Capacity and Efficiency improvement of Electrical accessories Product line using Lean tools – A Case study.

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ABSTRACT

Every day the Electrical accessories industry is optimizing their products to meet the changing needs and requirements of consumers. Buyers of electrical accessories are craving for the best electrical product in terms of durability, efficacy, quality, and most importantly price. The huge competition emanated from the business cycle three-principle patterns is tremendously substantial. Even though the Electrical accessories industry has evolved greatly during the last century, it is still governed by business cycle fluctuations. Electricity companies are now an indispensable domain specialty. They perform multiple tasks related to the electric sector. By all means, the electric utility does not touch upon domestic use only, but also industrial at large. In addition, nowadays electrical needs extend to vital parts of life such as education, health, tourism, technological centers etc.

Electrical accessories are shipped out to global market which is approx 40% of our cost of goods sold. Foreseeing the increase in demand (15 to 20%), and with lean tool implementation on existing line with minimal investment, customers are secured with highest quality and service level.

Keywords: VSM; electrical industry; Lean tools ; lean manufacturing; setup time reduction; efficiency improvement; Capacity improvement

Problem statement: Under utilization of line capacity with respect to high customer demand and Minimal adaptation of Lean.

Challenges faced in the Electrical accessories product line are:

- Capacity unutilized
- Low Industrial efficiency and line efficiency
- More Changeover with high Time
- Limited Elasticity & Flexibility
- Not compliance replenishment system
- High waste & Ergonomic issues
- Difficulty in management of product mix

This case study was done to focus to improve the line capacity and efficiency of Electrical accessories product line to meet customer orders on time.

Adoption of lean tools in electrical accessories production line:

Lean is considered an essential attribute of a successful manufacturing endeavor. The underlying principle of minimization of waste for enhancing productivity has become profoundly influential since being developed into the lean construct. The term "Lean" was coined in 1988 by John Krafcik, and defined in 1996 by James Womack and Daniel Jones to consist of five key principles; 'Precisely specify value by specific product, identify the value stream for each product, make value flow without interruptions, let customer pull value from the producer, and pursue perfection.' (Womack and Jones 1996 p10).

Value stream mapping:

Specifying the value, desired by the customer, and identifying the value stream of the product that adds value and challenges all the wastes is the base line of Value stream mapping. Value stream mapping is the process of creating a user friendly format of the workflow using visualizations. The Product development has different stages and steps involved in it, and each of these steps adds some value to the final product.

Value stream mapping is a great way to optimize the process cycle and make it more efficient. Value stream mapping helps to understand where there is waste in the product development system. This, in return, helps you plan on how to get the waste reduced or eliminated.

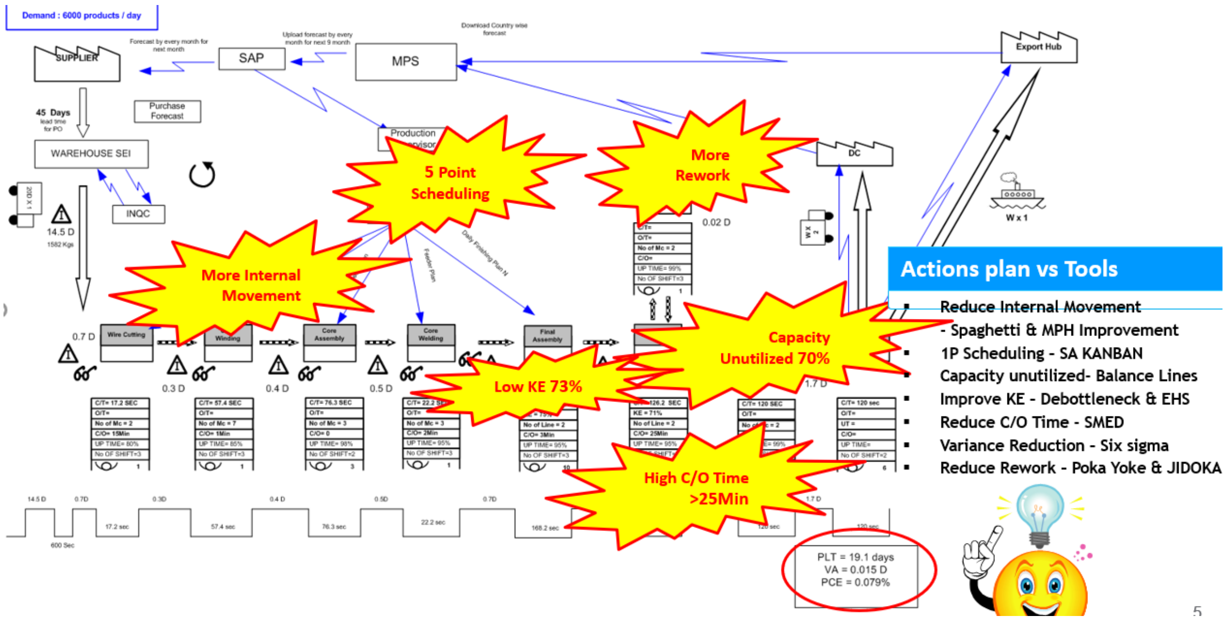

Figure-1 VSM output

Figure-1 represents the Current Value stream mapping output – which reflects: ***More internal movement, 5 point scheduling, Low line efficiency, High Changeover time, More rework, and Capacity unutilized 70%.***

The basic constraints regarding more internal movement are identified as: Toggle printing far away from lock assembly; Core assembly internal movement is high; Terminal subassembly spread on existing layout; All subassembly finished storage away from finishing line, as shown in figure – 2.

