lead time analysis a reputed and branded retailer of eyewear has been chosen and this company belongs to a major manufacturer of watches and jewellery. First a study was conducted to explore the performance of the vendors as demonstrated through order fulfilling and supply with minimum lead time. While the suppliers were able to meet the order requirements and thus maintained satisfactory volume requirement they were taking more time than what was identified during the planning period. This deviation from the planned lead time created several problems and in particular was causing out-of-stock situations. As the product happens to be a fashion accessory lack of supplies at the retail outlets caused customer dissatisfaction and eventually resulted in the loss of sales. This further demanded reworking the demand and revision of procurement plan.

The solution to the vexing problem was established by the application of "Theory of Constraints" a powerful technique that has found many applications in the business world. In addition the challenges faced by the existing supply chains were explored and many solutions like continuous monitoring of performance of vendors, reducing the total cycle time of supply chain and change in procurement plans are identified which can help in improving the existing supply chain system.

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Introduction

This paper analyses the existing supply chain system of an eyewear manufacturer and retailer and illustrates how the concepts of Theory of Constraints can be used to improve the supply chain system thereby ensuring the availability of products at the retail outlets.

As the "Theory of constraints" suggests the weakest link is the constraint that prevents the chain (system) from doing any better at achieving its goal it is extremely important to identify the weakest link in the existing supply chain system. Once the weakest link is identified the company can elevate the constraint by taking whatever action is needed to eliminate it. After this constraint is broken the company can focus on finding the next weakest link thereby repeating this process for continuous improvement.

Every selling opportunity the company loses due to non-availability of particular brand or line of merchandise will have a huge impact on the company. The customers may lose faith on the company and the competitors can grab this opportunity to increase their sales and making the customers loyal to them. Therefore it is extremely important to make sure that each and every product the customer is demanding is available at the retail outlets. Thus it is necessary to identify and eliminate the constraints that are causing shortage of product.

About the Company

The company is one of the leading manufacturer and retailer of eyewear in India. The company has a pan India presence with over 200 retail outlets. The company's product portfolio includes frames, sunglasses, and contact lenses etc. The company is facing stiff competition from both organized and unorganized sector in the eyewear industry. To become the market leader the company has to strengthen its supply chain system which is the backbone of retail industry.

Theory of Constraints

Theory of Constraints (TOC) is an overall management philosophy introduced by Dr. Eliyahu M. Goldratt in his 1984 book titled "The Goal", which is geared to help organizations continually achieve their goal. The title comes from the contention that any manageable system is limited in achieving more of its goal by a very small number of constraints, and that there is always at least one constraint. A constraint is anything that prevents the system from achieving more of its goal.

A system is generally defined as a collection of interrelated, independent processes that work together to turn inputs into outputs in the pursuit of some goal. Every chain has one "weakest link." If a force is applied to the chain at an increasing rate, it would eventually break at this point. Therefore, the weakest link is the constraint that prevents the chain (system) from doing any better at achieving its goal, (Pegels, and Watrous, 2005).

Theory of constraints (TOC) is about analysing cause and effect, verifying basic assumptions, exploring alternatives and process improvement. The goal of TOC is to maximize the efficiency

of a process selectively at the most critical points and thereby maximize profitability, quality, or other corporate objectives, (Cox & Goldratt, 1986)

According to TOC the constraints can be internal or external. When the market demands more from the system than it can deliver the constraint is termed as internal, and on the other hand if the system can produce more than the market will bear the constraint is termed as external. TOC aims at identifying these constraints and deciding how we can exploit these constraints by aligning the whole system to support the decision made regarding the constraints.

To boost the overall performance the bottlenecks in the system should be eliminated. The theory says that every system, no matter how well it performs, has at least one constraint that limits its performance – this is the system's "weakest link." The theory also says that a system can have only one constraint at a time, and that other areas of weakness are "non-constraints" until they become the weakest link. The theory was originally used successfully in manufacturing, but we can use it in a variety of situations as stated in Mabin and Balderstone (2003).

How Theory of Constraints Leads To Improvement

The improvement process focuses on three questions: What to change? What to change to? How to cause change? These three questions must be answered in sequence to make the improvement process effective.

