

A Case Study: Implementation of Lean Manufacturing Tools on a Coir Product Manufacturing Industry

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Abstract

Manufacturing units is always facing a challenge regarding to the cost-reduction, product quality and efficiency in their operations. Industry requires meeting up the optimum Production Lead Times and costs as well as high customer services to survive in the market. Because of this, industries are focusing more on the customers need and satisfaction. In this paper Various Lean Manufacturing tools will be used in Coir product manufacturing industry by focusing both on processes and their cycle times used for Mattress manufacturing. In order to apply the lean manufacturing, relevant data is to be collected and to analyze it. After collecting the data customer need will be identified. Value Stream Map (VSM) will be drawn by defining the resources and activities needed to manufacture, deliver the product. The study of current state map will show the areas for improvement and will help to identify the different types of wastes. From the current state map, it will be noticeable that the inventory can be reduced for the coir mattresses. With the help of lean manufacturing tools we can identify embedded wastes, which had been neglected before in the working process. The lead time and Process time can be reduced and the efficiency of this process can be increased with the help of value stream mapping. Waste activities such as waiting, redoing and batching are generally not modeled by other tools, however in value stream mapping those wastes can be easily identified.

Keywords: Coir manufacturing, lean manufacturing, muda, productivity, waste reduction, value stream mapping, quality, value added.

Introduction

The Rubberised coir product manufacturing company is manufacturing company is manufacturing 500 mattresses daily. The basic raw materials used in an industry are latex and various chemical and coir rope with the efforts of 133 workers including the management body. The Coir industry has to its credit a tradition and heritage of centuries. But development of Coir industry in India has begun in an organized way only in 1959. Ever since this humble beginning, Coir products have been improving in quality, quantity and variety. For historical reasons, cultivation of coconuts and extraction of Coir fiber and its further processing have taken deep roots.

Lean Manufacturing is tool which actually deals with the optimum use of resources and increasing the value of a product by reducing the waste (*muda*). It is discovered by Toyota automobiles in their manufacturing units. Lean manufacturing is having 25 different tools to enhance the quality of the product by minimizing the wastage as well as bring up the good environmental surroundings in an industry. In this research we are using three lean manufacturing tools i.e. *kaizen*, *poka-yoke* and *value stream mapping*(VSM).

Kaizen is that lean manufacturing tool which means continues improvement in a existing system. Kaizen deals with the continues involvement of the workers or team studying on a improvement of the existing manufacturing process or the system.

Poka-yoke is the lean manufacturing tool which indicates the defects or mistakes which are going on in a manufacturing system. It is also known as 'mistake proofing' where the mistakes are identified by the lean manufacturing team and the solution is implemented to avoid the mistakes which may indirectly helps to reduce the wastage and increase the productivity by minimizing the time required for the processes.

Value Stream Mapping is introduced by T. Ohno from Toyota Production in 1988 as 'Material and Information Flow Mapping', later it is named as Value Stream Mapping by John Shook and Mike Rother co-authored the book 'Learning to See', published by the Lean Enterprise Institute in 1989.

Literature Review

Govindaraju A. et al: Coir popularly known as the golden fiber, it is a natural fiber extracted from fibrous husk of the coconut shell and is used to make wide range of products such as ropes, mats, mattresses, baskets, brushes, brooms etc. husks are used as fuel, as surface and seedling pit much and for buying in coconut gardens as fertilizer due to the high due to the most important commercial Utilization of husk is for the manufacture of coir. There are eighteen varieties of coconut palms; but the husks form only three varieties are suitable for coproduction.[1]

M. Shabeena Begam et al: In the current era of globalization, industries are adopting new tools and techniques to produce goods to compete and survive in the market. The most daunting issue faced by manufacturers today is how to deliver their products or materials quickly at low cost and good quality. One promising method for addressing this issue is the application of lean management principles and techniques. Lean management simply known as lean is production practice, which regards the use of resources for any work other than the creation of value for the end customer, is waste, and thus a target for elimination. Though there had been numerous claims on the real origin of Lean Manufacturing principles, it was generally accepted that the concept With this back ground, business needs to compete with efficiency and quickly respond to market needs and niches.[2]

Shrut Bhati et al: Lean manufacturing is a methodical approach to identify and abolish waste of all Non Value Added elements through continuous improvement that has been adopted by industries or firms seeking for efficient manufacturing. Lean manufacturing consists of word lean which means to

reduce or to minimize the waste in production which leads to maximum utilization of resources and ends up with increased value of product.[3]

