International Journal of Research in Engineering and Science (IJRES)
ISSN (Online): 2320-9364, ISSN (Print): 2320-9356
www.ijres.org Volume 9 Issue 5 ǁ 2021 ǁ PP. 28-32

Implementing Lean Manufacturing Practice in an Lamp Manufacturing Industry

M. Nithish Kumar[1], P. Sriguruperiyasamy*[2], K. Gobi Krishnan[3], R. Kamala Kannan[4], K.P.Paranitharan[5]

[1]*Department of Mechanical Engineering, M.Kumarasamy College of Engineering, Karur, Tamil Nadu – 639113.*

[2]*Department of Industrial Engineering, TVS Sensing Solutions Private Limited, Madurai, Tamil Nadu – 625112.*

**- Corresponding Author P. Sriguruperiyasamy*

Abstract

Today Indian economy is creating both opportunities and challenges for small and medium enterprises to compete in global and local market. And to survive for long term, the manufacturer has to be continuously fulfilling the needs of customers. To overcome this problem, lean manufacturing is used as a strategic weapon to minimize the non value added activity (waste) and also improve the business profitability. The objective of this study in this paper is to minimize the non value added activity and revamp the existing system of brass lamp manufacturing Company by implementation of lean concept using seven step approaches. This paper provides a useful platform for in brass lamp manufacturer SME in India for their productivity improvement. The result shows significant improvement in increase productivity, reduction in lead time, reduction in inventory and also improves the process ratio.

Keyword: *Lean manufacturing, Value stream Mapping, 5S, Kaizen, Takt time*

Date of Submission: 27-04-2021 Date of acceptance: 11-05-2021

I. INTRODUCTION

The growth of today manufacturing industries, most companies have time-honored high customer demand. Those companies in the business have to compete among them to obtain trust from customer about their products and services. Hence, it is important for companies become crucial to analyze and improve the manufacturing system and the corresponding planning system continuously. Lean manufacturing technique has been one of the widely known productivity improvement technique. Many manufacturing companies have been trying to implement Lean in order to survive in the global market. Within Lean there are numerous techniques and tools that can be applied. One of the primary and effective tools is Value Stream Mapping (VSM) used for quick analysis of information flow, process flow and material flow in a manufacturing system. It is also effective tool to evaluate the non-value added activities through the system. However, VSM has limitation that is it only gives a static picture of the system. In recent years, the use of simulation has arisen as an important role in the development of manufacturing industries. Simulation is a process that imitates the activity during the operation of a real system, in a computer, with a focus on process flow, logic and dynamic (El-Haik. and Omar 2006). It helps to evaluate and improve system performance. In the case of VSM, simulation can be a tool to overcome the limitation. According to Lian and Van Landeghem (2007) state that simulation model could help managers to see the effects before a big implementation and after Lean transformation. Some of the author discussed VSM is a strategic lean tool and they are benefited which are described as follows.

Seth and Gupta (2005) have made a successful attempt to VSM as a technique to achieve the productivity improvement. Pereira, et al., (2018) consolidated specific CSF related to the context of small manufacturing companies reinforces the body of knowledge, reinforcing the establishment of a broader perspective of LM implementation in these companies for better practice.

Prasad et al.,(2019) studied the implementation of lean in pump manufacturing industries in India through an instrument consisting of seven lean implementation measures of lean practicing in the company. Psomas and Antony (2019) reported, based on 120 articles, majority are survey researches, while the minority are conceptual papers. Moreover, they concluded that the primary focus of LM ado adoption studies was regarding "lean effects", and that "lean benefits" studies were scarce. Bhim and Sharma (2009) mapped the value stream of automobile crank shaft gear manufacturing to identify the improved areas of the firm. Gurumoorthy and Kodali (2011) studied the application of VSM with simulation during the design of lean manufacturing systems (LMS) using a job shop production system to manufacture doors and window. they found that the case organization can achieve significant improvement in performance and can meet the increasing demand without any additional resources. Paranitharan et al. (2011) has made an attempt to

packaging box industry to bridge the gap between the existing state and proposed state of manufacturing process for productivity improvement and creating flow and provide useful platform for research in implementation of lean tools in manufacturing unit. His results show a significant improvement in productivity, reduction of lead time and reduction in inventory. These can be achieved by creating flow by layout modification and balance to TAKT time. Further at (2014), the same author studied by applying the concept of lean manufacturing in modulator valve manufacturing company benefited by reducing lead time and non value added activities.