What to Change—Identify the Weakest Link

The first step in the improvement process is to determine what to change. Improvement requires change, but change does not always lead to improvement. Sometimes, change makes things worse. Change results in improvement only when it focuses on the right element to change. If we view a system as a chain composed of many links, the strength of a chain is determined by the weakest link. When the weakest link is strengthened, the change is an improvement. When a non-weakest link is strengthened, the change is not an improvement.

What to Change to?—Design a Stronger Link

The next step in the improvement process is to determine what to change to. Once the core problem is identified, the development of the solution may simply be the elimination of the core problem. However, eliminating the core problem can also be hampered by the existence of two opposing forces pulling the decision makers in opposite directions, resulting in a tension or conflict.

How to Cause Change?—Operationalize this Stronger Link into the Chain

The last step in the TOC improvement process is the implementation of the solution. Its success depends on the degree of understanding and support participants in the improvement process. Participants might have doubts because they may perceive some critical obstacles that prevent the change from being implemented.

Application of TOC to Supply Chain Management

In this research we are concentrating on the internal constraints. The main focus of the research

is to identify the weakest link present in the existing supply chain system and provide the solution for supply chain system to create flow of inventory so as to ensure greater availability of products and to eliminate surpluses.

The TOC distribution solution is effective when used to address a single link in the supply chain and more so across the entire system, even if that system comprises many different companies. The purpose of the TOC distribution solution is to establish a decisive competitive edge based on extraordinary availability by dramatically reducing the damages caused when the flow of goods is interrupted by shortages and surpluses. This approach uses several new rules to protect availability with fewer inventories than is conventionally required.

Literature Review

Theory of constraints has been applied to many manufacturing processes for years, but it is finding its importance in retail industry in recent times. The focus of this paper is to find the weakest link in the existing supply chain system just like identifying the weakest link in a manufacturing process.

The theory of constraints (TOC) has been widely known as a management philosophy coined by Goldratt (1990) that aims to initiate and implement breakthrough improvement through focusing on a constraint that prevents a system from achieving a higher level of performance. The TOC paradigm essentially states that every firm must have at least one constraint. Goldratt and Cox (1992) define a constraint as any element or factor that limits the system from doing more of what it was designed to accomplish (i.e., achieving its goal). The owner of a system is assumed to establish its goal. The fundamental goal of most business entities is to make money now and in the future. Other stakeholders may develop necessary conditions that must be met to allow the system to continue operating. The TOC thus encourages managers to identify what is preventing them from moving towards their goals - as well as necessary conditions - and find solutions to overcome this limitation.

A study by Simchi-Levi et al. (2008) infers that supply chain performance affects the ability to provide customer value, from the most basic dimension of availability of products. Therefore, there is a need to measure supply chain performance. The need for well-defined measures in the supply chain stems from the presence of many partners in the process and the requirement of a common language.

Eon-Kyung Lee et al. (2001), concludes his research work on supply chain performance stating that, “Study is needed to develop a system that would suggest the detailed action plan to implement the best practices with respect to each managerial criterion in supply chain performance measurement.”

Study by Rueben Slone et al.(2007) infers that ,”If you’re disengaged from supply chain management, you run the risk of sabotaging partner strategy and customer relations-and leaving money on the table now and for the long term”.

With this insight, the literature review justifies the need to identify the major constraints that can affect the supply chain system of a company and how the constraints can be eliminated to improve the performance, which forms the basis of this research work. (Blackstone, 2001).

Research Methodology

To identify the constraints present in the existing supply chain system a detailed analysis of the past work orders placed among various vendors is carried out. The reason for conducting this analysis is to find out whether the vendors are supplying the ordered quantity of materials or not and how much time they are taking to supply the materials. For working out the demand plan the company is considering a lead time of 90 days for its in-house products supplied by vendors who are mainly located in china and it is considering a lead time of 60 days for fashion brand eyewear products like Rayban, Silhouette etc. To find out whether these assumptions hold true or not, a detailed analysis of work orders is carried out.

