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IMPLEMENTATION OF LEAN TOOLS IN APPAREL INDUSTRY FOR IMPROVING PRODUCTIVITY

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A B S T R A C T

To understand the benefits of the Lean manufacturing implementation in the Apparel Industry, a project was initiated in Pheonix International, Ludhiana (India). Different lean tools were implemented such as 5S, Kaizen, Poka-Yoke, Kanban, and Andon. Lean tools were implemented in all the departments including a fabric store, CAD lab, spreading and cutting department, sewing department, finishing and packaging department.

Implementation of lean tools in apparel industry increases productivity by around 8%. The implementation of lean tools resulted in a reduction of cycle time. The lean tools also result in managing and reducing the garment manufacturing waste and thus increasing quality. At the same time, the organization must have to maintain the effectiveness of lean tools to gain benefits over a period.

1. INTRODUCTION

The lean tool is most often found defined as, a tool that incorporates various principles to identify and remove waste to increase process speed. To put it bluntly, lean practices seek to increase the value of a client or customer, while minimizing waste of all kinds. The purpose of this paper is to investigate the effect of the implementation of lean tools within the context of the apparel industry. The process of lean tools implementation attempts to identify and eliminate waste through continuous improvement to make production activities efficient and productive. The system focuses not just on a systematic production flow, but also requires changes in the layout of the operations, time is taken by employees to finish a task and the movement

of a garment from start to finish. By implementing such tools, apparel companies can measure performances and take active steps to continuously improve them.

2. MATERIALS AND METHODS

First, for the implementation of the Lean tools, the thorough study was carried out regarding the various problems in the apparel industry. Overall, the problems can be listed as follows,

1. Less Production
2. Poor quality (more defects)
3. No standardization
4. A large amount of waste
5. Poor management
6. Lesser efficiency

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7.   More unnecessary inventory
8.   Lack of info flow throughout the factory

To understand the benefits of the Lean manufacturing implementation in the Apparel Industry, a project was initiated in Pheonix International, Bahadur road, Ludhiana (India) at a limited liability enterprise, which is exporting garments to the Bangladesh, Shri Lanka, and Dubai. The product mix of the company includes shirts, jackets, trousers, shorts, dresses and T-shirts for men, women and kids and has a capacity of manufacturing 60,000 pieces of garments per month.

Lean tools were implemented in all the departments including a fabric store, CAD lab, spreading and cutting department, sewing department, finishing and packaging department.

3. PRODUCTIVITY

Productivity is explained in a simple term as the relationship between output and input as given in equation 1.

$$Productivity = \frac{Output}{Input} \qquad (1)$$

In the garment industry, mainly the output can be considered several pieces of finished garments. The output of various departments within the garment factory could be the amount of fabric inspected in meters, the number of pieces cut in the cutting department, number of pieces ironed in the ironing department, etc. Besides, inputs can be fabric consumed in meters, man-hours, machine hours, etc. Usually, productivity is expressed in terms of efficiency. In another term, the productivity is about the efficient use of resources i.e., input in the production of goods i.e., output (Productivity in Apparel Manufacturing: Back to basics).

Here, the output is measured in terms of time required for garments produced per operator and input is allotted minutes per operator as given in equation 2.

$$Productivity\ \% = \frac{SAM \times No\ of\ garments\ produced}{Total\ time\ per\ operator \times Operators} \qquad (2)$$

4. LEAN TOOLS IMPLEMENTED IN THE INDUSTRY

4.1 5's

The 5S started as part of the Toyota Production System (TPS), a production method developed by the leaders of the Toyota Motor Company in the early 20th century. This system commonly referred to as Lean production (http://thequalityportal.com/pokayoke.htm). This system works by finding and eliminating waste from production processes. For implementation, one can use a shadow board, floor marking, signs, 5's tags, labelling, etc. 5's comes from five Japanese words, which are explained below.

- Seiri (Sort)

The first step in 5's is sort and for this, we have to go through each equipment, tools, materials, etc. This helps to identify necessary and unnecessary items in the workplace.

- Seiton (Set in Order)

After item are sorted out, they must be set in order. Each item should be placed in the respective department. There must be a place for everything and everything in its place. A type of product should make arrangements, its usability, necessity, frequently used items, etc. in respective storage containers.

- Seiso (Shine)

Shine stage refers to the cleaning up the work area and maintenance of the equipment and machinery. 5's gives everyone the responsibility for cleaning up his or her workstation. In industry cleaning session, take place daily after every few hours. In this time operator is made to clean up their workstation.

