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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.

I. INTRODUCTION

A. Power Line Carrier Communication

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.

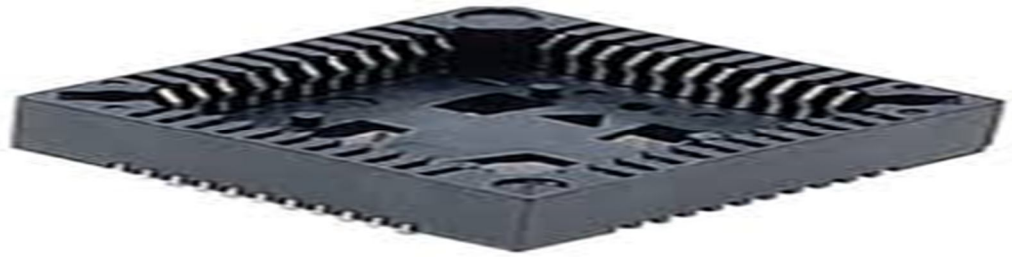

Fig.1 PLCC

II. LITERATURE REVIEW

[1] According to Mazni Omar(2015), had applied VSM tool in the educational field which focuses on the process monitoring in context of the team performance and measuring the efficiency of the each member of the group in completing task. This tool can easily identify and track non-efficient team member and recognize the difficult task that can cause for the delays in completion the project.

[2] According to Sony Priyanka D. (2015), VSM is a LMS tool which revealed that the value addition percentage (%VA) of the coil shop was around 5 %. VSM (future state) projected the value addition percentage to be 11.8% after the implementation of all the improvement projects, the increment of 140 % from the current level, which resulted from the setup time reduction of expander machine.

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[3] According to Palak P. Sheth(2014), had observed that the non-value added time is reduced by 25.6% with WIP reduced & lead time is reduced by 66.7% with the utility of the value stream tool.

[4] According to Anupamsihag (2014), had explain the leans production means the continuous improvement and can do iterative to improve the states of the production by using VSM for getting better results . This tools also helps in highlighting the process inefficiencies, transactional and communication mismatches and also guides about the improvement areas. This VSM tools helps to improve the inventory time with 33.33%, process lead time was reduced by 52.94% and processing time reduced by 80.69%.

III. 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.

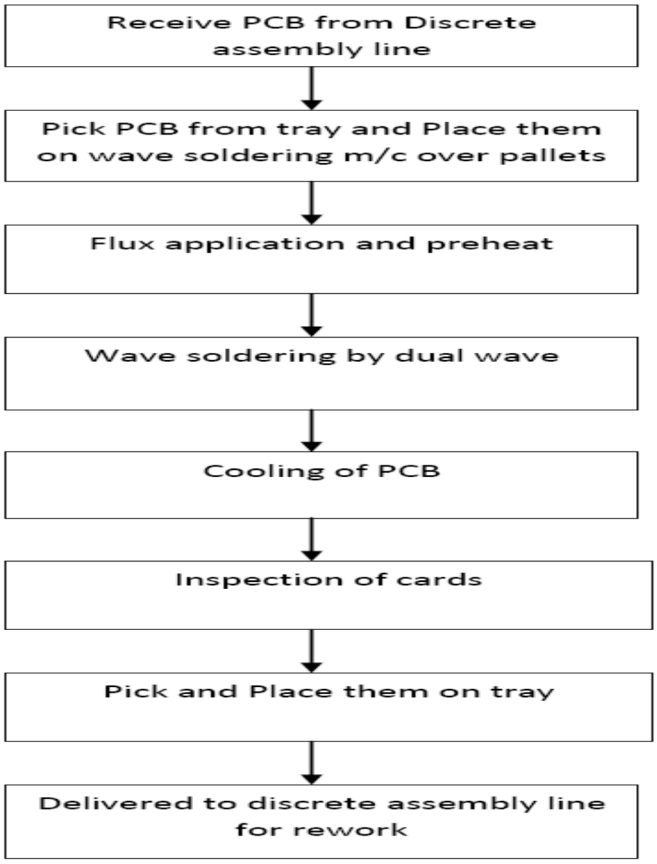

Fig..2. Process flow in wave soldering

IV. EXPERIMENTATION AND RESULT

A. Define Phase

In this phase problem is defined which is which is the target of this study. Purpose of Define phase is to state the problem precisely

which ensures that the project has a greater chance of success. Steps of this phase related to the project are as follows:

B. Statement of the Problem

During the production of power line communication carrier there are no. of problems arise which are as under:

Lower quality
Less labor productivity
More Waiting times
Large WIP
More rework

Due to these problems it creates wastages on the production line which will adversely affect the production schedule, quality of the product and customer satisfaction level.