The company is using SAP supply chain management software and the software records all the transactions that take place at the various points of the supply chain like corporate office, ware house, store etc. All the data is captured with a good accuracy and the analysis of this data will help in identifying the constraints present in the existing supply chain system.

This analysis can provide a good insight into the existing supply chain system. As the company is dependent on the suppliers located in China for its major range of products and the first step to identify the constraints is to analyse the vendor performance. Microsoft excel is used for the analysis involved in the research.

The data used for the above stated analysis includes purchase orders placed from November 2011 to January 2013 with various vendors for procurement of materials like frames, lenses, sunglasses etc. among vendors in India and abroad. This analysis is carried out for house brand items and fashion brands.

The analysis consists of two parts

1. The first part identifies what percentages of orders are fulfilled by various vendors and order fulfilment at brand level.

2. The second part emphasizes on finding out the lead times for various vendors and lead time for different brands.

Data Analysis

The vendors who are awarded the major supply orders are considered for the analysis of order fulfilment and lead time. The total quantity of orders placed among various vendors are analysed to find out who are the major vendors to the company. The analysis of the major vendors will represent the situation as a whole. For the purpose of data analysis the details of purchase orders and receipt of materials etc. as recorded by the ERP system is used. There is continuous updating of the data at every point in the supply chain system. The purchase order history reports are generated from the system and all the relevant information is used for the analysis.

The Table 1 shows the percentage of total orders placed among various vendors for house brand frames. The total number of stock keeping units (SKU) ordered from each vendor is captured along with their contribution to the total volume ordered. The first 9 vendors represented in Table 1 who supply 73% of the materials are considered for the analysis.

Order Fulfilment Analysis

The order fulfilment analysis aims at finding whether the vendors are supplying the ordered. Quantity of materials or not. To find out the order fulfilment and lead time for house brand frames, purchase orders raised from November 2011 to January 2013 were analysed. The vendors who supply the major chunk of the materials were identified and their performance in terms of order fulfilment was analysed.

Table 1 :
List of vendors and their contribution

Sl. No	Vendor Name	SKU Quantity	contribution (%)	Cumulative Contribution
1	CHOAM Optical company pvt. ltd	98681	17.14%	17.14%
2	Acme optical ltd	55718	9.68%	26.82%
3	Sirius import and export company ltd	48689	8.46%	35.28%
4	Momcorp International Business group	45868	7.97%	43.25%
5	Rich optics Co. Ltd	36695	6.37%	49.62%
6	Soylent industry & trade company	36548	6.35%	55.97%
7	Tide enterprises Co. Ltd.	33651	5.85%	61.82%
8	Frobozz magic optics limited	31911	5.54%	67.36%
9	Warbucks enterprises co. Ltd	28307	4.92%	72.28%
10	Shangai best Optics Ltd	19057	3.31%	75.59%
11	Wayne Import & Export company Ltd	16971	2.95%	78.54%
12	Virtucon Optical company Ltd	15729	2.73%	81.27%
13	Globex Foreign trade company	14880	2.59%	83.86%
14	Umbrella industries limited	11602	2.02%	85.88%
15	Wonka optical industries	11507	2.00%	87.88%
16	Stark Optical company Ltd	10720	1.86%	89.74%
17	Clampett Industry & trade company	9299	1.62%	91.36%
18	Oceanic optics limited	8950	1.55%	92.91%
19	Yoyodyne industries limited	8760	1.52%	94.43%
20	Cyberdyne optical co. Ltd	6160	1.07%	95.50%
21	D'anconia industries limited	3556	0.62%	96.12%
22	Gringotts Spectacle services Limited	3370	0.59%	96.71%
23	Oscorp industries limited	3230	0.56%	97.27%

24	Nakatomi trading co. Ltd	3101	0.54%	97.81%
25	Spacely space optics limited	2748	0.48%	98.29%
26	Sterling cooper optical co. Limited	2613	0.45%	98.74%
27	Bass industries limited	2400	0.42%	99.16%
28	Adventure works limited	1435	0.25%	99.41%
29	Northridge optical Co. Ltd	1200	0.21%	99.62%
30	Woodgrove industries limited	1039	0.18%	99.80%
31	Contoso industries ltd.	1000	0.17%	99.97%
32	Alpine optical co. Ltd	200	0.03%	100.00%

The analysis was done using the following assumptions and considerations.

