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An Application Lean Six Sigma Tool for Reducing the Production Lead Time

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Abstract—*Lean manufacturing is considered one of the quality improvement technique it increase the productivity and quality of product by reducing waste. Indian industries especially electronic sector have attempted to implement this, but a few research work is carried out in regarding to its suitability. This main focus of this research is to identify that applicability of one of the most important lean manufacturing tool called "value stream mapping (VSM)" for the electronics industry. The current state map was developed after making data for observation and calculations. Then various improvement techniques had been observed based on the lean manufacturing theories and the future state map was developed the observation revealed that VSM can be applied to production of power line communication carrier industries in order to derive positive results such as reducing wastes in inventory and defects. Further, VSM helped the team of the case company To see the different types of wastes generated in organization and future possibilities of reducing them.Lean is a working philosophy designed to produce better products by using less resources to obtain more profit and has been applied to waste variety of manufacturing sectors, very less work has been done in electronics industries in India hence study mainly focuses on this area.*

1. INTRODUCTION

POWER LINE CARRIERCOMMUNICATION

PLCC is new generation equipment for transmission and reception for speech, fax, RTU data, and tele –protection signal in frequency range of 32 KHz to508 KHz over high voltage overhead transmission lines of electric utilities such as power grid corporation state electricity board etc. Puncom has executed a large number of PLCC project all over INDIA.

- 10/20 or 40WPEP power at line output.
- Compliant with relevant ITU-T, IEC, AND IS standards.
- Fully complies to the relevant EMI& EMC specifications.

Fig. 1: PLCC

2. LITERATURE REVIEW

[1] Devi et al. (2013)examine the techniques of adopting lean, the tools implemented, the motivators, obstacles and challenges in adopting lean in Indian Electronics manufacturing industry. The results show that the degree of lean implementation in Indian electronics manufacturing industry is still nascent.

[2] Dey et al. (2013) study the applications of Six Sigma in Electronics Industry. They describe that six sigma is very effective tool to enhance quality performance of any process.

[3] Yogesh M. et al. (2012) describes that manufacturing organizations have adopted the concept of lean manufacturing in order to improve the quality of their products and reduce their wastes. This is done by ensuring that products are assessed or evaluated at each and every stage hence costs are reduced.

[4] Emil et al. (2011) describes that Value Stream Mapping is not a project that covers a specific period of time; instead it is a working methodology to differentiate activities that add value compared with the non-value added, and is addressing to all employees, to the management, suppliers and customers. Many companies are using this improving method because it identifies the problems from the production process, analyze them and provide some potential solutions for a better process.

3. MACHINE

WAVE SOLDERING-Wave soldering is used for the soldering of SMD and discrete components of PCB. Wave soldering is done with the help of wave soldering machine. Wave soldering machine consist of different section conveyor, pallets, flux section, pre-heaters, solder bath and cooling area. First of all pick and place operation for the PCB is done, it is picked from the tray are placed over the pallet which itself rest on the conveyor. After starting the machine, conveyor take the pallet into the flux section where flux is applied to the bottom side of the PCB. Flux is applied with help of the spray nozzle which uniformly apply flux on the surface of the PCB. After

application of flux PCB enters in pre-heater section, three pre-heater are used to heat the PCB and to activate the flux. Dual wave is used to solder the PCB having SMD components. Wave stops as the PCB enters into the cooling area. It is then pick and place in the tray which is delivered to the discrete assembly section. In the discrete assembly section it is inspected for the solder defects and rework is done to rectify it. After rework it is moved to cable section where different cables and connector are attached on the PCB.

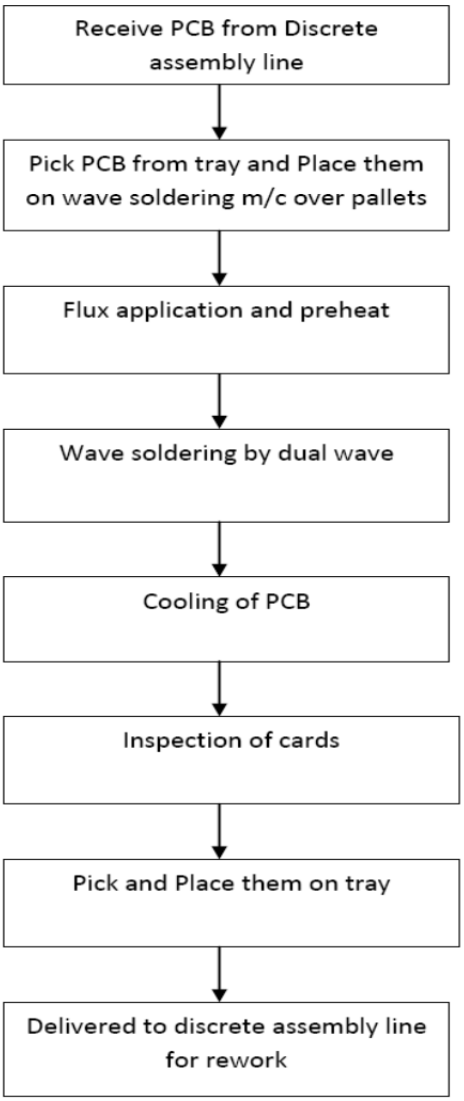

Fig. 2: Process flow in wave soldering

4. MEASURE PHASE WITH CURRENT STATE MAP

The first step wasto identify and understand the information flow of this order and worked backward all theway to the customer asked for the order and how the communication between the marketing department, ERP department, production department and then to the suppliers to obtain the raw materials. Upmost importance is given in company to inventory control and management. It is achieved through integrated online ERP system involving all divisions of the company.All the attributes of each process are summarized in the table.

