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Research Paper

IMPLEMENTATION OF A LEAN MODEL FOR CARRYING OUT VALUE STREAM MAPPING IN A MANUFACTURING INDUSTRY

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Value Stream mapping technique involves flowcharting the steps, activities, material flows, Communications, and other process elements that are involved with a process or transformation. In this respect, Value stream mapping helps an organization to identify the non-value-adding elements in a targeted process and brings a product or a group of products that use the same resources through the main flows, from raw material to the arms of customers. In this study, a practical study carried out in a manufacturing industry for the manufacture of products is discussed. The main aim is to draw the current state value stream mapping. It discusses the reduction in the set up time and cycle time that can be obtained through the implementation. This paper also discusses the plan of action for improving the Future State Value Stream Mapping (FVSM)

Keywords: Current state Value Stream Mapping (CVSM), Future state Value Stream Mapping (FVSM), Value added time

INTRODUCTION

The research study was carried out in manufacturing plant at Bangalore which manufactures automobile parts, bushes and rods. The company manufactures more than 300 different types of products on batch orders. The study discusses the implementation of Value Stream Mapping carried out in the foundry, stores and machining center division of the industry.

The main aim was to reduce the cycle time and to eliminate unwanted facilities and suggest improvement measures from the lean manufacturing perspective. Hence, the research work focuses on mapping the current state, reducing the cycle time and the setup time and suggests a future state value stream mapping for the manufacture of a machining center (Hines and Rich, 1997).

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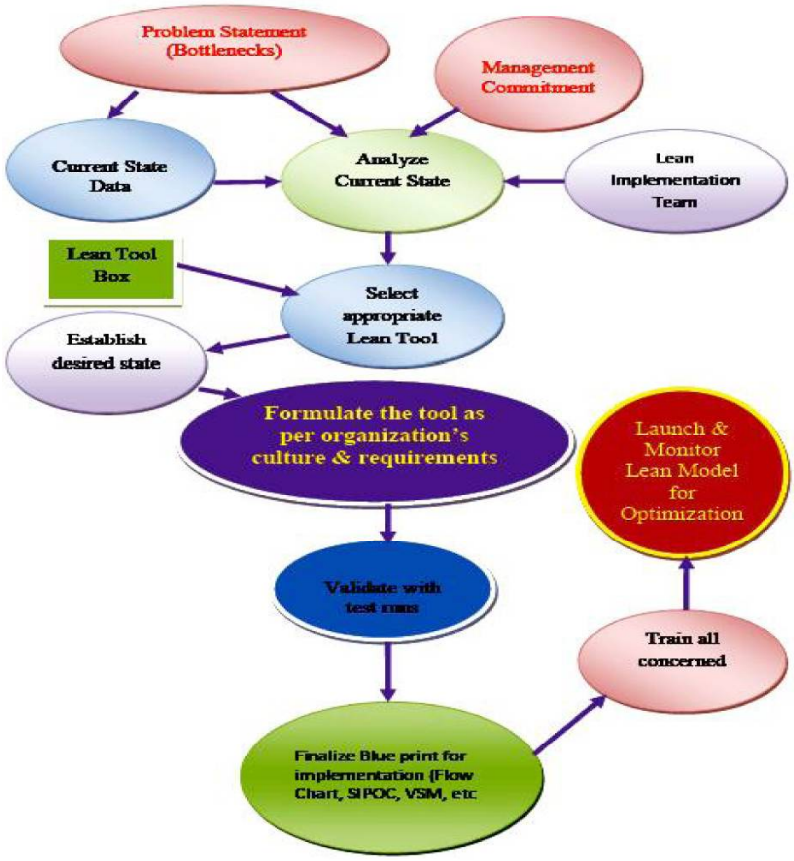
The objectives for the implementation of the lean manufacturing tools in this industry are:

- To study the Current State Value Stream Mapping by collecting the preliminary data.
- To identify the problems faced by the Industry in terms of Non Value Added time.
- To propose Future State Value Stream Mapping which can increase the Value added time and reduce non value added time.

A MODEL PLAN FOR THIS STUDY

A model plan was arrived at after the detailed discussions with the management. As the industry was manufacturing many products, it was proposed to carry out a case study in the in- house machining center division. A model for carrying out Value stream mapping in this industry was devised. The model proposed for the implementation of VSM is shown in the Figure 1. The model proposed is applicable for any Medium Scale Industries in India. The plan starts with problem statement and discusses the issues relating to the commitment from the management. A detailed plan is discussed herewith for the implementation in the phased manner. However, the paper discusses the issues relating to CVSM and FVSM for the manufacture of machining center.

Figure 1: Implementation Model for the Value Stream Mapping in a Medium Scale Industry



Implementation model for the Value Stream Mapping in a Medium Scale Industry.

