

Lead Time Reduction of Power Control Center (Pcc) Electric Panel by Lean Philosophy

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ABSTRACT: The focus of the approach is on cost reduction through eliminating non value added activities via applying a management philosophy which focused on identifying and eliminating waste from each step in the production chain respective of energy, time, motion and resources alike throughout a product's value stream, known as lean. The lean system was developed with reduced non value added activities so that greatly reduces the seven Mudras. People work with a greater confidence, with greater ease, and with greater peace than the typical manufacturing facility. The study of current state map shows the areas for improvement and identifying the different types of wastes. The present and future state of value stream map are constructed to improve the production process by minimizing the non-value added activities which are identified from the VSM. Before Current State Value Stream Mapping (CSVSM) tool used in panel manufacturing industry by focusing both on processes and their cycle times for a product Power Control Centre (PCC) & Motor Control Centre (MCC) in present scenario.

Keywords: *Lean Philosophy, VSM, 5S, PCC Panel, Panel, Lead time, Production Time.*

1. INTRODUCTION

Lean manufacturing is one of the initiatives that many major business units in world have been trying to adopt in order to remain competitive in globalization marketing. Lean Manufacturing that has taken by many manufacturing firms indifferent forms and names. The concept of lean Manufacturing was proposed by a Japanese automotive company, TOYOTA, during 1950's which was famously known as Toyota Production System (TPS). The first goal of TPS was to improve productivity as well as decrease the cost by eliminating waste or Non-Value added activities^{1, 2}. Lean is the set of "Tool" that assist in the identification and study elimination of waste (MUDA) the improvement of quality, production time and cost reduction. Lean was chosen as the key ingredients in the improvement program objectively to suit the purpose of waste removal. Lean application is guided by 5 simple step starting from identifying the value of process. Identifying the process value stream. Focusing on the process flow, configurations of the pull factor and work towards process perfection³. The Focus of the approaches on the cost reduction and -waste reduction by eliminating waste of time from each step in the production assembly line respective of energy, time, motion and resources a like throughout a product value stream.

1.1 VALUE STREAM MAPPING

VSM includes a set of all activities (Value added as well as Non-value added activity) that are essential to bring a product through the main flows, starting with raw material, and ending with customer. The main goal of VSM is to find different types of wastes and trying to eliminate them. The first step is to specific product or product family as the

target for improvement. The second step is that to develop a current state map that is a snapshot capturing how processes are currently being done. The third step to draw the future state map that is picture of how the production process should be done after the waste and inefficient have been removed. The future state map is created based on answering a collection of question on topic relevant to efficiency as well as implementing technical issues related to the application of lean techniques. Value Stream mapping is a method of lean manufacturing which uses symbols, metrics, arrows to show and improve the flow of inventory and information required to produce or service which is delivered to a consumer. A value stream map is visual representation which enables one to determine where the waste occurs. Value stream map are utilized to assess current manufacturing processes and create ideal and future state processes value stream mapping is tool which enables a company to map the process flow that helps in identifying various factors like:

- Value added time (Time taken for producing the end product)
- Non Value added time (Time taken which do not contribute to the production of end product)
- Cycle time (Time required to perform a process)
- Changeover time (Time required to change tool and programming)

This helps in identifying and eliminating Muda (waste).

1.2 5S

5S is the name of a workplace organization method that uses a list of five Japanese words: seiri, seiton, seiso, seiketsu, and shitsuke. Transliterated or translated into

English, they all start with the letter "S". The list describes how to organize a work space for efficiency and effectiveness by identifying and storing the items used, maintaining the area and items, and sustaining the new order. The decision-making process usually comes from a dialogue about standardization, which builds understanding among employees of how they should do the work.

Sorting (Seiri)

- Remove unnecessary items and dispose of them properly.
- Make work easier by eliminating obstacles.
- Reduce chances of being disturbed with unnecessary items.
- Prevent accumulation of unnecessary items.
- Evaluate necessary items with regard to cost or other factors.
- Remove all parts or tools that are not in use.
- Segregate unwanted material from the workplace.
- Need fully skilled supervisor for checking on a regular basis.
- Don't put unnecessary items at the workplace & define a red-tagged area to keep those unnecessary items.
- Waste removal.

Straightening or Setting in Order to Flow or Streamlining (Seiton)

- Arrange all necessary items so that they can be easily selected for use.
- Prevent loss and waste of time by arranging work station in such a way that all tooling / equipment is in close proximity.
- Make it easy to find and pick up necessary items.
- Ensure first-in-first-out FIFO basis.
- Make workflow smooth and easy.
- All of the above work should be done on a regular basis.
- Maintain safety

Shining (Seiso)

- Clean your workplace completely.
- Use cleaning as inspection.
- Prevent machinery and equipment deterioration.
- Keep workplace safe and easy to work.
- Keep workplace clean and pleasing to work in.

