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A Study the Lean Manufacturing and Supply Chain Management to Optimize Inventory

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Abstract- ***A supply chain is an integrated system that transfers goods or services from a supplier to a final customer through the use of operations, technology, human resources, & information sharing. SCM has garnered more attention lately because of its focus on the material, information, & financial flow from suppliers to customers or vice versa. SCM's inventory control is a big problem. Inventory is the term for idle products that are stored in various forms & locations, waiting to be used or sold. The procedure of confirming that the right amount and quality of material is available when needed while minimizing working capital & storage and ordering expenses is known as inventory control. The optimization of inventory in the SCM for lean manufacturing is the main goal of this study.***

Keywords- Supply Chain Management, Lean Manufacturing, Inventory, Techniques

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INTRODUCTION

Lean Manufacturing is the name given to an approach that was popularized in the 1990s under the phrase "lean" and is aimed at minimizing waste, cutting costs and production time. It was inspired by the Japanese automaker Toyota. Specifically, it means reducing three types of waste, known in Japanese as muda, mura, and muri: 1) processes or activities that don't add value (such as overproducing or moving items needlessly); 2) unevenness (such as irregular schedules, idle periods interspersed with rushes); and 3) overburden (such as overworked workers carrying excessive weights or using inappropriate tools, or teams or machines pushed past their reasonable limits). Reducing bottlenecks & facilitating fluid production flows are further components of the Lean Manufacturing methodology.

Lean Manufacturing is based on a managerial with cultural approach rather than just a set of tools. Its leadership creates or implements a strategy, procedures, standardization, & simplification with the intention of continuously improving while respecting people. As a result, a lot of attention is placed on maintaining long-term relationships with employees, explaining the lean philosophy to workers, and establishing a vital connection between veterans and recruits (known as Senpai & Kohai in Japanese), among other things. Lean Manufacturing initiatives are successful because of the employees' commitment to and conviction in the goals of continuous improvement & waste reduction. This is likely why these initiatives have been more difficult to adopt in Western societies. This also explains why some have referred to lean manufacturing as a religion rather than a science.

SUPPLY CHAIN MANAGEMENT

The supply chain can be described as an interconnected system of businesses that engage in various processes & activities with suppliers and customers to generate value for the final consumers through the provision of goods and services (Christopher, 1998). Another definition of the supply chain, according to Bagchi (2000), is a system of facilities or contractors that provide components or raw materials, reprocess them to create semi-finished goods or components, create the final product, and then allow the customer to consume it.

SCM (Kot, 2009) views the chain and the companies surrounding it as a whole. Regarding the definition of value chain management, however, there is disagreement (Koulikoff-Souviron 2000). An essential strategy in SCM is to remove obstacles between chain links, which will facilitate the coordination of product movement along the chain. This indicates that the procedures are the primary focus of SCM. According to Carbonara, SCM is integrated management focused on the information and commodities flow process from the raw material

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suppliers to the end user. By lowering expenses & raising the caliber of customer care, the goal is to add value for the client (Carbonara, 2000). Establishing the supply chain entails forming the connections within the network of businesses where material & information flows are processed. According to Kruczek (2011), the supply chain is made up of a network of interdependencies or procedures that are carried out by the various cells. SCM is integrated management, based on Carbonara, with an emphasis on the information and commodity flow process from raw material suppliers to the final consumer. The objective is to add value for the client by reducing costs and improving the standard of customer service (Carbonara, 2000). Forming linkages within the network of enterprises where material and information flows are processed is a necessary step in establishing the supply chain. The supply chain, according to Kruczek (2011), is composed of a network of interdependencies or processes that are executed by the different cells.

