A Case Study on Productivity Improvement of Assembly line using VSM Methodology

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ABSTRACT: This Project seeks to analyze the internal product flow in an Assembly line of the MCCB manufacturing company, located in Vadodara. An objective of the study is to carry out VSM for the product molded case circuit breaker which is manufactured in one of leading companies in India, to identify the non-valued added activities and reduce the same and propose a future state map to reduce the production lead time.

The main objective of this study is to increase the productivity against the demand. The Quality related issue regarding material& material shortage online is not in the scope of this study. Taking a value stream perspective means working on the big picture, nota just individual process; and not a just optimization but an actual improvement. It covers value adding as well as non-value-adding activities. This study also includes layout improvement and time study report.

This research shows marking benefit associated with the implementation of lean program because this project shows an industrial case study of MCCB manufacturing Assembly line.

Keywords: *Value stream mapping; kaizen; Cycle time; Productivity*

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1.INTRODUCTION

The research study was carried out in a unit based in Vadodara, India which manufactures molded case circuit breaker also known as MCCB. The objectives for the implementation of the lean in the company are as follows:

- To study the Current State map by collecting the data from the shop floor
- To identify the problems faced by the company in terms of Non Value Added time and minimize the waste.
- To propose Future State Value Map which can reduce Production lead time, increase the Value added time and reduce non value added time.

2. VSM METHODOLOGY

Value stream mapping can be a communication tool, a business planning tool and a tool to manage change in process. Value stream mapping initially follows the step shown at below. Notice that future state drawing is highlighted because our goal is to design and introduce a lean value stream. The future state map is most important. Material & information flow are two sides of coin, which included in VSM methodology.

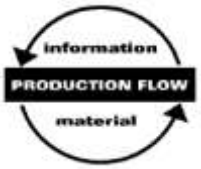

Fig-1: VSM flow

Fig-2: VSM Methodology

3. GENERAL OVERVIEW OF LITERATURE REVIEW

Rahani et al AR [1] focus on a case study of batch manufacturing product and to draw VSM. They suggest that we should walk and interact with workflow rather than doing office to collect data & to improve current stage. They make a series of Que. During their walk prod. Area 1: What is the

Takt time? 2: What are the bottleneck and constraints found? 3: Where can inventory can be reduced? 4: How can you improve process? 5: Potential process improvement for future state design? This basic ques. gives huge ideas for improvement. They reduce Bottleneck, WIP & thus cycle time.

In this paper Peter Hines [2] focuses on reduction of waste by adopting lean tools, if we reduce lead time the saved time can be used to improve quality & management issues. Thus this paper more focuses more productivity improvement rather than quality. He defines 7 stream mapping tools: (1) Process activity mapping (2) Supply chain response (3) Production variety (4) Quality mapping (5) Decision point analysis (6) Demand amplification (7) Physical structure (volume & value) .It helps the researcher to choose the most appropriate methods for the particular industry, people and types of problem that exist. The typology is based on the identification of wastes.

In this journal Colin Herrona [3] et al identified that if we want to apply VSM the first step of implementation is to implement 5-S.

Takt time = Available production time/ Total daily quantity and

Uptime % = (Actual production time of a machine– Value added time/Availability time) * 100 required. The aim of paper to use the Value Stream Mapping tool is to identify, quantify and minimize major wastes in a manufacturing set-up. By this approach A Marecha [4] et al make matrices of waste to mapping tool. And give ranking to waste as per their complexity. They try to minimize their defects as per their priority: like the implementation of First-In-First-Out (FIFO), semi-automated process, development of an economic batch quantity, etc. and improves throughput by 16%.

Here, R Domingo [5] et al gives an example of GM's VSM documents the performance of the process with the metrics of process time, wait time, and first time quality. Here researcher introduces us to Value Stream Mapping. VSM has its roots in the Toyota Production System (TPS) with a technique known as "Material & Information Flow Mapping".

Roberto Alvarez [6] et al has studied the real industrial case of assembly line improvement through rude management. Empirical results drawn from case studies show that an operating decision has helped improve lean matrix, especially reducing the the doc-to-dock time and increasing lean rate, and a pre-line manufacturing The change of organization is a better lean organization which has achieved the lowest cycle time. The movement of milk is wasted in the context of unnecessary inventions, excessive transportation and waste time, without changing production philosophy or layout. Combining milk and VSM combinations are an important tool for increasing the flexibility and way of improving the process for any industry.

Leonardo Rivera [7] et al briefly explained the procedure followed for the construction of CTP, its uses and its application. CTP & CTI both have been useful in the the evaluation of a production process and its performances. The evaluation of these improvements through the use of the CTP and the CTI highlights the economic impact of time improvements.