- Total quantity ordered is 294482 No's
- Total received quantity is 235472 No's
- Top vendors who contribute to 73% of overall orders are analysed.
- Order quantity greater than 100 is considered.
- Order fulfilment of more than 80% are considered for lead time analysis

The following table shows the order fulfilment of vendors who contribute to 73% of the business for house brand frames.

Table 2 :
The Vendors Who Contribute to 73% of the Business

Vendor Name	Contribution (%)	Order fulfilment
Choam Optical Company Pvt Ltd	17%	82%
Acme Optical Ltd	11%	91%
Sirius Import And Export Company Ltd	10%	66%
Momcorp International Business Group	10%	73%
Rich optics Co. Ltd	8%	87%
Soylent industry & trade company	6%	78%
Tide enterprises Co. Ltd.	6%	85%
Frobozz Magic Optics Limited	5%	100%

From Table 2 we can see that the order fulfilment for five vendors is more than 80%. During the preparation of demand plan a buffer of 10% is used for the procurement to account for the quality rejects. The average order fulfilment for the house brand frames stands at 85% which is little less than the 90% considered during the demand plan.

For fashion brand frames the vendors shown in Table 3 are analysed who contribute to 91% of the total order placed.

Table 3 :

Vendors of Fashion Brand Frames who Contribute 92% of the Total Order Placed

Vendor	Contribution (%)	Order fulfilment
Fourth Coffee eyewear Pvt Ltd	32%	77%
Parnell enterprise	14%	75%
Wide World optical industries	21%	70%
Baldwin India Pvt ltd	24%	72%

The average order fulfilment for the fashion brand frames is around 74% which is more than 70% considered during planning phase. The order fulfilments are acceptable as they are matching the procurement plan but still it is leading to inventory problems like shortage of products at the company's outlets and central warehouse and surplus of some stocks in the central warehouse. So the next step in identifying the constraints was analysis of the lead times for various vendors present mainly in China for house brand frames and vendors from India for fashion brand frames.

Lead Time Analysis

The lead time is considered from the date of raising the purchase order to the date when the material received at the ware house is cleared by the quality criteria for consumption.

Once the demand plan is prepared it is forwarded to procurement department for raising purchase orders. If the demand plan consists of only old SKU's then the purchase orders are raised directly whereas if the demand plan consists of new SKU"S then SKU codes have to be created in the ERP system to raise the Purchase orders.

Creation of SKU codes for the new Models of eyewear included in the demand plan takes some time (generally one week) as processes involved in the ERP system like taking the approval from the higher management etc. The time elapsed between the demand plan and the raising the purchase orders is called internal lead time.it generally hovers around 7 days. This project focuses mainly on external lead i.e. time taken by the vendor to supply the materials ordered by the company.

The bar graph depicted in Figure 1 provides the lead time for various vendors for house brand frames.

