

Scope of Productivity Improvement with Lean Manufacturing in a Unit

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Abstract

Many firms are increasingly interested in implementing a lean manufacturing strategy in order to compete in this competitive worldwide market. In this regard, it is crucial to examine the implementation of lean manufacturing in various firms in order to identify the critical best practises. This article discusses the creation of key areas that will be used to evaluate the adoption and execution of lean manufacturing processes. There are certain important areas established to analyse and minimise the most optimum projects in order to improve their production efficiency and boost the purpose of the manufacturing unit's economic advantages. By seeing customers and suppliers as partners, lean manufacturing is evolving into lean enterprise. This provides an advantage in today's cost and time competitive sectors. The company is strengthening in all traditional areas of competitiveness. They are as follows: price, quality, and delivery. Owners of lean businesses may offer high-quality items promptly and at a cheap cost.

Keywords: *Lean manufacturing, Implementation, Tools and Techniques, Competitive points*

INTRODUCTION

Toyota Motor Corporation developed the Toyota Production System in the 1950s, and it then formed a new type of

management idea known as 'Lean thinking' [1]. Lean manufacturing applications, such as lean production, lower manufacturing costs, cut development and manufacturing

cycle times, and boost corporate competitiveness. Aside from the car sector, Lean production has spread to machinery manufacture, electronics, consumer products, aerospace, and shipbuilding, becoming the second milestone of modern manufacturing processes after mass production methods. In the twenty-first century, the application of lean thinking has advanced and has evolved into a new generation of management revolution guided thought.

Lean manufacturing entails removing waste across the supply chain by identifying non-value added operations. The five fundamental Lean principles are to specify value from the customer's perspective, identify the value stream, make the identified value flow, set the pull system (only make as needed), and finally perfection in producing what the customer wants and when it is required in the right quantity with minimal waste.

Lean manufacturing, often known as lean production, has piqued the interest of both academics and practitioners. The technical components of lean manufacturing have received a lot of attention. It has become a worldwide manufacturing approach, with various facilities throughout the world, including Toyota and other corporations,

effectively using it. Though Lean manufacturing originated in the automobile sector, it has now been effectively used in a variety of other fields. Due to increased competition from global competitors, several firms are pursuing lean manufacturing as a production approach. However, research that focuses on combining the different main techniques of lean manufacturing and analysing their level of adoption in real life are few. This article examines the lean manufacturing practise areas. To investigate the implementation of lean manufacturing processes, a collection of areas is employed.

Literature Survey and Review

Toyota Production System (TPS), also known as Lean manufacturing, has affected industrial techniques throughout the world as described in their book "The Machine That Changed the World" [2]. TPS is based on the principle of eliminating waste and producing just the things necessary at the appropriate time and in the required amounts. Lean principles are ubiquitous because they are widely recognised by many industrial operations and have been effectively applied across many disciplines. It has evolved into an integrated system comprised of highly interconnected

aspects and a wide range of management methods such as Just-in-time delivery, quality systems, work teams, cellular manufacturing, and so on [3].

The primary goal of implementing lean manufacturing is to enhance production, decrease lead time and cost, and improve quality in order to provide the maximum value to consumers. There are several definitions of lean manufacturing. It is most usually related with the reduction of the seven major wastes in order to mitigate the consequences of supply, processing time, or demand unpredictability. Overproduction, waiting, needless transport or conveyance, overprocessing or wrong processing, excess inventory, unnecessary movement, and defects are the seven wastes described. Lean manufacturing, according to J.P. Womack, requires half the human effort in the plant, half the manufacturing area, half the investment in tools, and half the engineering hours to design a new product [1]. Furthermore, it necessitates maintaining significantly less than half of the required inventory on hand, resulting in far fewer faults, and generates a wider and ever-expanding range of items. In a nutshell, it is named lean because it utilises less, or the bare minimum, of

everything needed to manufacture a product or provide a service.

What exactly is Lean Manufacturing?

Lean Manufacturing is defined as follows: Lean manufacturing, often known as lean production, is the most efficient technique of creating things by eliminating waste [4]. OR "Lean manufacturing is a system that tries to eliminate waste from the system through a systematic and continuous approach." Lean Manufacturing is an operational approach aimed at attaining the lowest cycle time achievable by eliminating waste. Lean manufacturing procedures are founded on five principles that drive management's actions toward success [5].

A. Value

The value of a product is determined completely by the consumer in lean manufacturing. Identifying value in lean manufacturing entails understanding all of the activities necessary to manufacture a certain product and then optimising the entire process from the customer's perspective.