The model parameters to be considered during the implementation are:

Problem Statement: The main aim is to identify the problems prevailing and to fill the gap in order to establish lean compliancy.

Management Commitment: This is an important step for lean implementation initiative. The management has not only to be committed but also should be willing to implement change.

Current State Data Collection: This is an important step in VSM analysis. The data is collected while walking along the actual pathways of material and information flow. The data collection begins at the shipping end and work towards the upstream. Data has to be collected using the stopwatch and should personally collect the data of cycle time and change over time for the process of manufacture. Hence, as per the requirements, the appropriate data has to be collected. The analysis of the current data collection is based on the bottle necks observed in the process of manufacture.

Lean Implementation Teams: The team should have managers, engineers and workers, who are multi skilled, should be ready to accept the changes which the proposals suggest. This plays an important step in the lean tool implementation. A survey with interviews has to be carried out.

Lean Tool Box: A detailed knowledge on the implementation and the use of Lean Manufacturing tools like Kanban, Value Stream Mapping, Pareto diagram, Cause and effect Diagrams, Total Quality Management, etc., are required. However, in this case, an attempt has to be made in mapping the Current and future Value Stream Mapping.

Select Appropriate Lean Tool: Once the data is collected, depending on the problems and the gaps prevailing in the manufacturing activity, an appropriate lean tool need to be applied. This is based on the customer's requirements in the downstream.

Establish Desired State: The desired state is based on the objectives set by the management.

Formulate the Tool as per the Organization's Culture and Requirements: This is the most critical step for effective implementation in any medium scale industry from the Indian context. The medium scale Industries in India as a policy stated by Government of India are intended for high contribution to domestic production, significant export earnings, low investment requirements, operational flexibility, location wise mobility, low intensive imports, capacities to develop appropriate indigenous technology, import substitution, contribution towards defense production, competitiveness in domestic and export markets. But, the limitations the medium scale Industries face are low Capital base, concentration of functions in one/two persons, inadequate exposure to international environment, inability to face impact of World Trade Organization (WTO) regime, inadequate contribution towards R&D and lack of professionalism. Further, these companies face problems of cultural factors in their implementation initiatives as many medium scale industries are launched in regional belts with cultural barriers. Further, the training initiatives form

one of the core need areas in the implementation.

Validate with Test Runs: The model has to be validated by carrying out test runs before launching the proposal on a full scale.

Finalize Blue Print for the Implementation: Use flow chart, Supplier-Input-Process-Output-Customer (SIPOC) system of implementation, Value Stream Mapping, Kaizen etc. In this study, the research scholar has planned to propose a future state value stream mapping.

Train all the Employees/Employers Concerned with the Implementation Plan: This is the most crucial step, as the workers should cultivate the lean thinking. It is proposed to the management to carry out training program for the effective implementation.

Launch and Monitor: This is the final step in the work (Ramesh *et al.*, 2008).

CURRENT STATE VALUE STREAM MAPPING

Mapping helps to see the sources of waste in the value stream. The reward of VSM is the elimination of large amounts of wastes in the organization. The extended value stream mapping includes suppliers and customers in their decision to suggesting Future State Value Stream Map.

It is possible to identify and eliminate waste and the problem faced by every industry is case specific. In this connection, it was felt that the machining center section in this industry was having some non value added processes, which can be avoided. Hence, as per the model suggested, the study was carried out. Further, Value Stream Mapping (VSM) is a visual tool that integrates material flow and information flow into a critical path chart to understand the relationships and importance of all Value Added and Non-value Added actions. This methodology enables the team to prioritize projects for a systematic Lean approach (Ohno, 1988).

The study involved in identifying a team consisting of a representative from TQM dept, a lean consultant, engineers and workers were involved in carrying out the study. The data required for plotting the Current State Value Stream Mapping (CVSM) was collected.

Further, the following procedure was adopted to draw the Current State Map.

- Identification and drawing the product flow from the raw-material entry point of the manufacturing division (MFD) to the finished goods exit point of the MFD.
- Calculating the number of Work-In-Process (WIP) for each component at each work cell.
- Calculating the cycle time set up time and utilization percentage of each process.
- Plotting the Current State Value Stream Map based on the data collected.