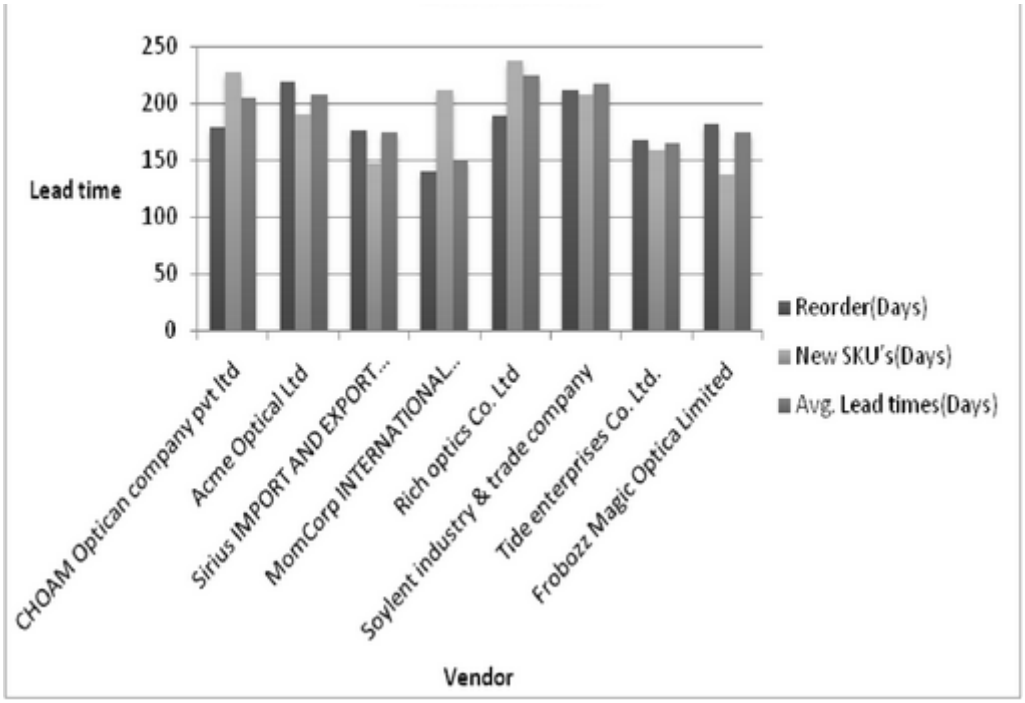

Figure 1 : Lead time of vendors

The data in the chart shows that the lead times for various vendors are usually more than 180 days. For the reorder of SKU's the lead times are comparatively less than the lead times for new SKU's as the New SKU's take more time as the vendors will not be having the designs ready and they have to start working from scratch. As the eyewear industry is fashion based every now and then the company introduces new products and old products are discontinued. So new SKUs are frequently added to the orders placed with the vendors and lead time for these new products will be high.

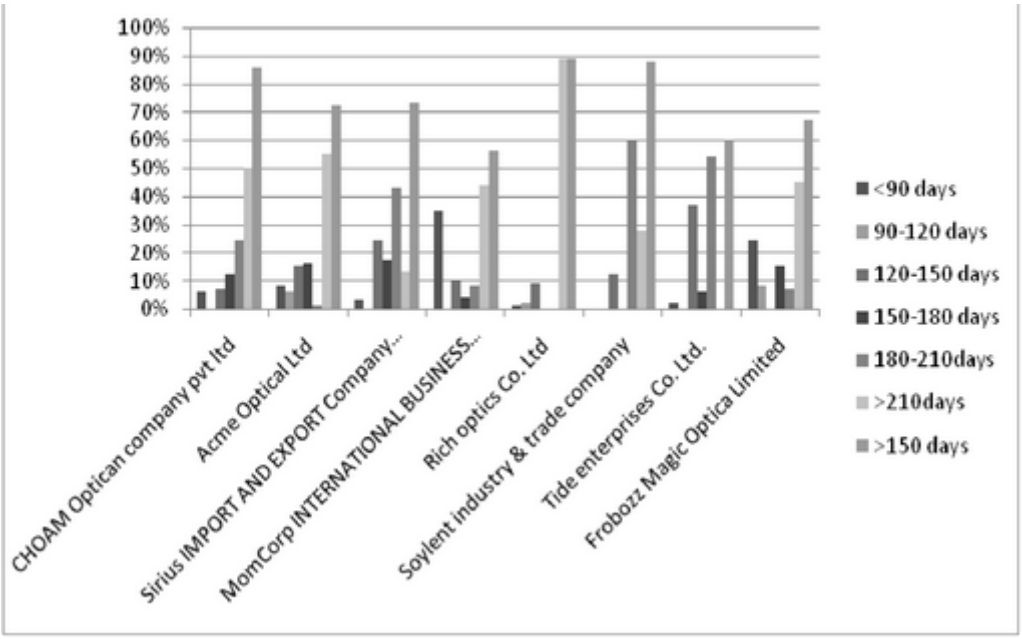

Figure 2 : Percent of materials supplied by vendors within specified time interval

The Figure 2 shows the percentages of materials supplied under different brackets of lead times. The lead times are divided into brackets like less than 90 days, 90-120 days etc. the table shows that major chunk of materials is coming after 150 days which is a worrying factor as the lead times assumed during planning are three to four months. The flow of inventory initially will be very less as compared to the flow after 150 days. The Table 4 shows the lead time for vendors for fashion brand frames.