P. Kuhlang[8] et al carried out research on the MTM that is also known as Hybrid Optimization of Added Value and VSM(value stream mapping) how interconnected to each other at different segments & different levels. If we consider the mutual benefits of both Application then it should increase in productivity, standardize the process and also reduce inventory/lead time. They have also examined ergonomics & some logistics aspects in their case study.

In this paper Sanjay Sharma [9] examined the relationship between cycle time & cost in the manufacturing company. Generally it is in reversely proportional to each other. However, as the focus is presently on the cost of the supply chain, a suitable framework is developed to analyze the overall CT compression. The paper also approaches the DOF in the present context. Through an example of ACB & MCCB packaging he will try to explain the Make o order situation with relative to the cycle time reduction in the case study.

Ravindrakumar [10] et al provide a case study of a hub manufacturing process by applying VSM technique. By application of VSM they succeeded to achieve 7 % cost saving & also reduction in the cycle time. It can be concluded that VSM is an effective tool for identifying the process.

Dushyanth Kumar KR[11] et al present a case study of a pump Assembly of a manufacturing company of the the pump.In this case study he findss out the waste by developing CSM and try to eliminate them. He also developed FSM for that. He succeeded to reduce process time from 240 hours to 150 hours. He just made a small change in the the shaft sleeve manufacturing process by using fishbone diagram & kaizen.He also used 5 S principle & some mechatronics principle for Accurate process & also helped in lead time reduction.

James T. Luxhoj [12] et al suggests that predetermined time systems could be employed for the remaining operations in the crop schedule for the single truss tomato production system, as well as for other crops that involve highly repetitive, short cycle work elements. With predetermined time systems, the focus is on the operation or method, and not on the operator. There is no need for a subjective "performance rating" factor. Therefore, the very use of predetermined time systems can potentially motivate substantial method and ergonomic changes. In addition, a macro predetermined time system, such as MOST, can provide labor data for the design phase of new greenhouse materials-handling systems.

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4. CASE STUDY

To start VSM by identifying different waste in the MCCB assembly process and then removing it by applying suitable lean toolsin the process, in our case study VSM (Value Stream Mapping) is the better visualization tool to identify NVA in the process, then the FSM can make through the application of Lean principles for decreasing throughput time.

4.1 CSM

From the below data collected, we have identified areas for development to reduce the throughput time of Process. The current state process and related value stream mapping ofas shown in Table 1 and Figures 3 & 4.

Assembly Station	Process	Time(seconds)
AS-1	Release Assembly	150
AS-2	Mechanism Assembly	114
TS-1	OT/CP Testing	180
TS-2	Thermal/Magnetic Testing	200
FS-1	Cover joining	120
FS-2	Mid-cover joining	158
Packing	Carton packing	96