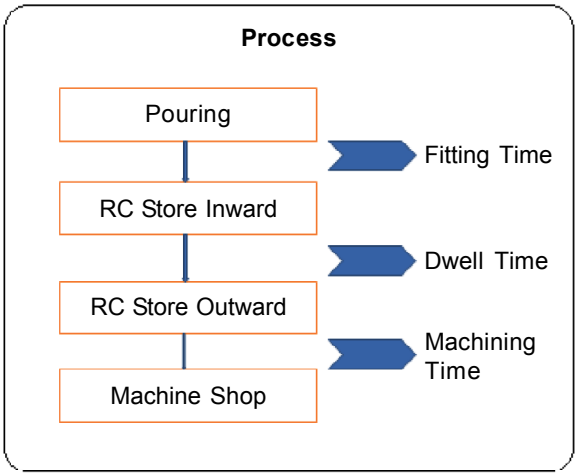
DATA COLLECTION AND STUDY OF THE PROCESS

The data regarding the cycle time, setup time was calculated for the manufacture of all the items.

Further, the details regarding the various processes involved in the manufacture was noted down. It was observed that the flow of the process of manufacture was melting, pouring, pre fettling, fettling, final inspection at foundry, RC store inward, RC store outward,

machining, final inspection at machine shop and finished goods. The cycle time, set up time was noted down. It included fettling process time, dwell time, and machining time as shown in Figure 2 below.

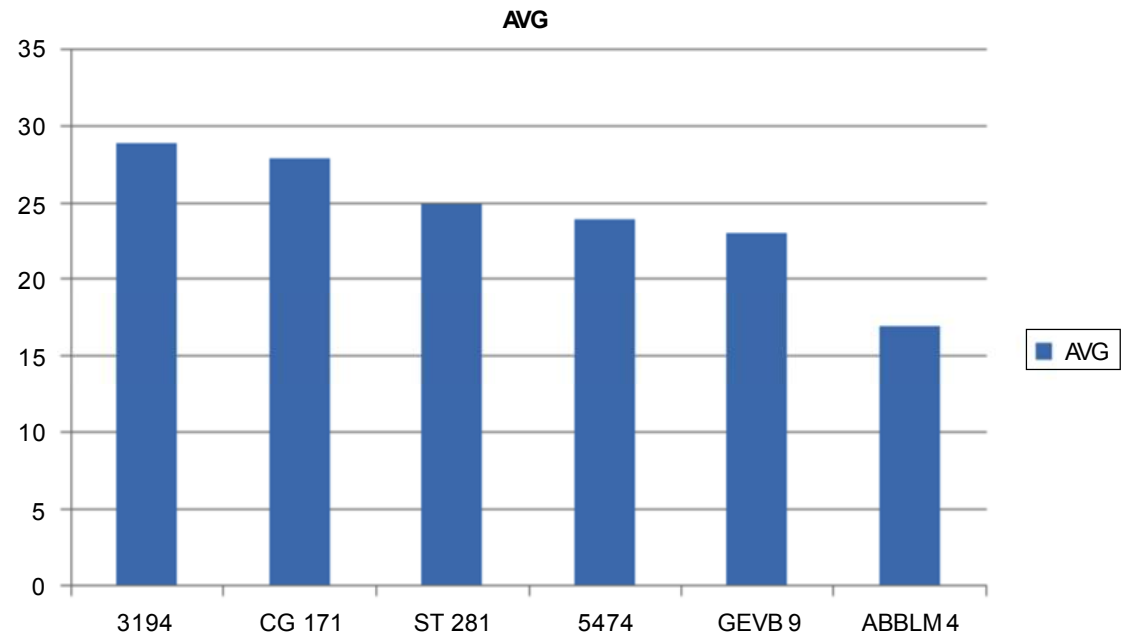
Figure 2: Process Flow Chart to Calculate Lead Times



Analysis of Lead Times

With reference to previous months data the items were categorized into three main categories: runners, eventual repeaters and occasional occurring items. Only frequently running items were considered. In this category Pareto analysis was done the most critical top 6 items were identified as shown in Figure 3.

Figure 3: Pareto Analysis of Top 6 Items Lead Times



It was observed that the percentage value added time ranged from 4.63 to 13.62% and remaining was idle time. Maximum time was wasted waiting idle.

Analysis for the Present State Value Stream Mapping For Product 3194.

It was observed that Product 3194 had above observed times for all the operations in the Fettling Process and RC Store The above times have been calculated for production of 6 items. The processing time and idle time can be observed from above Figure 4.

Figure 4: Fettling Time of 3194

Operations	Process time (avg)	Idle time (avg)
1. Melting	4 hrs	-
2. Pouring	20 mins	-
3. Cutting	1.5 hrs	12 hrs
4. Heat treatment	6 hrs	2 hrs
5. Flashes cleaning	18 mins	5 hrs
6. Final inspection	1 hr	12 hrs
7. RC store inward	10 mins	1hr

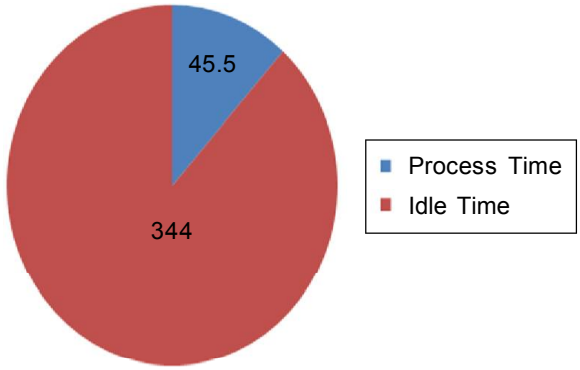
Above Figure 5 explains the machining Operations on 3194 and the Processing times and idle times observed.