B. Constant improvement

The shift to a lean workplace does not happen overnight. To achieve your company's objectives, you must have a

continual improvement mindset. The word "continuous improvement" refers to the gradual improvement of goods, processes, or services over time in order to reduce waste and improve workplace functionality, customer service, or product performance.

C. Customer orientation

A lean manufacturing firm is concerned with its customers rather than with operating equipment quickly to absorb labour and expense. Ensuring client input and feedback ensures quality and customer happiness, which all help sales.

D. Perfection

The idea of perfection in lean manufacturing implies that there are limitless chances for optimising asset usage across the board. The methodical reduction of waste lowers an enterprise's operational expenses and satisfies customers' need for maximum value at the lowest price.

E. Concentrate on waste

Lean Manufacturing seeks to eliminate waste in all aspects of manufacturing, including customer interactions, product design, supplier networks, and plant management. Its objective is to include less human work, less inventory, less time

to produce goods, and less space in order to become extremely responsive to client demand while delivering top-quality products in the most efficient and cost-effective way possible.

Organizational Wastes

Lean manufacturing relies on compressing time by removing waste and continuously improving the process. Oh no defines waste as any component of manufacturing that increases costs without providing value that the client is willing to produce. Wastes in the organisation include: [4] Overproduction: producing more than is required.

Waiting refers to idle operator or machine time.

Motion: Non-value-added movement of humans or machines.

Inventory is any quantity that is greater than what is needed to produce a product.

Any material movement that does not directly support value-added processes is referred to as transportation.

Defects: The production of faulty parts. Extra processing is defined as any process that adds no value to the product.

People are underutilised when they are not fully used.

Tools for Lean Manufacturing

The following tools are at the heart of lean manufacturing: [4]

Standardized work: Operations are planned in the safest, most well-known order, employing the most effective resource combination. Jobs are disassembled and inspected to identify the best and safest way for each. The standard is then created, taught, and upheld by repetition.

Workplace Organization/5S: Various housekeeping tasks are frequently employed for continuous improvement in the workplace. Sorting out what is necessary and what is not required is one of the workplace organising activities.

Put everything in its place and everything in its place;

Shine / cleanliness - cleaning all work areas with a preventative maintenance mindset;

Standardize - the system across the organisation; **Sustain -** the efforts via self-discipline.

Visual factory (VF): Information is made visible and intelligible to each operator in order to achieve continual improvement.

Point of use storage: Keep all parts, raw materials, tools, and fixtures as near to the point of use as feasible.

Kanban: A Kanban system is a type of information system that manages the necessary pieces at the necessary time.

Kaizen is the Japanese term for constant improvement. Kaizen is the process of finding and removing waste as rapidly and as cheaply as feasible [6].

Quick changeover / single minute exchange of dies (SMED): SMED is a technology that allows production to be mixed without reducing output or increasing expenses due to setup waste.

Flow in one piece: To reduce work in process, the operator should concentrate on finishing one phase of the process before moving on to the next.

TAKT time: The maximum time permitted per unit to create a product in order to satisfy demand.

Total productive maintenance (TPM): TPM is a companywide equipment maintenance programme that encompasses the whole equipment life cycle and needs employee involvement [7].

Value stream mapping (VSM): VSM is a beginning point for managers, engineers, suppliers, and customers to recognise and identify waste. VSM is a method for graphically mapping the production chain of a product, encompassing material and information flow. It examines the activity necessary to transport a product from raw material to customer (both value added and non-value added).

Work processes, scheduling, inventories, equipment, layout, material handling, personnel, quality, product design, suppliers, tools and methods, customers, ergonomics and safety, and management and culture are the areas responsible for boosting the efficiency of any unit [8].

Employees that are motivated and empowered are necessary because people are the most important aspect of lean production. Unexpected machine downtime would cause a halt in production and reduce productivity. Equipment is a critical area where preventative maintenance and setup time reduction are critical to the success of lean production.