C. Target and Scope

There is much wastage in the power line communication carrier unit in the company which increases the delivery time of the finished product. This project helps us to implement leans six sigma in the electronic company which helps to increase the productivity and to reduce the delivery time with better quality. By working on this project we came to learn the DMAIC integrated VSM which is termed as lean six sigma. Our target is to reduce the wastage which helps us to increase the quality by increasing productivity, reducing WIP, reducing waiting time, reducing rework etc. up to a certain level.

D. Process Attributes

The attributes of each operation were gathered by taking manual time and observations. The measures, that were taken cycle time, value added time, Non value added time, necessary non value added time; change over time, availability, uptime, work in process (WIP) and number of operators. All the recorded times on the current state map are based on average time except for the number of operator and the work in progress. The availability and the uptime of each process were calculated. Furthermore, this information was collected while walking on the floor and talking to the operators and key person in the area. The identification of the attributes was required to analyze the current state of the identified product:

Availability: The total available production time is 8 hours. There is a 30 minute lunch break and two tea breaks of 10 min each.
Total available = total time per shift in seconds – total time of breaks, meeting, etc. (Tapping, Luyster and Shuker, 2002)
Total available = (8 hours x (60 min/1hour) x (60 sec/1min)) – ((30+10+10) min x (60 sec/1min))
Total available = 25,800 seconds
Therefore, the available production time is 430 minutes (25,800 seconds) per day. This available time is the same in each step of the production.
Uptime: It is calculated by dividing actual operating time by available time. The operation time is the total available time minus the time that the changeover takes.
Uptime = [Total available (min) – change over time (min)] / Total available (min)

Takt time for the process
Takt time- Takt time" refers to the rate at which customers are buying products from the production line; i.e., the unit production rate that is needed to match the customer requirement.Takt time of each production processes is actively managed and monitored, so that a continuous flow can occur. It is calculated by dividing available time per day by the daily customer demand.
Takt time = Available time per day/ Daily customer demand

V. MEASURE PHASE WITH FUTURE STATE MAP

Future state map should be drawn by considering all the suggestion and improvements which are generated after brainstorming shown in table 5.1. There is effort put by the company in the dynamic system which leads to collect information of the tact time and different alternative to make the product. This information can be collected by allocated kanban cards along the production.

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ATTRIBUTES

Process stages	Cycle time (day)	Value added (day)	Non value added (day)	Necessary non value added (day)	Changeover (min.)	Availabiliy (min.)	Up time (%)	No. of Operator	Wip
IGI	3	3	0	3				2	
Store	2	2	0	2.5				4	
SMD assembly line	.42	.42	0	.25	20	430	95.34	2	80
Coil section	.185	.185	0	.44	15	430	96.51	4	80
Discrete assembly line	.45	.45	0	1				8	80
Wave soldering	.65	.65	0	.5	90	430	79.06	2	60
Cable soldering	.25	.25	0	.5				2	80
Testing	5	5	0	.25	40	430	90.06	4	30
Quality assurance	.25	.25	0	2				2	
Customer Inspection	.125	.125	0	1					
Packing and Diaspatch	.25	.25	0	4				3	

Table5.1 Summary of all attributes of future state map in each process stage

VI. RESULT AND CONCLUSION

DMAIC and VSM is an integrated leans six sigma tool, which plays a vital role for realizing the lean six sigma manufacturing. The results come out by comparing processing time, production lead time; WIP and value added ratio.The research results indicate that an overall reduction of 19.87% was achieved in the processing time, 39.85% in the lead time and 33.33% reduction in inventory. The increase in value added ratio was 33.65 %. The results are shown in table 6.1.