Standardize (Seiketsu)

- Standardize the best practices in the work area.
- Maintain high standards in workplace organization at all times.

- Maintain orderliness. Maintain everything in order and according to its standard.
- Everything in its right place.
- Every process has a standard.

Sustain (Shitsuke)

- Not harmful to anyone.
- Also translates as "do without being told".
- Perform regular audits.
- Training and discipline.
- Training is goal-oriented process. Its resulting feedback is necessary monthly.

2. PROCESS DESCRIPTION

In electric panel manufacturing all the raw material collected from store and various vendor. From the store material issue by Bills of Material (BOM). In First of all there are create an Electrical Design and Mechanical Design (3D). After mechanical drawing approved then drawing go to panel fabrication phase. When panel was fabricated then come to assembly line. At assembly line there are assembly of Busbar, Switchgears and wiring was done as per General Arrangement (GA) drawing. Then the panel got inspected based on respective control and power side GA drawing and Wiring Schedule. Then the panel sends for testing, once the testing was over the panel send for packing.

3. OBSERVATION, RESULT, DISSCUSSION

It is clear from the current state value stream map that some processes have more non-value added time. Due to larger non-value added time also increase production lead time. In this observation there are 10 Feeder Power Control Panel. Due to high waiting time and mistake proofing time also increase lead time. There are 11 activity in Power Control Panel Assembly line. Listed below:

- 1) Busbar Inventory
- 2) Busbar Cutting, Punching, Bending
- 3) Busbar colour code sticking
- 4) Busbar assembly
- 5) Logo sticking in panel
- 6) Mounting Plate Assembly
- 7) Switchgear Assembly
- 8) Cutting Wires & Wiring
- 9) Quality & Check Error
- 10) Inspection
- 11) Packing

In current state Value stream map there are huge motion waste, large tool searching and logo searching time. In current state value stream map for identification and elimination of wastes through time study calculation. After the identification of the process conducted by stop watch and video study.

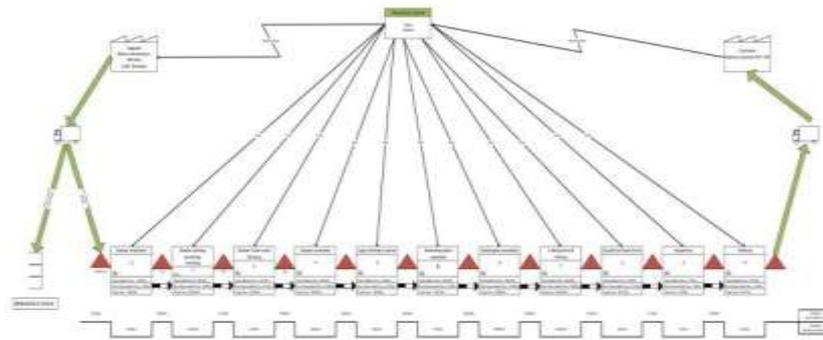


Fig.01 – Current State Value Stream Map

From the fig.1 current state value stream map there are many types of wastes are available on panel assembly line. So, after time study we get the initial result of Value Added

time and Non Value Added time and total lead time of production of PPC panel (See Table 1).

Task	VA Time	NVA Time	Total Time	Time (Hr)
Busbar Inventory	110	54	164	2.733333
Busbar Cutting, Punching, Bending	646	412	1058	17.63333
Busbar Color Code Sticking	303	63	366	6.1
Busbar Assembly	784	117	901	15.01667
Logo Sticking	138	34	172	2.866667
Mounting Plate Assembly	546	51	597	9.95
Switchgear Assembly	1207	513	1720	28.66667
Cutting Wires & Wiring	787	377	1164	19.4
Quality & Check Error	307	33	340	5.666667
Inspection	53	17	70	1.166667
Packing	211	45	256	4.266667
Total Min	5092	1716	6808	113.4667

Table – 1 VA & NVA Time Study – Before Implementation

We conduct every month 5S audit by higher management and to archives 80% of implementing of 5S work. In 5S audit there are different evolution criteria for each “S” and also maintain the daily cleaning sheet and follow the standards.

In each process/activity non-value added activity present. So, how to eliminate non value added activity here I will show you by each step of process/activity (See fig.2).