Table-1: Process Activities with Time

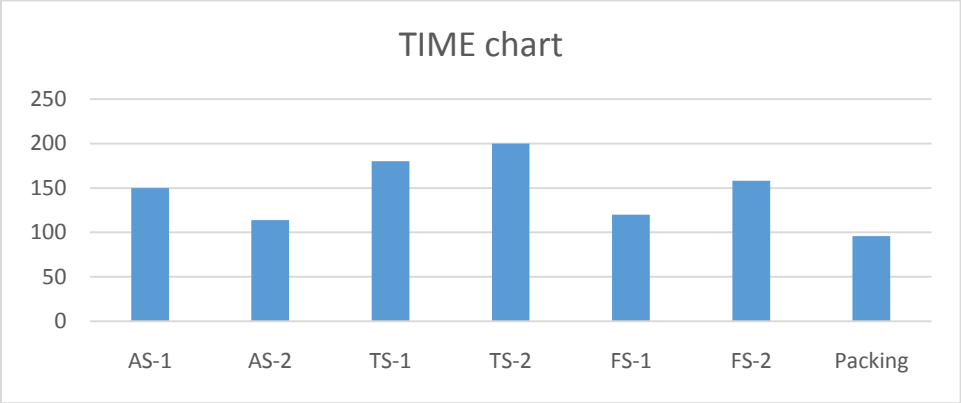

Fig-3: Graphical Representation of Station Timing before VSM

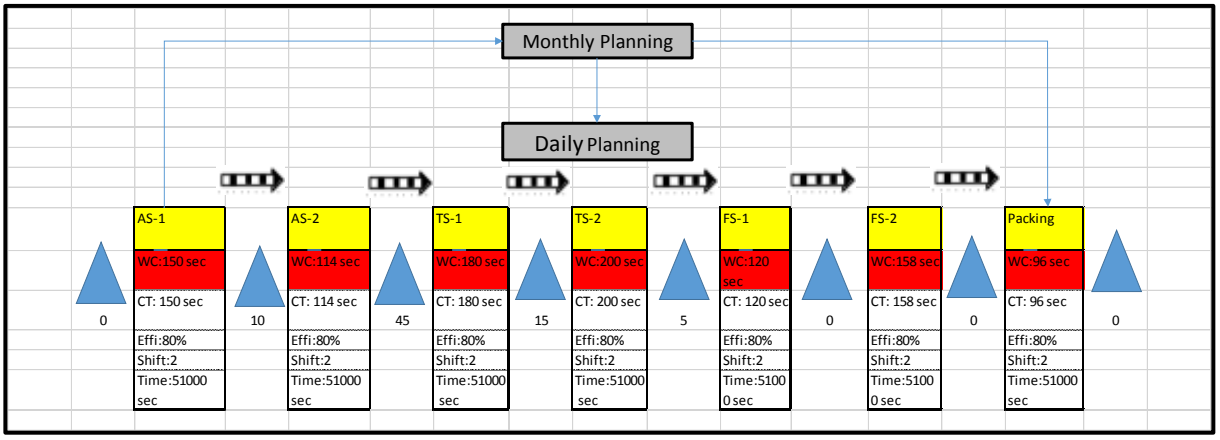

Fig-4: Current State Map

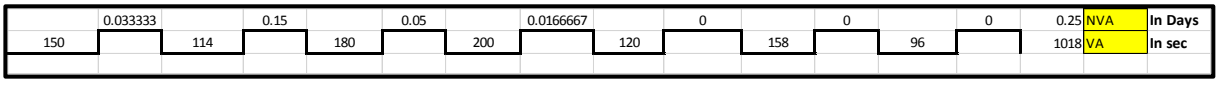

Fig-5: Timeline Diagram of Current State Map

Calculations of CSM ratio:
Percentage of NVA Time=Total NVA time in seconds/Total processing time in seconds × 100
=900/1918 × 100
=47%
Percentage of VA Time=Total VA time in seconds/Total processing time in seconds × 100
=1018/1918 × 100
=53%

4.2 Takt time

After completing CSM we identified the Key characteristics of the Future State and are reviewed with the Top management to obtain input and gain mutual agreement on the direction of the Future State. Looking at the current state map for several things showed up. From the German word, Takt is the word for the wand a conductor uses to control hisOrchestra's speed, beat and timing. In manufacturing, it refers to the frequency of a part or component must be produced to meet customers' demand. [6]
Described mathematically, Takt time is:

Available time for production / required units of production

In our Case Demand is 250 units/day.
Available time for a shift is 25500 seconds.
So, Takt time = 25500/300
=85 Breaker/shift

5. Lean implementation through kaizen anddevelopment of FSM

Kaizen shows a lead role inimproving the productivity and quality of the products. Kaizen is a strategy to include concepts, systems and tools within the bigger picture of leadership involving people and their culture all driven by the customer. The brain storming analysis of VSM revealed the following major NVA identified as operator's movement and their skill, poor process, delay in material transfer and cooling time for which the proposed lean solutions are suggested as follows. Table 2 and Figures 7 and 8.

Station	Task Involved	NVA Activities	Proposed solution
AS-1	Release inserting in Housing	Delay in material Pick up	Rake provide near Station
AS-2	Trip plate Inserting	Manually trip plate Cutting	Mould modification
TS-1	Doing CP testing manually	Take reading Manually & note down in a register.	Automated set up for CP testing
TS-2	Thermal /magnetic Testing	Cooling time	Increase Shift timing
FS-2	Cover Assembly on Breaker	Waiting & transport Delay	Re-lay outing

