Review of Lean Manufacturing Implementation: Case of Junction Box Post Processing Phase

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Abstract—In today’s world, competition is very intense in business. Customers are keen towards the quality of the product with timely receipt of products. So it is essential to implement lean manufacturing technique, for better product quality customer satisfaction. We have studied various papers from different backgrounds as listed below in review summary, from the study we have found that how companies use the benefits of lean tools in their conception of lean implementations. The different LM tools applied in various industries like Automotive, Bearing, Colour, Pharmaceutical, Aircraft manufacturing, Automobile, Manufacturing & Process Industries were studied with reduced machine downtime, wastages & non value adding activities. This paper aims to propose a suitable LM tool for post processing of Junction box in Discrete Manufacturing environment.

Keywords—Lean Manufacturing (LM), Kaizen, Value Stream Mapping (VSM), 5S, Reduction, Lead time, Non Value added activities.

I. INTRODUCTION

Lean manufacturing techniques are widely used by industries to eliminate waste and make the process more efficient. Lean has been recognized as one of the key approaches in enhancing the productivity and hence the competitiveness of an organization.

Lean manufacturing is a Japanese method focused on 3M’s. These Ms are: Muda, the Japanese word for waste, Mura, the Japanese word for inconsistency, and Muri, the Japanese word for unreasonableness. Muda specifically focuses on activities to be eliminated. Within manufacturing, there are various categories of waste. Waste is broadly defined as anything that adds to cost of the product without value addition to the product. Lean manufacturing primarily focuses on i) defect reduction, ii) inventory control, iii) reduced lead time & change over time. Lean manufacturing also reduces the human effort in the factory by over 50%. Lean manufacturing is flexible manufacturing techniques.

A number of LM tools can be applied, depending on the requirement in the industry, like VSM was applied in Colour, Bearing, Pharmaceutical & Process industries for addressing non value added activities resulting lead time reduction, change over time & waste reduction. Cause & Effect diagram, Kaizen, 5S were used in automotive MNC industry to reduce machine downtime, wastages & non value adding activities.

5S in auto mobile industry for elimination of waste which is explained in below in literature review.

An industry where implementation of Lean manufacturing techniques is yet to be implemented is discrete manufacturing environment. One such discrete manufacturing environment is the post-processing of Junction Box, where the absence of any Lean Manufacturing technique increases lead time, and thereby delaying the supply to target customers. The current study focuses on applying VSM to the Junction Box Industry and reduction in lead time.

II. LITERATURE REVIEW

Lean manufacturing also reduces the seven types of waste occurring in industry say (a) Transport (b) Inventory (c) Motion (d) Waiting time (e) Over Processing (f) Over Production (g) Defects, with the help of various lean tools according to the requirement.

Lean manufacturing tools –

The various types of lean tools available are discussed below.

1. 5S

5S creates a work environment that is clean, well organized and efficient. It provides the organization with a rapid, visible achievement, while preparing the workforce for other advanced improvement efforts. 5S is so named for its 5 primary undertakings.

Sort: Remove all unneeded items from the workplace.

Set In Order: Make a place for everything and put everything in its’ place.

Shine: Thoroughly clean and inspect everything in the work area (preventative cleaning also applies).

Standardize: Maintain the improvements through discipline and structure.

Sustain: Continue to support 5S efforts through auditing, job descriptions that include maintenance of the system,
management support and expectations, etc.

2. Value Stream Mapping
Value Stream Mapping is used to illustrate the flow and relationship between work processes. A key component of VSM is differentiating value adding activities from non-value adding activities. Reduction or elimination the non-value adding activities are of utmost importance and the principle goal of Lean Manufacturing. Upon careful and detailed examination of the processes through VSM, it becomes obvious where improvement opportunities lie.

3. Total Productive Maintenance (TPM)
TPM is a powerful program for planning and achieving minimal machine downtime. Equipment and tools are put on “proactive” maintenance schedules to keep them running efficiently and reduced downtime. Machine operators take far greater responsibility for their machines upkeep. Maintenance technicians are liberated from routine maintenance, enabling them to focus on urgent repairs and proactive maintenance activities. A solid TPM program allows you to plan your downtime and keep breakdowns to a minimum.

4. Kaizen Blitz Events
Kaizen Blitz Events (also known as “Kaizen Events”) are highly focused improvement events designed to address and resolve important business issues and/or constraints. This is a team effort best engaged in by associates from the area of focus, supporting areas, and internal customers. By the end of each Kaizen Event, substantial improvements have been made, plans and responsibilities for longer range improvements are assigned, and bottom-line results are expected.

Kaizen Events function best when focused on “real constraints” rather than general improvements. Achieving the best results through Kaizen Events requires highly skilled facilitators. Though we train your designated staff to lead the events in the future, facilitators necessarily require substantial understanding and experience to achieve the best possible results.