- Seiketsu (Standardize)

This stage focuses on standardizing the process. Standardize provides standard functions, creates schedules, and sends instructions for these tasks to become routine. It makes the standard operating procedure for 5's so to maintain the work quality.

- Shitsuke (Sustain)

Sustain refer to maintaining, repeating and keep updating the 5's system by involving everyone in the organisation to make this process long time running. 5's system must run smoothly for a long time and not let things slide back to the way they were (Vorne, 2020).

Some questions to ask during 5's implementation includes
1)   What is the purpose of this item?
2)   When was this item last used?
3)   How frequently is it used?
4)   Who uses it?
5)   Does it need to be here?
6)   Are more storage containers necessary to keep things organized?

These questions help determine the value of each item. A workspace might be better off without unnecessary items or items used infrequently.

4.2 Kaizen (Continues improvements)

Kaizen is a Japanese word, which simply means 'changes for the better' or 'continuous improvements'. Kaizen is a lean tool, which ensures employee engagement by making their way of doing work easy, safe and fulfilling.

Even small changes can result in better improvements. The small changes in Kaizen can involve making standard operating procedure, just in time (JIT), use of efficient equipment, making automation in the process; standardize work, elimination of waste, quality control, etc. Kaizen changes the way of doing work. For this change, work-study is very important.

Implementing Kaizen, we recognise that small changes now can have huge impacts in the future. Many employees neglect small changes in their workplace believing it is having no impact on productivity, quality, safety, etc. Thus, many big, as well as small organisationsare now focusing towards lean tool having Kaizen implementation, which will make employees believe in small changes for the better future. The organization encourages and empowers all employees to identify areas where they can be developed and make practical solutions (Sujata and Prahlada, 2013).

The traditional Japanese ideas of the kaizen follow the three basic principles Teamwork, Personal training, improved quality and Suggestions for the improvement. This leads to improving the quality of the product, reduction in waste, standardisation of process and good work culture.

4.3 Poka-Yoke (Error proofing)

Poka-Yoke is also a Japanese word meaning "Error Proofing". It is made from two words Error (Poka) and Avoids (Yokeru) Its purpose is to eliminate product defects by preventing, correcting, or paying attention to human errors as they occur. The concept was legalized, and Shigeo Shingo as part of the Toyota Production System adopted the name (http://thequalityportal.com/pokayoke.htm).

Poka-yoke is derived from poka-o-yokeru refers to avoiding an unexpected action. Shigeo Shingo used the term Poka-Yoke in the 1960s in industrial processes mainly designed to prevent human mistakes. The first name was baka-yoke, which means 'fool-proofing'. Defects occur when errors are allowed to reach the customer. The purpose of the Poka-Yoke is to design the process so that errors can be detected and corrected quickly, removing defects from the source.

Ideally, the Poka-Yoke ensures that there are appropriate conditions before applying the further action step, to prevent the mistakes from occurring in the first place. Where this does not happen, the whole Poka-Yoke team does the investigative work, removing the defect in the process as soon as possible. Poka-yoke does not need to be expensive. With the use of Poka-Yoke, errors can be quickly detected and prevented from leading to defects.

It can implement as 1) Warning Poka-Yoke (bells, buzzers, lights, and other sensory signals, using colour-coding, shapes, symbols, and distinctive sounds.) and 2) Control Poka-Yoke (It prevent the process from continuing until an error is corrected if an error has already occurred) (Fantin, 2014).

As per Shigeo Shingo, there are three types of poka-yoke methods for detection and prevention mistakes in a mass production system:
- The contact method: This method identifies product defects by examining the product's shape, size, colour and other physical features.
- The fixed-value (or constant number) method: It notifies the operator if a certain number of movements are not performed.
- The sequence method (Movement): It helps to determine whether the next (prescribed) steps of the process are followed.

As per Applied Problem Solving (APS) methodology, there are three-step analysis of the risks to be managed:
- Identification of the need
- Identification of possible mistakes
- Management of mistakes before satisfying the need

This approach can be used to emphasize the technical aspect of finding practical and effective solutions.

4.4 Kanban

Kanban is also a Japanese word, which means signboard or billboard. Kanban is developed to achieve Just in Time (JIT) with improved manufacturing efficiency. It is a visual indicator used to displays, tracks the production throughout the factory or manufacturing plant, and improve the communication of information.