Based on the review of literature, the addressed problems can be resolved by formulating sevevn steps methodology to improve the process ratio of manufacturing process, reduce the lead time of entire stream and continues improvement over by implementing lean practice. The objective of this paper is to use a case-based approach to demonstrate how lean manufacturing tools when used appropriately, can help the process industry eliminate waste, maintain better inventory control, improve product quality, and obtain better overall financial and operational control. A small scale brass lamp manufacturer is used to illustrate the seven step approach as followed. In this case, value stream mapping (VSM) is first used to map the current operating state for brass lamp manufacturing company. This map is used to identify sources of waste and to identify lean tools for reducing the waste. A future state map is then developed for the system with lean tools applied to it. Since the implementation of the recommendations is likely to be both expensive and time-consuming, so we develop a simulation model with the help of managers in brass lamp manufacturing industry in order to quantify the benefits gained from using lean tools and techniques.

1.0 Case Study

This section deals with details about the case of company, background details of case study, product selection and application of seven step methodology.

1.1 About the case company

The case study of company has been carried out at lamp manufacturing industry (here after referred as XY industry). XY industry is located in Madurai, Tamilnadu, India. The product manufactured by XY Company is Brass lamp with different product variety based on size and weight. They supply their products to customers in Kerala and Tamilnadu.

1.2 Methodology

There seven steps involved in implementation of lean manufacturing as proposed by paranitharan et al (2011).

1.2.1 Selection of critical product family

The first step is the selection of critical part family from the product mix. After identified the various product families' in industry selection critical part family is taken as brass lamp for lean implementation, due to higher demand of brass lamp in market.

1.2.2 Preparation of Current Manufacturing Scenario

Interaction with the sales and marketing team, the firm information regarding customer's requirements was estimated from market survey and past sales data, the company has a wide range of customers requesting for a wide range of product. The requirement of brass lamp has Demand of 6500/month and data collected to trash the opportunity for improvement. Based on data collection the production processes are mapped in present state value stream mapping.

1.2.3 Analyses the process with lean tool

In this phase, the production process is analyzed with suitable lean tool with help of literature review. By analyzing the root cause of problem by process measures and field experience a suitable lean tool is suggested to improve the process.

1.2.4 Implement lean tool

In this case production problem are analyze with appropriate lean tools to resolve by the process of kaizen activity in production. In order to implement lean principles, a task of group formed with different part of organization. The objective of group task operation is to reduce the lead time, improve the process ratio, reduce the inventory and eliminate customer end line rejection. The seven step methodology of lean implementation approach helps to achieve these objectives.

1.2.5 Current state value stream mapping

After selecting the critical part family, the next step is to draw a current state mapping (CSM) of the existing process. Current state mapping has been prepared in the existing Brass lamp manufacturing process. The relevant data are collected for constructing current state mapping according to Rother and Shook (1999). In Brass lamp manufacturing the raw materials are moved from stores to foundry for pattern making, and moulding to cast the product. After it move to machine shop for performing operation namely welding to join the top rod, metal removing is carried out for removing excess metal from middle rod, grinding operation is performed for all the sub item of brass lamp for finishing, drilling operation is carried out for top and bottom plate, threading

operation is done in lathe to assemble the sub items like top and bottom rod, polishing is performed by using polishing machine to achieve surface finish. Finally it moves for packing in order to get complete assembly of product. The product is accepted after packing. The production lead time and value added times of current state mapping are noted. The current value stream mapping provides to identify the gap between the demands of customers and manufacturing TAKT Time of operations. The current value stream map is shown in Figure 1.

1.2.6 Analysis of Present State Value Stream Mapping

In existing process of brass lamp manufacturing, the Takt Time is high, due to higher cycle time of operation and inventory time leads to increase in lead time of product. Since the proposed value stream mapping is developed to balance the Takt Time in to individual process of bras lamp manufacturing by effective utilization of resources.

- No of Working day per month: 26
- No of shift per day: 1
- Available Time per Shift: 8 hrs
- Customer demand per day: 250 Nos
- Takt Time:115 Secs /day

Regarding the customer demand of brass lamp manufacturing is concern; it may reach up to 6500/ month, which are forecast from past sales data from marketing department. And production shift which was operated 8 hrs / day and it is a one shift manufacturing company. The demand information from customers and suppliers to production planning department through email and telephone. The customer demand may vary from period to period due to product seasonality. In present case the company maintains the material work in process inventory of 9.85 hours for first product to manufacture and the actual value addition of product is around 55.2 minutes. And it observed that to produce first product, the average waiting time is around 9 hours 03 minutes. Hence scope for improvement regarding increase in productivity of brass lamp is essential to meet the customer demand. The system based on the continuous evaluation of process and identifies the scope for improvement.