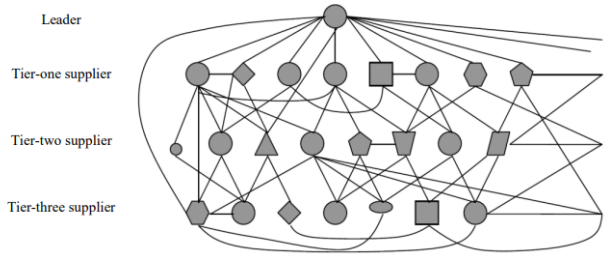

Figure 1 Supply chain structure

LEAN MANAGEMENT

Lean management is a concept that aims to gradually & continuously improve organizational processes. The foundation of lean methodology is cost reduction combined with increased manufacturing process throughput & efficiency. Its primary goal is to increase process productivity while concentrating on producing goods that meet client criteria (Zimon, 2012). This idea originated in Japan. The concept of constant improvement via waste removal forms its basis. Its goal is to lower foundation costs while increasing the manufacturing process's output quality. A perfect manufacturing process concentrates on tasks that add value for the client and gets rid of ones that are unnecessary in the client's eyes. Alternatively, the objective is to generate value for the client, something for which they are prepared to pay. The customer's willingness to pay for the goods determines its worth. The product offers more value the more the buyer is ready to spend. It is typical for logistics to define added value from the standpoint of the customer (Witkowski, 2003).

The process of reducing the reasons of ineffective & inefficient processes may be summed up as five phases that must be continuously executed in order to gradually enhance the process (Kruczek, 2008):

1. Identification of the problem

2. Analysis of the problem

3. Removal of the causes

4. Check remedies

5. Standardization of solutions.

INVENTORY MANAGEMENT

Inventory management is one of the most important business practices for a manufacturing or production company's sales, purchasing, and logistical activities. It addressed inventory management throughout the whole supply chain. Inventory control is located at the data level, which is also where everyday business is organized. The primary goals of data-driven activities in this case are short-term planning & event documentation. The two main objectives of inventory control are monitoring stock movements and making sure it is maintained at the appropriate level.

According to [Kotler 2002], inventory management includes all of the activities involved in setting and monitoring the stock levels of raw materials, semi-finished materials (work-in-progress), or finished goods in order to guarantee a sufficient supply and reduce costs related to having too much or too little inventory. Inventory management is one of the most important business practices for a manufacturing or production company's sales, purchasing, and logistical activities. It addressed inventory management throughout the whole supply chain. Inventory control is located at the data level, which is also where everyday business is organized. The primary goals of data-driven activities in this case are short-term planning & event documentation. The two main objectives of inventory control are monitoring stock movements and making sure it is maintained at the appropriate level.

According to [Kotler 2002], inventory management includes all of the activities involved in setting and monitoring the stock levels of raw materials, semi-finished materials (work-in-progress), and finished goods in order to guarantee a sufficient supply and reduce costs related to having too much or too little inventory. Increasing in the redundancy of machinery or operations due to inventory shortages may result in production loss & related costs.

In manufacturing systems, production control is typically dictated by the physical arrangement or functionalities of the machinery, even in highly intricate and adaptable processes incorporating numerous products. Since work varies and machines are not made for a particular task, many tools need to be set up every time [Kumar 2013]. Controlling supply chain expenses is the most important aspect of any firm, and it can only be accomplished by engaging experts in inventory management techniques.

TYPES OF INVENTORY

Three categories can be used to classify inventory:

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i. Raw material inventory: All goods that a company buys to process its materials are included in this. For example, a confectionery company's raw material inventory includes things like flour, yeast, eggs, and so forth.

ii. Work-In-Progress Inventory: phase of raw material inventory that is in between stages and is not yet complete enough for the plant to move on to the next processing step. These are materials that have undergone some processing but not all of it.

iii. Finished Goods Inventory: The amount of finished goods stock depends on the coordination of the organization's production & sales departments. These could be goods that are in stock & waiting to be shipped or stored in a warehouse.

INVENTORY MANAGEMENT TECHNIQUES

The success of inventory management strategies & reduction of expenses for the company depend on enhanced supply chain performance & staff knowledge. For this reason, inventory management techniques are critical to business operations. The ability to implement these approaches for the benefit of the firm is a must for managers & procurement staff as they are vital and highly sought.

Economic Order Quantity

EOQ inventory management methodology is utilized to identify the ideal delivery size & select the least expensive provider, ensuring that the overall costs of inventory investments are kept to a minimum. Every time an item's inventory runs out, the EOQ model calculates the best quantity of inventory to order [Chambers 2011]. When determining the quantity to utilize for refilling item inventories, EOQ model takes into account the trade-off among ordering cost & storage cost. Although a higher order quantity means fewer orders to place and hence lower ordering costs, it also means keeping a higher average inventory, which raises holding costs.