5. KanBan
KanBan are “self-evident signals” that indicate what work is to be done and when.
We have developed an intuitive approach to helping you quickly establish KanBans and modify them to meet your changing needs. Ultimately, most KanBans evolve into what is known as “One Piece Flow” where parts are literally passed from one operation to the next, with no wait time between work stations.

With minimal investment, KanBan manufacturing systems enjoy many real benefits. We work with your staff from the beginning to establish proper KanBans throughout all operations.

6. JIT
Just-in-time (JIT) is a methodology aimed primarily at reducing flow times within production system as well as response times from suppliers and to customers. The term refers to producing only what is needed, when it is needed & in needed quantity.

7. Setup Reduction (S.M.E.D.)
Single Minute Exchange of Die (also known as S.M.E.D.), is the Lean tool used to create very fast changeovers and setups that greatly reduce machine downtime and increase throughput. It is common to reduce machine changeover times from hours to less than ten minutes. While that may sound too good to be true, we’ve seen it happen time and time again.

8. Poka Yoke
Poka Yoke (also known as “Error and Mistake Proofing”) is one of the powerful Lean tools used to ensure products and processes are completed correctly the first time.
The goal is to reduce scrap, rework, and eliminate production losses due to inconsistent processes, methods, materials, etc. Improved quality and cycle-times are nearly always achieved.

Depending on the level of implementation needed, we can make experts out of your staff relatively quickly and leave them competent to effect more scrap/rework improvements across the organization.

III. SUMMARY OF PAPERS REVIEW
Lean manufacturing is a technique to reduce human efforts and to produce defect free product. According to Jafri Mohd et. al. [1] used production line analysis through value stream mapping for color industry, thereby identified and eliminated waste by using team formation, product selection, conceptual design, and time frame formulation through TAKT time calculation. Some lean techniques were used to reduce change over time by 5s, decreased lead time from 8.5 days to 6 days and value aided time decreased from 68 minutes to 37 minutes. 00

Praveen Saraswat et al. [2] (2015) applied value stream mapping on bearing industry for reducing the work in process and inventory and lead time. This research study described how the value mapping graphically visualized the flow of material and flow of information from customer order to finish product. With this approach (VSM) wastes in the company can be reduced. Reduced work in process inventory & lead time.

Rahani AR, et. al. [3] (2012), used a case-based approach to determine how lean manufacturing tools helped the process industry eliminate waste, maintain better inventory control, improve product quality, and capable of better operational

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control. There is a significant amount of the time the products spent on the production system as waiting and non-value added. Quantitative evidence showed that many of the Lean tools had an expected impact related to the reduction of this waiting time. The evaluation of these improvements through the use of the CT evaluation highlights the economic impact of time improvements. VSM applied to assess the expected impact of a change in the production process resulted in savings (lower rejection rates). SOP could be a key driver in continuous improvement sustainability on the production floor as operators are fully aware on the long-term commitment to practice Lean.

Maria Elena Nenni, et. al. [4] (2014), demonstrated the positive effect of a Lean Management (LM) approach, in a pharmaceutical company, subject to critical market issues, by using VSM tool outcomes, with decrease in non value added activities, Total cycle time reduction, Work force reduction, Work in process reduction, Reduction of shop floor area and floor space.

Rahul et al.[5] studied implementation of lean manufacturing in computer integrated environment in an automotive MNC industry applying the cause & effect diagram, kaizen, 5S to reduce machine downtime, wastages & non value adding activities. Machine downtime was reduced up to 5% and the wastages were eliminated. The study also suggested that the upper management must stay engaged and constantly challenge employees to improve and develop higher value adding work as a team for the successful implementation of lean manufacturing.

P. Arunagiri et, al. (2014) studied the use of high impact lean tool in automobile industry using weighted average method by studying about 91 industries, using 30 or more lean tools, to maximum useful tools in automobile industry. The usage of any one among the five tools such as 5S, Overall Equipment Effectiveness, 8 Step Problem Solving Methodology, Pareto analysis, Elimination of waste was observed to have a positive impact towards the productivity of the automobile industries.

A. P. Chaple, et al. [6] (2014) emphasized on good understanding of lean principles and practices for successful implementation, as lean practices without knowing lean principles would give short term success but may fail as a long term strategy in automobile, service sector, discrete manufacturing, etc. A review of barriers of lean implementation was carried out, and thus understanding the barriers was important for managers to avoid failures and sustain lean leap. Study on multiple criteria decision-making (MCDM), for lean assessment to assess lean performance holistically was also carried out. In the Indian industry, other than automobile and electronics industry, others are having a medium to low diffusion of lean.

D.T. Matt, et. al. [7] (2013), studied the importance of small enterprises for the whole economy. In the case study in this paper an action research in a small company with 25 employees was studied, that the introduction of Lean Production methods brought improvements and advantages for the described company.