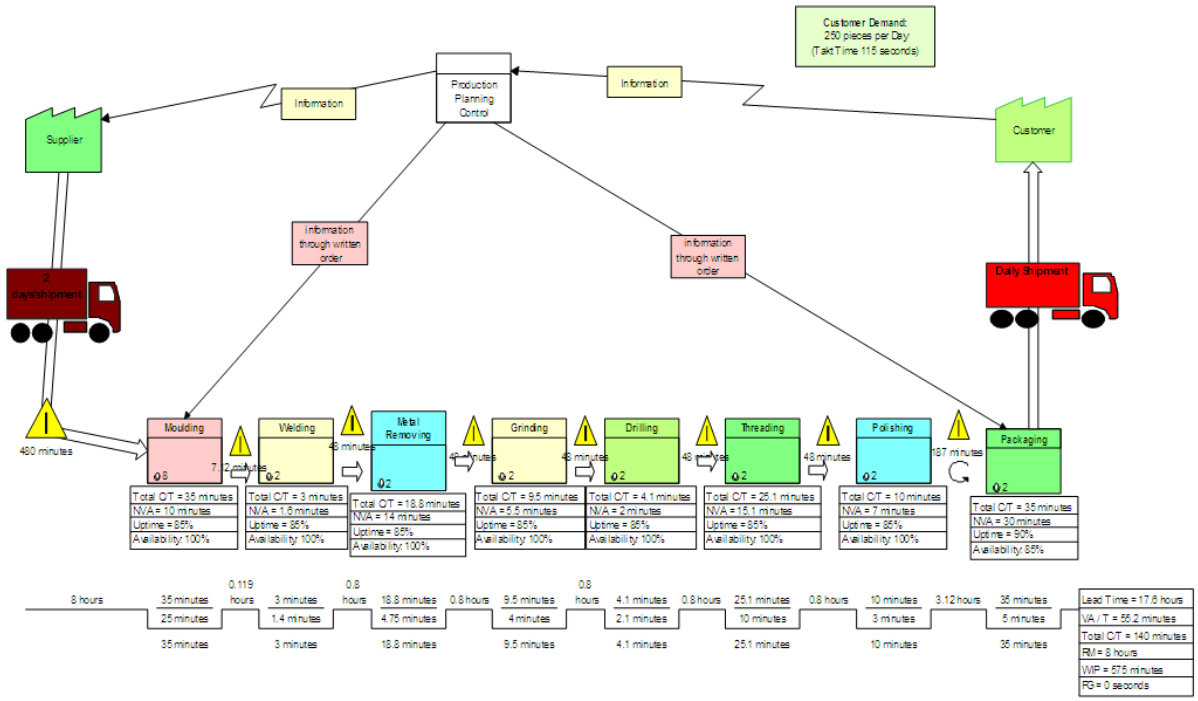

Figure.1 Current state value stream mapping of lamp manufacturing

1.2.7 Future state mapping

The proposed state map depicting the various modifications incorporated in the manufacturing process of brass lamp is shown in Figure 2. And with help of seven step Methodology by creating flow, Balance to TaktTime, Stabilize the Production, Improve Flow, Zero Defect and Leveled Production will achieve the proper implementation of lean techniques in industry. After analysis the existing manufacturing process of brass lamp, various proposals for waste elimination and process optimization have been developed in consultation with of

XY industry is described in Table 1. And few suggestions of present manufacturing ideas are presented as follows:

- The concept of 5S is found an important for the following stages of operation namely moulding, metal removing, drilling, threading, polishing and packing.
- Introduction of suitable jigs and fixture is proposed for drilling and polishing operation.
- By use of molasses molding can eliminate the drilling operation for top and bottom plate. It lead to reduction in cycle time.
- Reduction of Work in process inventory between moulding and packaging is optimized by maintaining optimal inventory between each work center of brass lamp manufacturing.
- Middle split rod are welded by gas welding to join as one piece, this can making by single piece with use of molasses molding process.
- Use of double shaft bench grinder and polisher machine is reduces the grinding and polishing operation cycle time by making two part at a time.
- Threading from lathe operation consists of manual setup which is time consuming and use of thread roller reduces the cycle time of operation.

The above suggestion will help the industry for balancing the present TaktTime of industry. Few suggestions were considered for future improvement will help to balancing the leveled production