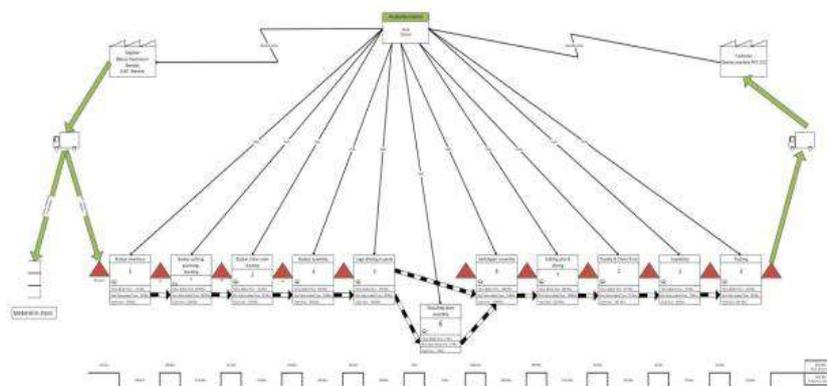


Fig.02 – Current State Value Stream Map

- After change in Busbar section layout there are motion time was reduced and easy to handle Busbar at that condition and due to this type of layout there are more space in Busbar section.
- After making shadow box we can directly fine the tool in within 2-5 min. After use of all tool operator set in shadow box. So we can find tool easily and reduce tool searching time

Before removing a mounting plate assembly at panel assembly line there are issue for how to fix the mounting plate. It's come in different dimension and all mounting plate measuring time and fix to hole to hole will be take more time.so, we directly removed this operation at assembly line. Now mounting plate assemble in fabrication Phase.

- Wrong Wiring is possible due to more number of wires and identification of wire and wiring.
- Due to wrong wiring there are need to more time to change to a right wiring and there are take more time to solve this problem.
- In Panel testing and inspection mode there are more time taken to replace the rejected material. After replace the material then final testing and inspection conducts.

After implementing this tools and techniques finally find the after implementing lead time study result (See Table 2) are below:

Task	VA Time	NVA Time	Total Time	Time (Hr)
Busbar Inventory	107	41	148	2.466667
Busbar Cutting, Punching, Bending	547	267	814	13.56667
Busbar Color Code Sticking	257	42	299	4.983333
Busbar Assembly	673	95	768	12.8
Logo Sticking	113	17	130	2.166667
Mounting Plate Assembly	484	48	532	8.866667
Switchgear Assembly	1127	387	1514	25.23333
Cutting Wires & Wiring	647	293	940	15.66667
Quality & Check Error	197	72	269	4.483333
Inspection	47	19	66	1.1
Packing	197	44	241	4.016667
Total Min	4396	1325	5721	95.35

Table – 2VA & NVA Time Study – After Implementation

Task	NVA TIME For Panel 1	NVA TIME For Panel 2	Total Reduced Min.
Busbar Inventory	54	41	13
Busbar Cutting, Punching, Bending	412	267	145
Busbar Color Code Sticking	63	42	21
Busbar Assembly	117	95	22
Logo Sticking	34	17	17
Mounting Plate Assembly	51	48	3
Switchgear Assembly	513	387	126
Cutting Wires & Wiring	377	293	84
Quality & Check Error	33	72	-39
Inspection	17	19	-2
Packing	45	44	1
Total Min	1716	1325	391

Table 3:- Comparison of Three Panel NVA time

After taking two reading (See Table 3) there are comparison of Non value added activity before and after implementations there are **391 minutes** reduced total lead time of Power Control Centre (PCC) Electric Panel.

4. CONCLUSION

Based on the studies, the main operation and strategy of the company and the total production time for all operation total time calculated. From the data obtained, it is analyzed that there is a large difference in work contain and the time taken by each operator. To achieve this goal, lean principle was most significant lean techniques called Value Stream Mapping to improve the assembly line of electric panel production industry. So, there is a need for reduced the Non Value Added Activity. Initially the total non-value added activity time was 1716 Min. After applying the lean tool (5S, VSM) the operation Mounting Plate Assembly removed from assembly line of panel and its assembly directly send it to panel fabrication phase. So, there are no any mistake to assemble the mounting plate and also reduce the waste and time taken for assembly at Assembly line. So, Finally the Non Value Added Activity reduced from 1716 Min to 1325 Min. The total Non Value Added time reduce time was 391 Min. This study helps to identify the waste and eliminate it step by step, thereby reducing the Non Value Added Activity. So, also reduce total production time of electric panel by Lean principle.

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Active Engineers (Ahmedabad) is an eminent name in the field of manufacturing and supplying of all types of panel board like Power Control Centre (PPC), MCC (Motor Control Centre), APFC (Automatic Power Factor Control Panel), Synchronizing panel and bus ducts, LT/MV panel. Company mission is to deliver the satisfaction of core quality and services.

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