Figure 5: Machining Time of 3194

Operations	Process time	Idle time
1. RC store outward		24 hrs
2. OD turning	6 hrs	2 days
3. ID turning	6 hrs	-
4. 1st side profile	3 hrs	4 days
5. 2nd side profile	3 hrs	-
6. Drilling	3 hrs	2 days
7. Slitting	8 hrs	-
8. Deburring	2 hrs	1 day
9. Final inspection	1 hr	1 day
10. Finished goods		

As we can clearly understand from above Figure 6 that idle time is 344 hours and processing time is just 45.5 hours. the processes were carefully monitored and suggestions were given to management which were seriously considered

Figure 6: Total Cycle Time of 3194



Proposal for the Future State Value Stream Mapping

It was proposed to suggest the following steps to be taken to implement a Future State Value Stream Map (FVSM). Lean manufacturing tools will strive in eliminating these activities and in turn eliminate the wastes in the manufacturing process. FVSM for the manufacture of the parts were drawn. Since, these steps have to be taken up in the phased manner, the proposed FVSM has indicated the processes that can be avoided to reap the benefits of value added time and reduce the non value added time. Hence, the following steps were suggested for the improvement of the process of manufacture (Womack *et al.*, 1990).

Table 1 shows the detail of CVSM, cause for delay and the improvement measures to be undertaken for improving the Future Value Stream.

Hence, in summary, the following suggestions were proposed for FVSM implementation

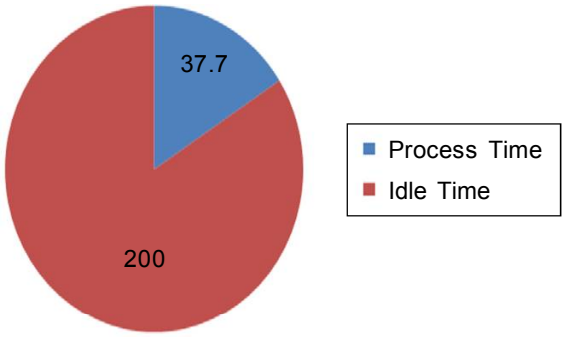
The above Table 1 consists of the suggestions for future value stream map, it consists of the actual causes for delay and suggestions to reduce non value added time.

Table 1: Proposal for FVSM Implementation for 3194

Operations	Causes for Delay	Suggestions
1. Melting	Metal stock not available	Keep always extra stock
	Waiting for quality dept approval	Approval should be given early
2. Pouring	Shell not ready	Shell should be checked frequently
	Quality of shell	Good quality of shells should be used
3. Cutting	Knock out not done properly	Should be done with exact precision of time
4. Heat treatment	Dependent on lab person	Training to be given to operator also
5. Flashes cleaning	Machine busy	Proper queuing is required
	Machine breakdown	
6. Final inspection	Waiting for route card	Increase in manpower
	Non availability of manpower	
7. RC store inward		
8. RC store outward	Waiting for earlier stock to be cleared	Proper planning is required
9. OD turning	Machine busy	Proper queuing required
10. ID turning		
11. 1st side profile	ID step problem	Insertion of ID back tool DCGT
12. 2nd side profile		
13. Drilling		
14. Slitting	Lot of time taken in loading and unloading of item in machine	Usage of extra fixtures
	To be done manually	Usage of automatic brushes
16. Final inspection	Manpower	Increase of manpower

After implementing few suggestions there has been a drastic decrease in non value added time which has certainly decreased cycle time.

Figure 7: Total Cycle Time of 3194 After FVSM Implementation



From above Figure 7 it can be noticed that idle time has been reduced and even processing time.

CONCLUSION

It was observed that, due to enormous potential in the lean manufacturing tools, value stream mapping study was carried out in a manufacturing industry. It was observed from CVSM that the value added time was less. Hence, the study mainly focussed in reducing non value added time which was successfully implemented for product 3194. A CVSM was drawn for all the processes as it was one of the main

objectives of this study and identified the reasons for increase in cycle and set up time. FVSM for improving the value added time by reducing the cycle time and the set up time. Finally, the reductions in the cycle time after the implementation is estimated and proposed.

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