Table 1: Summary of all attributes of current state map in each process stage

	Attributes								
Process stages	Cycle time (day)	Value added (day)	Non value added (day)	Necessary non value added (day)	Change over (min.)	Availabiliy (min.)	Uptime (%)	No. of Operator	Wip
IGI	3	3	1	3				2	
Store	3	3	1.5	2.5				4	
SMD assembly line	.42	.42	.95	.25	30	430	93.02	2	120
Coil section	.185	.185	.1	.44	20	430	95.34	4	120
Discrete assembly line	.45	.45	.65	1				8	120
Wave soldering	.65	.65	1.49	.5	120	430	72.09	2	120
Cable soldering	.375	.375	.54	.5				2	120
Testing	7	7	.75	.25	60	430	86.04	4	50
Quality assurance	.25	.25	6	2				2	
Customer Inspection	.125	.125	1.12	1					
Packing and Diaspatch	.25	.25	1.25	4				3	

5. PROBLEM FORMULATION

PROBLEM STATEMENT

In the production of the power line communication carrier there is delay in the delivery process, rework of the components, improper utilization of the work force, and high work in progress inventory affected the scheduling of the production and quality.

PROJECT GOAL

1. Improve the quality of the production and the product.
2. Wastages reduction.
3. Improve the delivery time.
4. Reduction of the work in progress inventory.
5. Optimum utilization of available resources.
6. Optimum use of the work force.
7. To improve the profit of the company.

RESEARCH PROBLEM AND QUESTIONS

Competition over the customers is harder all the time and due to this, companies should continuously find new ways to differentiate from competitors. It is clearly indicated in case-company, that the ability to respond quickly to customers gives the competitive advantage in a rapidly changing manufacturing environment. Due to this, the management of the case-company has decided to conduct this research to investigate, how the radical delivery time reduction can be achieved in cost efficient way. Cost efficiency means that productivity and efficiency should be considered, when proposing suitable solutions.

To enable systematic long term lead-time reduction, following research questions were defined:

1. What kind of working method is the most suitable for process improvement activities in case-company‘s environment?
2. How much effort is needed to reduce the delivery time?
3. Demonstrate how Lean Six Sigma can be used in a project focused on manufacturing lead time reduction?
4. Create a set of working solutions through which the target company can reduce its manufacturing lead time?
5. Illustrate how to base the solution creation on data analysis rather than intuition alone?

6. METHODOLOGY

The problem stated above will be under go by the following method

LEAN MANUFACTURING

Lean Manufacturing can be defined as "A systematic approach to identifying and eliminating waste through continuous improvement by flowing the product at the demand of the customer." TaiichiOhno once said that “Lean Manufacturing is all about looking at the time line from the moment the customer gives us an order to the point when we collect the cash.

Fig. 3: Principles of Lean Manufacturing

6.1. CELLULAR MANUFACTURING

A cell is a combination of people, equipment and workstations organized in the order of process to flow, to manufacture all or part of a production unit. Following are the characteristics of effective cellular manufacturing practice.

- Should have one-piece or very small lot of flow.
- The equipment should be right-sized and very specific for the cell operations.
- Is usually arranged in a C or U shape so the incoming raw materials and outgoing finished goods are easily monitored.

6.2. CONTINUOUS-IMPROVEMENT

Continuousimprovement (CI) can be defined as the planned, organized and systematic process of ongoing, incremental and company-wide change of existing practices aimed at improving company performance. PDCA: The short description of PDCA cycle is given below:

Plan: When problems are detected the first thing we have to do is to establish the principal causes of the problem. Tools such as Cause-and-Effect diagram, Failure Mode Effects Analysis and so on can be used to identify the possible causes.

Do: When an important cause of a problem or a solution is found, an implementation is carried out through a number of steps.

Check: Use data to analyze the results of the change and determine whether it made a difference.

Act: If the change was successful, implement it on a wider scale and continuously assess the results. If the change did not work, begin the cycle again.

6.3. PULL PRODUCTION

A core concept of Lean Manufacturing is Pull Production in which the flow on the factory floor is driven by demand from downstream pulling production upstream as opposed to traditional batch-based production in which production is pushed from upstream to downstream base on a production schedule.

6.4. JIT

Just in time is an integrated set of activities designed to achieve high volume production using the minimal inventories of raw materials, work in process and finished goods. Just in time is also based on the logic that nothing will be produced until it is needed.

6.5 VALUE STREAM MAPPING

A value stream is the set of actions, processes or tasks, both value added and non-valueadded that occur to make a particular product or service. When these processes aredocumented, recorded or drawn out for evaluation, it becomes a Value Stream Map.

DMAIC methodology(six sigma)

Define: Investigate the point of view of supplier and customers.

- Identify the customers and their requirements
- Identify the critical factors that have the most impact on supply chain performance

Measure: Measure current process.

- Measure and validate the current processes
- Identify the factors that influence on processes and measure the defects relative to those processes

Analyze: Analyze contributors to poor performance and variation.

- Determine the critical causes of defects
- Identify the key variable to understand defects that cause process variation

Improve: Define, test and validate the improvements.

- Remove the causes of defects
- Modify the existing process to provide a better performance

Control: Ensure that changes are successful.

Ensure the success keys working through the modified process

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