The goal of the Kanban system is to limit the formation of excess inventory at any time in production i.e. to reduce the inventory and Work in Progress (WIP). Besides, it identifies the bottleneck formed in the production line and fix them to make workflow effective and smooth. This is done as a Kanban board displays the inventory involved (WIP) within the production line. It shows total WIP, input, output, total machine breakdown, target, etc. By reducing the amount of material or inventory between operations, Kanban converts any 'Push' system into a 'pull system' for production. Kanban refers to a pull system (Kumar and Naidu, 2012).

As Kanban tracks the production in manufacturing plant, we can easily determine will supply meet the actual demand /requirements or not. Formerly Kanban was manual but nowadays many organisations have Implementation E-Kanban to eliminate the common problems like manual data entry errors, lost cards, etc. This can be integrated into Enterprise Resource Planning (ERP), which makes better data tracking. Tracked data can be easily shared with the buyer,

buying a house, merchandiser, etc. so that they can monitor the status of the production, total inventory involved and can ensure that production can meet the demands (Azian et al., 2013).

4.5 Andon

It originates from the Jidoka methodology used in the Toyota Production System. Its main function is to give visual as well as audio signal to alert operators and employees. Andon system helps to stop the work now when mistakes happen which will save the organization from major and costly issues in the future. Andon light system can be operated manually by pressing the button or activated automatically. This system has a function to stop the operation in case of any mistakes happen, defects are produced or if any accident occurred.

In the apparel industry, stack light is popularly used for the individual sewing machines as well as other machines like spreading, cutting, etc. This stack light provides visual as well as audible signals to the operators and employees near to the machine. This stack lights can also be visible from a few long-distance (Mohitlal and Prakash, 2018).

It is having various colour segments to indicate different conditions of the machine. Stack lights generally have red, yellow, green, blue and white colour in column structure. E.g. red light indicates machine has stopped due to some failure, the green signal indicates the machine is running, yellow signals warning such as low oil or maintenance is required. This can be monitored by using computers. So that one can know how many times, a particular machine has break down, how much time it runs without any resistance. Along with this, we can also add audible alarm buzzer for any higher propriety alert. Andon light system makes supervision and maintenance process easy and effective (Kumar et al., 2017).

Overall benefits by the implementation of Lean tools in the apparel industry
- Maximizing efficiency and profit.
- Uniformity in quality.
- Data tracking.
- Reduces the number of rejection.
- Elimination of defects before they occur.
- Preventing defective product from reaching to the customers.
- Built-in quality control.
- Reduction in the inventory or WIP.
- Improved the flow of material throughout the production.
- Improved the flow of information throughout the factory.

4. RESULTS AND DISCUSSION

Results are taken for productivity for the overall 30 days as before and after the implementation of lean tools. Reading of calculation for productivity for a sewing line has taken before implementation of lean tools and after implementation of lean tools for 15 days respectively. The effects of the implementation of lean tools are as follows:
a. Implementation of lean tools in apparel industry increases productivity by around 8%.
b. The implementation of lean tools resulted in a reduction of cycle time.
c. The lean tools also result in managing and reducing the garment manufacturing waste and thus increasing quality.
d. At the same time, the organisation must have to maintain the effectiveness of lean tools to gain benefits over a period.
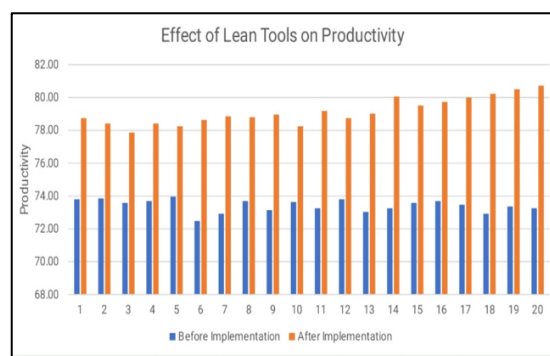

Figure 1. Effect of Lean Tools on Productivity

Feeling the need for an immediate action plan to reduce the enormous inventory in the medium size Garment Factory – Pheonix international apparel industry, an extensive study was carried out to collect all the data about the existing mode of operation. This leads to the conclusion that there was an immediate need to introduce an effective system in the factory.

Accordingly, a lean manufacturing system was conceived and implemented across various stages of the garment flow. This resulted spontaneously in improved productivity, efficiency, data collection, reduced inventory, maximizing profit, reduction in rejection of pieces, minimum wastage to the materials and higher clarity in the material flow as well as information flow. Production is going well and staff morale is enhanced. The total profit and residual value of the company will inevitably increase as a direct result of reduced asset costs.

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