Joseph C. Chen et al: They have cleared in their research that Although Lean was initially introduced by the automobile industry, its principles have more recently spread into other industries. There are a variety of companies that have experienced the advantages of applying Lean in their manufacturing area. For instance, Lean was applied by Boeing to eliminate waste and make its products more cost-competitive. Lean is a systematic approach for identifying and eliminating waste through continuous improvement by 'flowing' the product at the pull of the customer in pursuit of perfection.[4]

M. Rother et al: John Shook and Mike Rother co-authored the book published by the Lean Enterprise Institute, Cambridge, England. They were pioneers in introducing material and information flow diagramming and how to develop lean thinking using that practice. They have given the name as Value stream mapping, and is a flexible tool that let us put all of the information in one place in a way that is not possible with process mapping or other tools.[5]

Bhim Singh et al: They have Researched in their research paper that the original concepts and definitions about value stream mapping (VSM) demonstrated that it is necessary to map both inter-company and intra-company value-adding streams. Value stream refers to those specifics of the firm that add value to the product or service under consideration. VSM was initially developed in 1995 with an underlying rationale for the collection and use of the suite of tools as being "to help researchers or practitioners to identify waste in individual value streams and, hence, find an appropriate route to its removal". The process itself is very simple and straightforward. It usually starts with customer delivery and work its way back through the entire process documenting the process graphically and collecting data along the way. Finally it results in a single page map called "Value stream", these maps contains data such as cycle time, work-in-process (WIP) levels, quality levels, and equipment performance data.[6]

Madhubala Rauniyar et al: She had given very significant points in her research that, every organization is striving hard on getting more work done in less time and with greater ease. The fundamental aim of any organization has been to continuously minimize waste and maximize flow which would ultimately lead to customer satisfaction

by providing right product at the right time in the right quantity and the right quality at a reasonable price. This can be achieved greatly by adopting lean manufacturing system which is more than a cost reduction program. It aims at eliminating wastes which could be in the form of excess production and inventory, redundant movement of material, waiting and delays, over processing, excess worker motion, rework and corrections.[7]

Various processes conducted in an industry

Rope Recoiling In this process the coir rope can be recoil with the help of motor and for coir rope can be recoil in opposite way for removing moisture at few percent.

Rope Vulcanization: In Rope vulcanization process coir rope can be stored into the vulcanization chamber at 24 hours at temperature 120 to 130. This process can be used for removing the moisture from coir rope.

Fiber Separation: This process coir rope can be separated by the use of MultiMate machine to get fiber and this fiber passes with the help of conveyor belt to the sheet machine.

Fiber Feeding: The fiber can be fed into conveyor belt with the help of rotor or fan having high power with required amount of fiber can be supplied to the sheet machine. The arrangement in a machine to supply required fiber.

Rubber Spraying: The rubber can be sprayed into fiber with automatically and fiber passes to sheet machine having a heater to remove moisture. Fiber can change side with help of roller and rubber spray opposite side again pass to sheet machine to remove moisture up to 10 percent from coir sheet.

Lamination: In this process the coir sheet can be passed to lamination. In this process the weight of sheet can be measured and accordingly it can be cut the sheet with 10 percent extra laminated. It can be passed into drum press for pressing the sheet.

Hydraulic press: The Mattress Hydraulic Press application is when the rubberized coir sheet is being manufactured from the Rubberized Coir Sheet plant, the coir sheet is being sprayed before they are put on the pressing bed into the hydraulic press to attain the desired thickness of the mattress. It has a capacity to press 12 mattresses of size 2 meter x 1 meter or 6 pieces of size 2 meter x 2. The pressing plates have heat in them and the mattress gets its desired shape and thickness into the hydraulic press.

Problem Definition

Various problems are observed during our case study:

- The lamination section in which the worker has to pull the lamination sheet which may result in the tearing of sheet which leads to the loss of material as well as time.
- There are chances of accidents with the workers working on the cutter.
- There is a misobservation of the temperature reading by the worker as the panel is situated far away from the working area.
- The worker needs to access the lamination sheet of various sizes which are placed together and it consumes lots of time and misoperation.

Various Suggestions Given to an Industry

KAIZEN

- During lamination the worker has to pull the lamination sheet through a roller but the improper pulling causes tearing of the lamination sheet as well as an increase in delay time. Thus, by fixing the bearing to the rolling shaft, we eliminated tearing and saved time, as shown in **Fig - 1**.