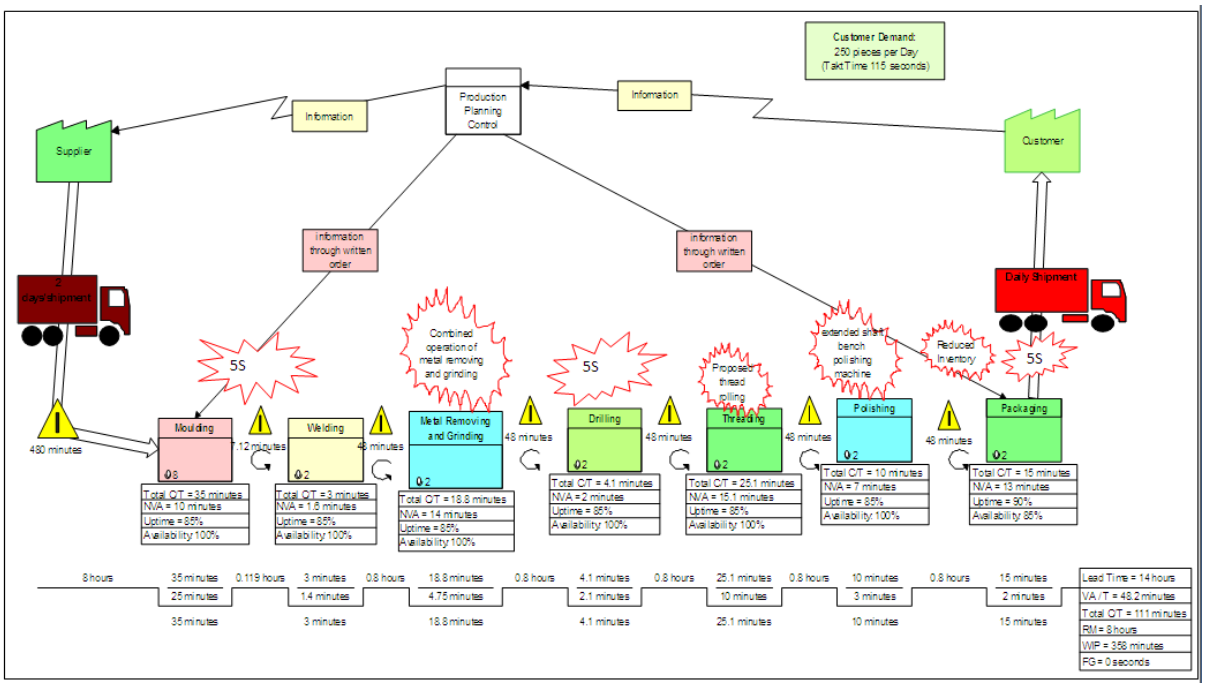

Figure.2 Future state value stream mapping of lamp manufacturing

II. RESULTS AND DISCUSSION

2.1 Industrial Impacts

- Development and deployment of 5S effective policy will enable clean and quick access of equipment to reduce the non value added activity.
- Use of Jigs and Fixture reduces errors and it act as a fool-proofing measures effectively, which is an important lean manufacturing concept.
- Certain operation related to equipment which is not in optimal use, due to its traditional device of operation, which may enhance through by implementation of modulator equipment to incorporate all the features necessary for quick manufacturing of brass lamp.
- Due to reduction of work in process inventory in the value stream of production line reduces the operational lead time of component to ensure timely supply for customers.

2.2 Improvement in lean parameters

The improvement of various process measures by implementing lean tool. And the comparative process improvement, before and proposed state after implementation of value stream mapping has been presented as shown in Table 1. And the Lean performance measures of brass lamp manufacturing process are showed as follows.

- Value added time has been decreased from 55.2 Mins to 48.2 Mins.
- Total cycle time has been reduced from 140 Mins to 111 Mins.
- Lead time has been reducing from 17.6 hrs to 14 hrs.
- Work in Process Inventory reduced from 575 Mins to 358 Mins
- Process ratio will increase from 5.22 % to 5.73%.

Table 1 Comparison of Present and Proposed State of Improvement for Present TaktTime

Process	Before Implementing Future VSM (Min)	After Implementing Proposed VSM (Min)	Improvement (%)
Molding (Excluding Preparation of mold)	10	2.24	22.4%
Welding	1.2	1.2	-
Metal removing	14	-	Operation eliminated
Grinding	5.5	2.55	46.33%
Drilling	2	2	-
Threading	15.1	3.3	21.8%
Polishing	7.1	3.35	47.1%
Packing	35	2	5.7%

III. CONCLUSION

Nowadays manufacturing organizations are forced to adopt a new manufacturing management concept for paradigm shift to meet the global market turbulence. Lean manufacturing is a paradigm change concept that focused on restructuring and reconfiguring the business process based on waste elimination. VSM is a powerful tool for elimination of waste and to make effective supply chain for any manufacturing organization responsiveness. This proposals for this case study has implemented and it contributed significant improvement in process ratio and reduction in manufacturing throughput time. Based on the practical validation conducted, it advocated that VSM is an effective lean manufacturing technique for industrial environment for achieving leanness and meet out the competitiveness. And also it helps the managers to visualize the waste and identify the future possible improvement.

IV. LIMITATION AND FUTURE RESEARCH DIRECTIONS

The study reported in this paper has been carried out for a single product line of brass lamp manufacturing organization and assumption in logistic activity that are not described in this paper. In future, the researcher can develop Extended VSM incorporating different production lines, for several lines of the organizations across the Industry.

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