Table 4 :
Lead Time for Vendors for Fashion Brand Frames

Vendor	Average Lead time(days)
Fourth Coffee eyewear pvt ltd.	58
Parnell enterprise	40
Wide World optical industries	52
Baldwin India Pvt ltd	57

Table 4 shows that the average lead times for vendors of fashion brand frames are under 60 days and the lead times are matching the procurement plan. During planning phase a lead time of 60 days is assumed for the supply of fashion brand frames.

Major Findings

The order fulfilment analysis for the vendors shown in Tables 1&2 yielded the following results.

- The average order fulfilment for house brands is 85% which is little bit less than what was considered during the planning phase which is 90%.
- The average alignment for fashion brand frames is coming out as 74% which is acceptable as the alignment is expected to be 70% during the planning phase.
- The analysis carried out on the purchase order history of the vendors shown in Table 3 yielded the following results
    - The average lead time for house brand frames which are procured from china are having a lead time of around 180 days which is hihger than the lead time of 120 days considered during planning.
    - The average lead time for fashion brand frames is around 45 days which shows that the assumptions during planning period are correct. The order fulfilment and lead times are acceptable but still shortages are observed in stores implying some changes are required in demand plan estimation.

Recommendations

Anything that is not monitored in the corporate setup is likely to be dysfunctional and might lead to problems. The areas which are not monitored in a business environment might lead to loss of sales, problems in smooth operations etc. To reduce the lead times the company can concentrate on the following recommendations

1) The procurement plan can be altered and materials can be ordered taking into account of higher lead times for house brand frames.

   The demand plan can be altered to five to six months demand plan to overcome the problems created by higher lead times but again it will not eliminate all the constraints because it might lead to storage problems and demand plan cannot be for 6 months inventory as there might be demand fluctuations as the eyewear industry is turning into fashion based industry

2) Proper monitoring of orders placed with various vendors and follow up with vendors to reduce the lead times.

   To reduce the lead time a tracking mechanism can be setup where expected delivery dates can be mapped to all the orders placed with all the vendors and the shortfall at the central warehouse and outlets can be covered by a proper follow up with the vendors.

The process involves the following steps

- Estimate the requirement in each category of products
- Study the stock coverage in Central warehouse
- Study the stock coverage in open Purchase orders
- Checking which categories are not fully covered
- If the categories are not covered then taking suitable steps like immediate follow-up and raising purchase requests to make sure that all categories are covered.

3) Time compression in the supply chain

   All supply chains have two distinct lead-time pipelines, first, the order information transfer pipeline, from point of sale to raw material supplier, and second, the product transfer from raw materials to end customer.

Once information ages, it loses value and old data causes amplifications, delay and overhead. The best way to compress the information pipeline is to directly feed each player in the supply chain with the market sales data thereby eliminating the traditional long pipeline. So rather than each player making his/her order decision based purely on the internal chain order data he/she can now make an informed judgement based on what the end consumer is actually buying at the point in time of sale. So the company should make its vendors an integral part of its supply chain system by sharing information with them which makes the vendors to schedule their production plans and manage inventory based on needs of the end users. When there is a smooth information flow between the each player of the supply chain there will be an improvement in material flow time.

Conclusion

In order to keep the cost of manufacturing down, the Company is procuring the materials from countries like China and South Korea where the production costs are low but it is leading to higher lead times as the company does not have control over the production facilities. To have a competitive edge over the competitors The Company has to reduce the cost as well as strengthen the supply chain system by reducing the lead times. The order fulfilments are acceptable as they occur according to the demand plan assumptions, but the lead times are higher. According to the findings of research conducted we can clearly identify “lead time” as the major constraint and the company should focus on reducing the lead times.

When this constraint is eliminated the company should identify the next biggest constraint in the supply chain system and should continue this process to improve the overall performance of the supply chain system. As TOC concept states there will always be a minimum of one constraint present in a system, the company can keep on identifying the constraints and exploit them by elevating them.

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