Appropriate scheduling systems, such as the pull system, might help to minimise inventories and prevent overproduction. Quality is crucial in lean manufacturing

since poor quality management leads to a lot of waste like scraps and rejections. Suppliers promote the development of JIT manufacturing and JIT delivery capabilities in order to improve long-term competitiveness. Material handling is emphasised in lean manufacturing since material transportation and waiting time are wastes that must be reduced. The travelling distance and processing order are determined by the layout. An inefficient plan would result in unneeded transportation or conveyance, which would be a significant waste. In order to achieve lean, it is also critical to standardise work processes and remove non-value added operations. Aside from that, there is a need to keep inventory at a minimal because extra goods would take up more precious space and result in greater carrying costs. Product design is also significant since the structures and materials used in the product impact production processes and costs. Concurrent engineering approaches are critical in the creation of "lean" products. Establishing solid customer connections would allow a firm to satisfy consumers' wants and effectively foresee their desires. All activities are built on the foundation of safety. Ergonomics is also significant since it helps humans increase productivity while decreasing injuries and weariness. Unnecessary movements (one

of the primary wastes) are decreased by adopting ergonomic features. This helps to eliminate mistakes caused by human error, hence improving product quality.

Case Study

This is a practical case study of an assembly line setup with the goal of producing 3200 pump sets each month on a two-shift basis. The assembly line, which had a monthly output capacity of 3200 pump sets, was transported on a closed loop conveyor with a total of 12 stations, each with a tact time of 6.2 minutes. Three test beds were available for testing the engines and physically moving the tested engines from the testing area to the pump set assembly area. The overall cycle time for testing the engines is 40 minutes for each test bed, except the fitting of sensors (exhaust, intake, lube oil temp.) which must be attached before testing and removed when the testing cycle is completed. Many of the activities were performed manually, which was hazardous to one's health. According to market research conducted by the company's marketing department, customer demand (as per sales forecasts) is more than the needed production rate, i.e. 8000 pump sets each month.

The system under consideration is a semi-automatic pump set production line with

the goal of producing 8000 pump sets per month on a two-shift basis with a tact time of 2.80 minutes for each assembly station and a three-shift basis for testing, pump assembly, pump set assembly, pump set painting, and pump set packaging. The pump set manufacturing line is divided into eight stations: washing, sub-assembly, assembly, testing, pump assembly, pump set assembly, pump set painting, pump set packing, and two types of conveyors [9].

Various tools, techniques, and areas of lean manufacturing were implemented during the assembly line setup to improve efficiency and remove wastes throughout the installation and work in progress. Various topics were covered, including the layout, material handling, equipment, personnel, suppliers, inventory, tact time, line balance, kaizen, single minute swap of dies, ergonomics, safety, and employee intake all played important roles.

1. Six different layouts were considered based on the available space, and one layout was chosen where it was possible to set up the assembly, testing, pump assembly, pump set assembly, pump set painting, and pump set packaging without disturbing the initial setup of the chimney, fuel - water - air pipe line, and sludge tank area.

2. Different material handling applications were introduced to transport material from the initial stage to the final stage; slat conveyor for assembling the product from the raw component stage to the finished assembled stage with a total of 24 assembly stations, EMS for handling the engines before and after testing, monorail, cranes, and buffer conveyors for conveying assembled engines from assembly to testing area, testing to pump set area. Forklifts are used to transport packed engines from the pump set packaging area to the completed goods area, while stackers and trolleys are used to transport 2 - bin material and raw components from the storage area to the appropriate location.

3. Because of the job distribution and increase in work stations, the takt time was lowered from 6.4 minutes to 2.80 minutes.

4. As the manufacturing capacity expanded from 3200 pump sets per month to 8000 pump sets per month, so did the staff intake.

5. New equipment was introduced to improve productivity, including washing machines for cleaning oily and dusty parts, an engine leakage testing machine, and the filling of one litre of lube oil in the

assembled engine using a hand pump for testing purposes.

A. Advantages

i. The arrangement chosen for the new manufacturing line maximises floor space usage.

ii. The distance traversed is shorter than on the traditional assembly line.

Buffer stock can be kept before and after engine testing.

iv. There is no disruption to the present setup (the other series engine can work continuously).

v. More finished goods storage space is available.

vi. Use of an existing chimney foundation.

Drawbacks

1. The investment is substantial.

2. The need for more and more trained labourers to work on the line.

3. No engine backtracking or rework is feasible if certain operations are left behind while working on the assembly line.

4. Because the manufacturing is for 8000 pump sets, there is a strong need for components from sub suppliers within the allotted time frame; if not available, the line will be shut down.

CONCLUSION

The lean manufacturing approach is an efficient strategy to improve management and increase the worldwide competitiveness of manufacturing businesses. The major categories provided are more thorough in assessing the current condition of lean manufacturing adoption and implementation. A pilot study with experts from academia and business will validate and enhance the suggested selection of critical topics. According to the case study, the production of the pump set has grown from 3200 to 8000. This boost in output may result in considerable financial benefits and savings for the firm.

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