EOQ model presupposes the subsequent:

- Demand is constant and known with certainty.
- Depletion of stock is linear & constant.
- No discount is allowed for quantity purchases.
- Order and receiving delivery time interval are constant.

Vendor-Managed Inventory (VMI)

The VMI technique, particularly in large-scale production management, can yield substantial benefits from transparent collaboration with reliable suppliers of crucial inventory. VMI allows the vendor to plan, manage, and control inventory for their clients in a vendor/customer relationship. The client concentrates on improving demand accuracy, and the provider keeps the inventory within predefined limits. The customer organization gives up order-making responsibilities in exchange for timely inventory replenishment, which eventually enhances overall capacity planning & organizational effectiveness. Mathematical models that lower vendor and buyer/customer costs can be developed to lower the total cost of the inventory management system.

Just-In-Time

JIT inventory replenishment is to supply commodities to businesses only when needed. This is the preferred method for inventory products that are exceedingly expensive when there is little demand for the item but a reasonably high purchase price, holding cost, or ordering cost. The model tries to avoid having too much inventory and associated costs. As a result, companies only buy inventory when their current supply is likely to run out. One essential requirement for the success of the JIT approach is the vendor's assurance of quick delivery. This is to avoid expensive and permanent business interruptions brought on by inventory delivery delays. Reducing carrying costs and in-process inventories in order to maximize return on investment is the aim of JIT scheduling, a burgeoning topic in scheduling. JIT is recommended as a production scheduling approach in environments with single & parallel machines, but it is also starting to be taken into consideration in contexts with flow shop machines [Adamu 2014].

Activity Based Costing Analysis

According to Fellows (2005), keeping merchandise at your business provides a benefit for the company as well because it will immediately satisfy customers, which will raise performance ratings. An business can benefit from prompt delivery and avoid stock outs when it has inventory in its warehouse. As a result, businesses must make sure they have enough inventory for their distribution & operations. The "Pareto Analysis," commonly referred to as Activity Based Costing (ABC) analysis, is one method by which they might accomplish this. A popular categorization method for differentiating inventory goods for inventory control is the ABC scheme.

The different items are divided into three groups based on the unit cost involved:

- A, which consists of products with a high investment;
- C, which consists of items with relatively small investments but a reasonably large number of items; and
- B, which is in the middle of categories A and C.

Category B merits less attention than A but more than C, Category C needs the least attention, and Category A needs the strictest monitoring.

The steps involved in putting ABC analysis into practice are as follows:

a) Sort inventory items according to their estimated usage in units & price per unit.

b) Multiply the predicted units by the unit price of each item to find its total worth.

c) Sort the objects by total value, placing the things with the highest total value at the top and so forth.

d) Determine the percentages of each item's number of units relative to the total number of items as well as the ratio of each item's total value to the overall value of all things.

e) Sort the objects into three groups, A, B, and C, based on how valuable each is in relation to the others.

Table 1 Activity Based Costing.

Particulars A item	A item	B item	C item
Control	Tight	Moderate	Loose
Requirement	Exact Close	Exact Some	Estimated
Check	Regular	Some	Little/No
Expenditure	Industrial	Individual	Group/None
Posting	Low	Medium	
Safety Stock	High		Rare

Table 2 Techniques for Inventory Management [2014, Kontuš]

No	Inventory Management Techniques	How Performance Improvement will be achieved
I	Economic Order Quantity	Ability to know how much and when to replenish inventory
Ii	Marginal Analysis	Reduce loss for inventory that is perishable within a short period of time by ensuring they are ordered at the right time.
iii	Just-in-time	Ordering inventory when they are required thus reducing storage/holding costs
iv	Simulation	Capability of laying out inventory management plans for the organization
v	Order Batching	Minimizing on unnecessary costs on transport
vi	Vendor Managed Inventory	Improving on inventory management systems by engaging outsourced suppliers to management inventory monitoring and replenishment.
vii	ABC Analysis	The organization is able to account for each inventory according to its classification and this can be achieved through the Pareto analysis.