Amelia Natasya et. al. [8] (2013) conducted a preliminary study in developing a conceptual model to measure leaness in manufacturing industry. This research showed that there are seven main dimensions contributing to leaness measurement in manufacturing. Supplier Relationship, Work force, Manufacturing Process & Equipment, Visual Information System, Manufacturing Planning & Scheduling, Product Development & Technology, Customer Relationship. The research also showed how lean dimensions in the manufacturing system relate to eight types of wastes.

R. Sundara, et. al.[9] (2014), attempted to develop a lean route map for the organization to implement the lean manufacturing system. Analyses of the exploratory survey results illustrated the implementation sequence of lean elements in volatile business environment and the need for development of a unified theory for implementation of lean elements. Successful Lean Manufacturing System implementation needs integration and simultaneous implementation of Lean elements along with proper sequence. The survey also proposed the detailed implementation Road Map giving a unified theory for Lean Manufacturing System implementation.

Rother et al [19] suggested that the Visual representation of VSM facilitates the identification of the value-adding activities in a Value Stream and elimination of non-value adding activities. A second step in VSM is to draw a future map based on improvement plan. The availability of information in the VSM facilitates and validates the decision to implement lean tool and can also motivate the organization during the actual implementation, in order to obtain the desired results. VSM clearly indicate the inventory, process time, Lead time, waiting time, etc and

Figure 1 Lean dimensions in a manufacturing system and its relation to wastes.
process flow from which can sort out bottleneck cycle time against Takt time.

Fawaz et al. [20] investigated the “before” and “after” scenarios, and a reduction in production lead-time and lower work-in-process inventory was observed. It was concluded that simulation model could be used to evaluate basic performance measures before lean implementation. The systematic continuous improvement starts with the bottleneck area.

According to Taho Yang Yiyo Kag [21] suggested and implemented lean production system for fishing net manufacturing, using the various lean tools and simulation method and make to order (MTO) process are apply for the regular shipment. VSM tool was used to predict future state map and increase service level and reduce lead time, also provided guide lines for the implementation of Value Stream Mapping in any manufacturing industry successfully and cost reduction by elimination of waste.

Halpan and Kueckmann (2001) explained using Value Stream Mapping in aircraft manufacturing. They drew current and future state maps, with the objective of reducing lead time according to customer requirements. The implementation of the future state map attained lead-time reduction.

Ramnath B.V. et al [22] described using Value Stream Mapping as a main tool to identify the opportunities for various lean techniques and to provide a background on lean manufacturing, and also studied various tools and techniques used for transforming a company into a high performing lean enterprise. The focus of the lean manufacturing approach is on cost reduction by eliminating Non- Value added activities; identify sources of waste and to identify lean tools for reducing the waste. To eliminate the wastes found from the current state map, Kanban system was suggested for pre machining section and single piece flow concept is suggested for Machining section.

Rajenthirakumar and R.G. Shankar [23] reported a noticeable reduction in cycle time and increase in cycle efficiency with an application of value stream mapping (VSM). The production flow was optimized, thus minimizing several non-value added activities/times such as bottleneck time, waiting time, material handling time, etc.

K. P. Paranitharan [24] provided a useful platform for research in implementation of lean tools in any manufacturing unit. Their results showed a significant improvement in productivity, reduction of production lead time and reduction in inventory. These were achieved by layout modification and balance to TAKT time.

R.M. Belokar [25] reported the application of VSM in an automobile industry where they achieved nearly 67% improvement in cycle time by improvement in value adding activities.

From the above discussion, it is observed that, among all the LM tools, VSM was most effective for lead time reduction and eliminating non value added activities in different industries. Hence, a study on the implementation of VSM for lead time reduction in discrete manufacturing industry i.e. in post production processes of Junction Box can be done studied.

### IV. RESEARCH METHODOLOGY

In XYZ company, manufacturing junction box is currently facing problems like, on-time delivery, limited quantity production & unable to deliver onetime full quantity, ultimately leading to more lead time. The following methodology is adopted to study the problem & which tool can be used for the reduction of lead time.

### V. CONCLUSIONS

This study is aimed at proposing a most suitable LM tool for application in a discrete manufacturing industry. Cause & effect diagram, kaizen, 5S were used in automotive MNC industry to reduce machine downtime, wastages & non value adding activities. 5S, Pareto analysis, 8 Step Problem Solving Methodology were successfully applied in automobile for elimination of waste.

VSM was successfully applied in Bearing, Colour, Pharmaceutical, Aircraft manufacturing, Automobile, Manufacturing & Process Industries. On application of VSM to indicate the inventory, process time, Lead time,
waiting time, etc. there is cycle–time reduction, waste reduction, reduced lead time and change-over time, reduced bottleneck cycle time against TAKT time, thus significantly decreasing wastage and non value added activities. Simulation model could be used to evaluate basic performance measures before lean implementation. The systematic continuous improvement starts with the bottleneck area.

It can hence be concluded that Value Stream Mapping can be considered for implementation in post-production processes of Junction Box in a discrete manufacturing industry.

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