Fig -1: KAIZEN on rolling shaft.

- The workers working on the sheet cutting machine have chances of accidents that are more and it is required to be as safe as possible. Thus, a sensor and relay circuit is designed for the blade where the process became more safer and efficient, as shown in **Fig - 2**.



Fig - 2: KAIZEN on cutter machine.

POKA-YOKE

- Every time worker have to move close to the temperature indicator placed every production section in plant. Thus We have placed magnifying screen on the front side of panel as shown in **Fig3**.



Fig - 3: POKA-YOKE on temperature panel.

- Various partitions are provided to the lamination sheets so that worker can access the correct sheet from the rack this lead to minimize cycle time required for laminating single mattress. as shown in **Fig - 4**.



Fig - 4: POKA-YOKE on lamination section.

VALUE STREAM MAPPING (VSM):

The value stream mapping helped to reduce the inventory, total lead time and man power used.

Current state map:

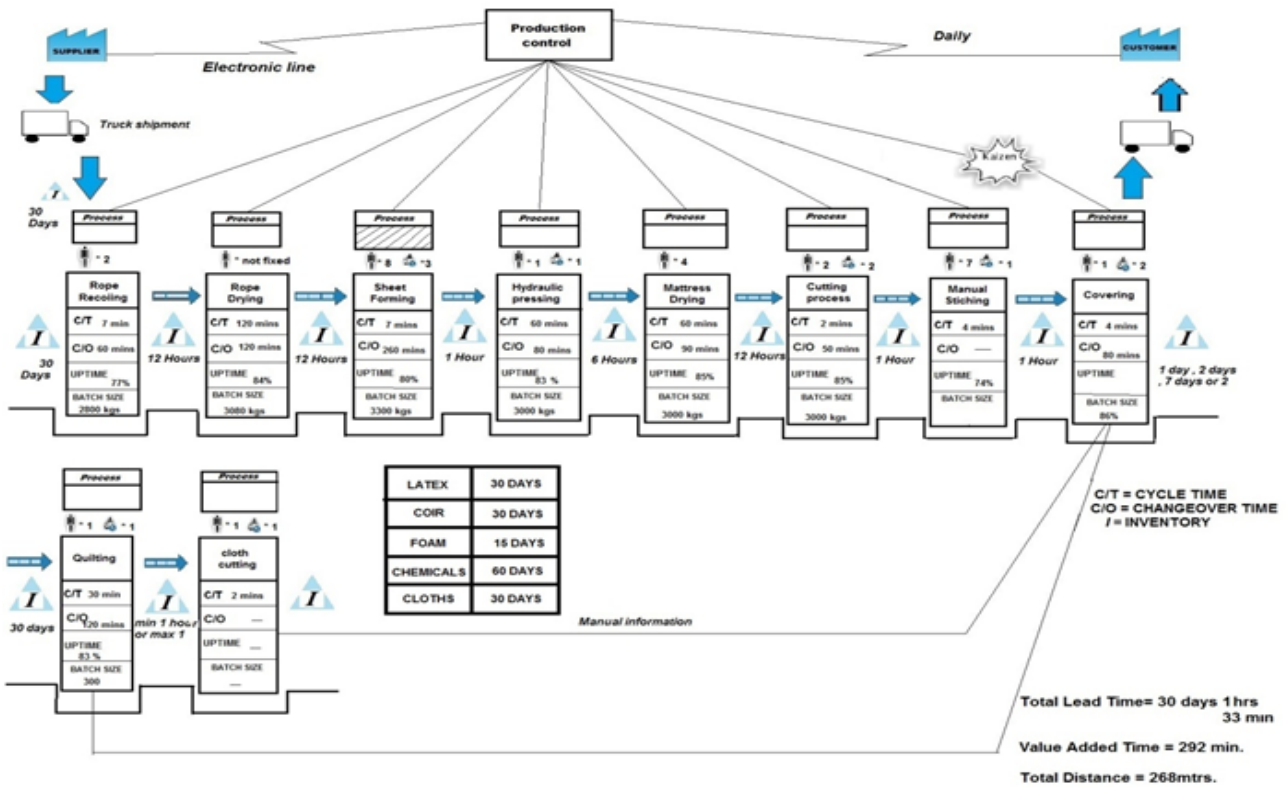


Fig-5: Current state value stream map

Future state map:

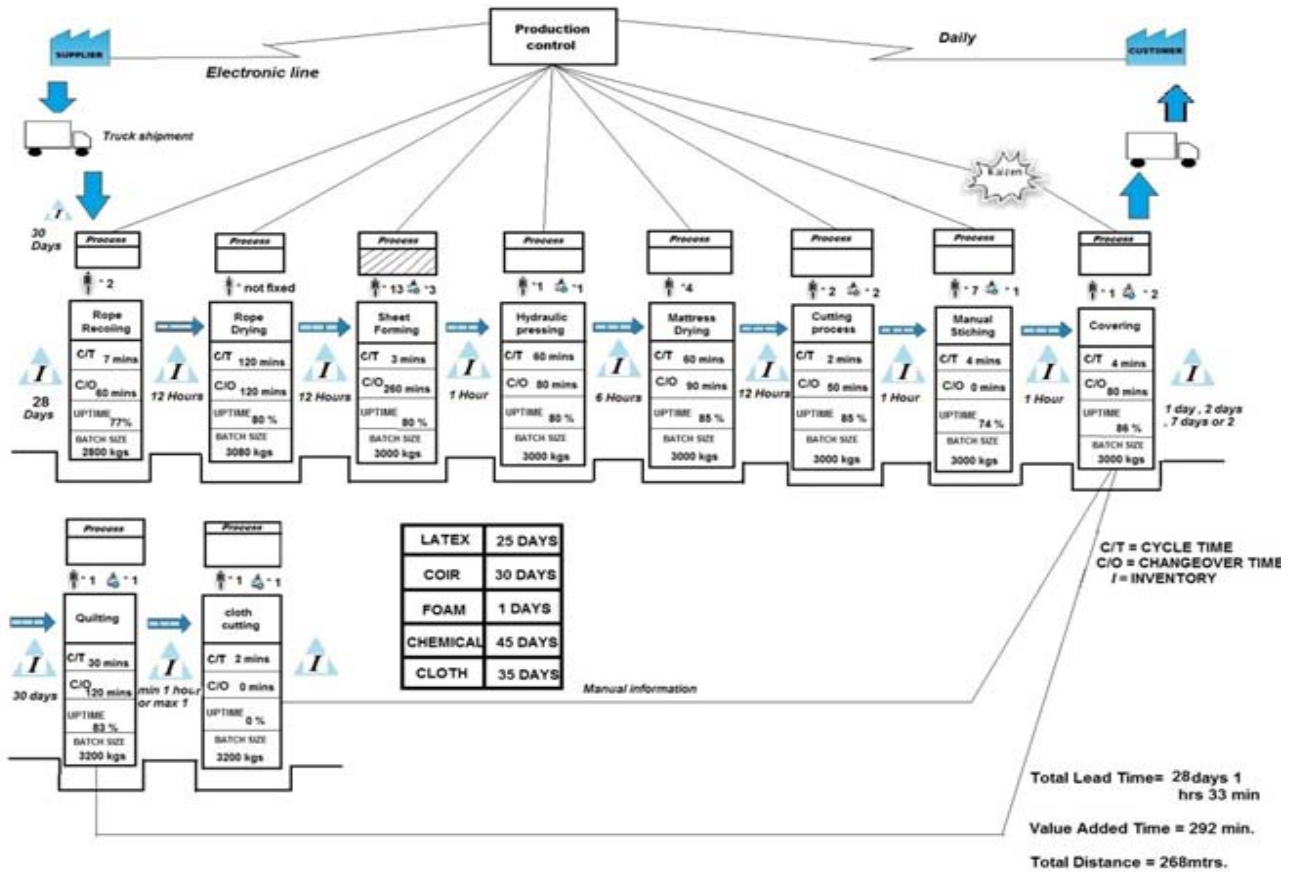


Fig-6: Future state value stream map

Results and Discussions

- KAIZEN reduced the time required for the process by 2 seconds which is approximately 16.69 minutes per day. It also prevent tearing of lamination sheet And also the safety of the workers increased.
- By applying POKA-YOKE the process time is reduced to 3.5 seconds which is approximately 29 minutes per day. And it also reduced the chances of mistakes committed by the worker.
- With the help of Value stream Mapping(VSM) the inventory time is reduced by 5 days and the total lead time is also reduced by 5 days and which leads to the augmentation in productivity.

Conclusions

The lean principles and techniques implemented and suggested, future state map is created and the total lead time is reduced. Also is enhanced the quality of the product, helped in reducing the waste and overall increase in productivity.

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