KEY PRINCIPLES OF LEAN INVENTORY MANAGEMENT

Lean inventory management's primary objective of greater efficiency is achieved by businesses through the use of five fundamental concepts. These ideas are based on a book written in 1996 by James Womack and Dan Jones, who founded the Lean Enterprise Institute & Lean Enterprise Academy in the United Kingdom. The foundational ideas of lean manufacturing were outlined by the authors of Lean Thinking: Banish Waste & Create Wealth in Your Corporation.

The term "responsiveness" is frequently used to refer to Womack and Jones' "value stream" idea for lean inventory reasons. The whole product lifecycle—from raw materials to ultimate disposal—is examined by the value stream. A more limited definition of responsiveness is the ability to adjust inventory to match shifts in supply or demand.

1. **Value:** Value, as defined by the five Lean principles, is what customers desire and are willing to pay for. Businesses must consider customer demand when deciding how much and what kind of goods to carry when looking at inventory management. Demand planning, a cross-functional process that assists businesses in giving customers what they want while eliminating excess inventory & dead stock, is responsible for determining this.

2. **Flow:** Companies need to understand how inventory moves within their business in order to implement lean inventory practices. Three questions are posed in a solid materials requirements planning (MRP) practice, and the answers determine the flow: What is required? How much is required? By when is it required? Schedules of production must be driven by the replies.

3. **Pull:** JIT inventory management, in which things are produced only when and in the amounts needed, is inherently based on a pull-based method. In contrast to a push-based system that is more demand-centric and heavily dependent on prior sales data to predict production levels, pull systems naturally flow from flow processes.

4. **Responsiveness:** The ability to adjust to change helps prevent out-of-stock circumstances and higher carrying costs. Reactivity is enhanced by efficient procedures in inventory management, such as ABC analysis, demand forecasting, & EOQ.

5. **Perfection:** The lean concept is best summed up by aiming for perfection in any process, be it manufacturing, inventory control, or anything else. Companies get closer to the ideal when they make constant changes to raise quality to obtain waste and inefficiency.

LEAN INVENTORY MANAGEMENT ATTRIBUTES

The process of developing & sustaining a lean management system involves six key components:

1. **Demand planning:** Inventory is provided by businesses to customers upon purchase. This calls for sophisticated inventory forecasting, in which businesses utilize the use of past, present, and future event data to make sure they have precisely the right amount of inventory to satisfy anticipated client requests.

2. **Cross-enterprise collaboration:** Here's the deal: information access and a collaborative atmosphere. To stay up to date with forecasts, every team requires quick

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access to real-time data from ERP, CRM, sales, and other platforms.

3. **Cost and waste reduction:** One of the key motivators is to reduce waste & costs, but only until doing so starts to negatively affect the value that customers receive. The objective is to maintain high levels of customer service while offering the most economical options.

4. **Process standardization:** Employees waste less time & firms boost repeatability, reduce errors, and find automation opportunities more quickly when they optimize and then standardize the processes in a work process. Having a clear work procedure increases the likelihood of consistent adherence and, as an added benefit, facilitates training.

5. **Industry standardization:** There is a limit to how far you can standardize internal processes. Businesses must find a balance between retaining the benefits of proprietary processes and utilizing components & procedures that are industry standard. An carmaker that uses conventional tire sizes but customizes the rim design is one example.

6. **Cultural change:** Research indicates that when a lean culture is appropriately applied, employee engagement increases & culture gets better. Employees that have a sense of process ownership are more committed to continuous enhancements.

CONCLUSION

A supply chain is a system that combines people, organizations, information, and resources to move goods both physically and virtually from a supplier to a customer. The supply chain's operations combine raw materials & components to create a finished good that is shipped to customers or users. The location of the production facilities, storage facilities, transportation, & inventory all play a significant role in how well the supply chain performs. An inventory control system is crucial to the efficient process of the supply chain. Inventory is the term for idle products that are stored in various forms and locations, waiting to be used or sold. Manufacturing facilities are loaded with inventories of machinery, equipment, spare parts, & personnel in addition to inventories of raw materials, work-in-progress, and finished goods.

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