Variable	Before	After	Improvement
Production lead time	106.45 days	64.03 days	39.85%
Processing time	15.70days	12.58 days	19.87%
Value added ratio	14.59%	19.5%	33.65%
WIP inventory	120 cards	80 cards	33.33%

Table.6.1. Improvement of power line communication carrier production process

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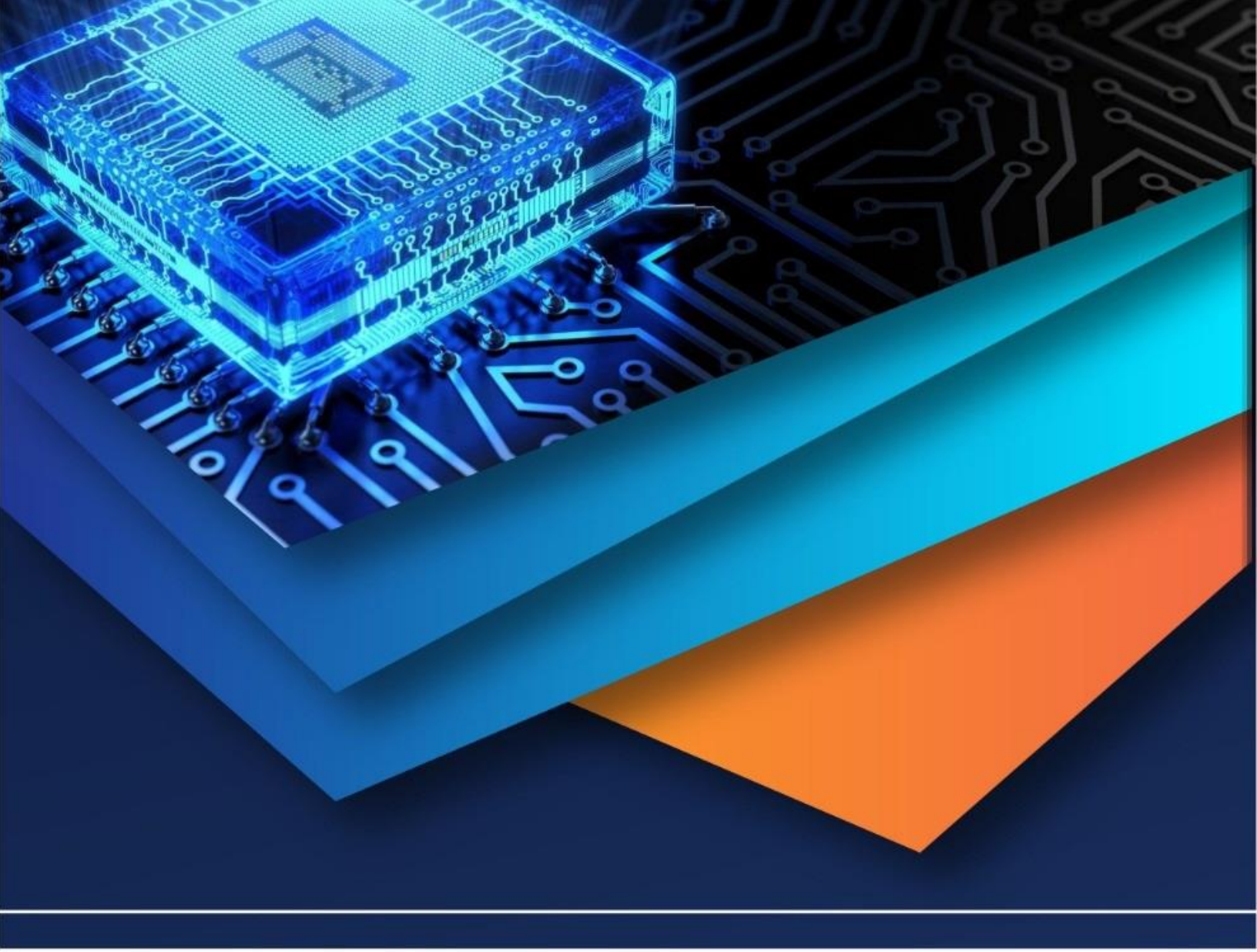

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