Table-2: Proposed Lean Solution

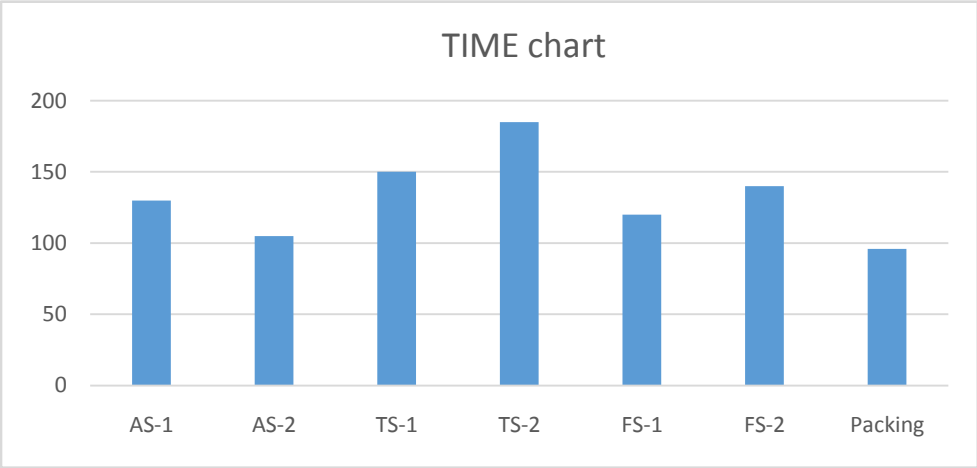

Fig-6:Graphical Representation of Station Timing after VSM

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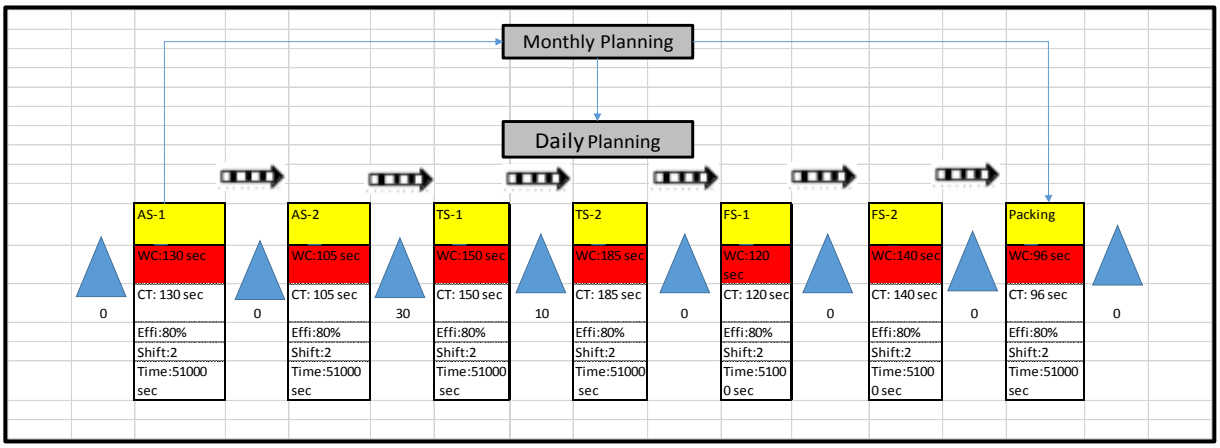

Fig-7: Future State Map

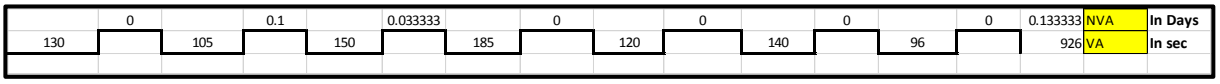

Fig-8:Timeline Diagram of Future State Map

Calculations of FSM ratio:

Percentage of NVA Time=Total NVA time in seconds/Total processing time in seconds × 100

=480/1406 × 100

=34%

Percentage of VA Time=Total VA time in seconds/Total processing time in seconds × 100

=926/1406 × 100

=66%

6. CONCLUSION

In our case study, applying VSM tool for the MCCB assembly, a current scenario isdeveloped as a part of CSM to find the non-value added activities and an FSMis created by eliminating non-value added activities of the process VSM future state map shows significant improvement in the MCCB assembly process and its throughput time is also reduced to 1018 seconds to 926 seconds, Which demonstrate that any delay can be analysed through value stream mapping. The present study provides a case study of the improvement of MCCB manufacturing industry by focusing reducing NVA activities, cycle time and increasing productivity through VSM and kaizen principles, it can be concluded that VSM and kaizen are the effective toolsfor identifying and reducing the process wastes respectively. By performing the technical suitability, economical justifications and feasibility analysis, we have suggested the recommendations of these tools to induct for the medium scale enterprises confidently.

APPENDIX

Available Production Time: Available time is the shift time minus planned breaks and is measured in minutes.

Available Operating Time: Available production time minus changeover time measured in minutes.

Kaizen: ‘Kai’ meaning way, ‘Zen’ means good. Which together account for continuous improvement.

Lead Time: The amount of time that elapses between when a process starts and when it is completed.

Takt time: Derived from the German word Taktzeit, translated best as meter, is the average unit production time needed to meet customer demand.

MCCB: Molded Case Circuit Breaker

VSM: Value Stream Mapping

CSM: Current State Map

FSM: Future State Map

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