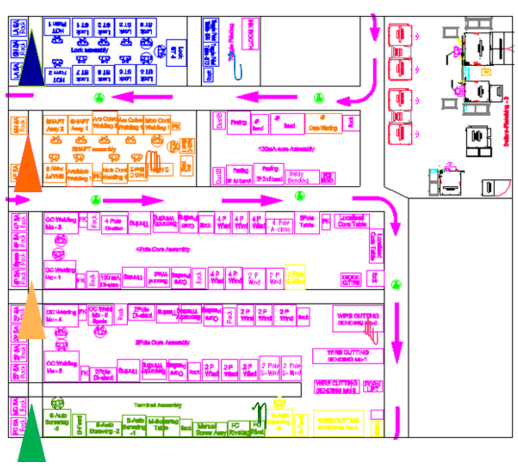

Figure-2 Material flow

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A careful and detailed observation of the present layout and load summary paves an improvement in the layout structure with minimal material handling distance and cost, which results in the reduction in the part and subassembly travel distance and time (Toggle: 24 metres; Screwing: 4.8 metres; Riveting: 5.5 metres; Core assembly: 23 metres.

By implementation of kanban, multiple scheduling is eliminated and the results are summarized below in table – 1. It is a visual method for controlling production as part of Just in Time (JIT) and Lean Manufacturing. As part of a pull system it controls what is produced, in what quantity, and when. It is a system of signals that is used through the value stream to pull product from customer demand back to raw materials.

The process of kanban implementation and the various stages are depited in the figure – 3.

MPH Report for RCCB & ATIM Line				
Sl No	Particulars	BEFORE	AFTER	Improvements
		Time(Sec)		
1	WH KANBAN Signal Collecting Time	433	308	29%
2	RCCB to WH	520	420	19%
3	Matrial Pick Time	1492	1092	27%
4	WH to RCCB	545	420	23%
5	WH-Matrial Deliver Time	1985	1235	38%
6	No of Trip/Shift	5	6	Additional 1 Trip
	Number of Water Spiders Available	**2**	**1**	50%
	Total Cycle Time (Sec) (2+3+4+5)	**2271.00**	**3167.00**	**39%**
	Total Cycle Time (min) (2+3+4+5)	**37.85**	**52.78**	
	Total Cycle Time (Hrs) (2+3+4+5)	**0.63**	**0.88**	
	Total Lead Time (Sec) (1+2+3+4+5)	**12437.50**	**20850.00**	**68%**
	Total Lead Time (min) (1+2+3+4+5)	**207.29**	**347.50**	
	Total Lead Time (Hrs) (1+2+3+4+5)	**3.45**	**5.79**	
	Previous Water Spider Utilization	**48.32%**	**81.00%**	

Table – 1

EPEI- Every part every interval is also known by the Japanese term Heijunka, which literally means "leveling." In this context, it refers to leveling production or inventory. Either way, the basic idea is to bring production capacity, demand, and inventory into synchronization. Breaking the production into lots of feasible size based on the desired capacity, and then producing the lots in repeated cycles to meet demand and keeping inventory from stagnating. The time for each lot to be produced is referred to as the interval, which varies from a single shift at the factory to an entire quarter. It all depends on the product, demand, etc.

Model	Part No	Forecasted demand / day	Container size	Container Type	Cycle Time(Sec)	C/O Time(Min)	Safety Stock	Trigger Point (pc)	Maximum Stock	Daily/ Weekly RUN	Product Cost	Total Cost
STD	3527468 AK	2500	60	CC-43120	4.0	5	2	6	12	Daily	12.2	8784
EASY 9	HRB13799	3000	60		3.3	5	3	9	14	Daily	12	10080
DOM/NEO	3527468 PB	1500	60		4.1	5	1	3	6	Daily	12	4320
IDK	BBV170905	2500	60		3.3	5	2	6	12	Daily	12.3	8856
BICO 9	SIB75669	500	60		3.3	5	1	2	4	Weekly	12	2880
							9	26	48			34920

Figure-4 EPEI Sheet Introduced for RCCB feeder Subassembly

Model	Part No	Forecasted demand / day	Container size	Container Type	Cycle Time(Sec)	C/O Time(Min)	Safety Stock	Trigger Point (pc)	Maximum Stock	Daily/ Weekly RUN	Product Cost	Total Cost (INR)
2P STD	3528577 AD	3430	200	CC-43120	7.1	8	2	4	8	Daily	52	83200
2P IDL	3530527 BE	2940	200		7.1	8	1	3	6	Daily	49	58800
2P Imported	51002920 AC	294	200		7.1	8	1	1	2	Weekly	65	26000
4P STD	352878 AG	2940	100		11.7	8	3	7	14	Daily	52	72800
4P Imported	51002811 AC	196	100		7.8	8	1	1	2	Weekly	52	10400
							8	16	32			251200

Figure-5 EPEI Sheet Introduced for RCCB Lock Subassembly

EPEI influences the following key performance indicators, which plays a vital role in the capacity enhancement. (Refer figure 4 and figure 5).

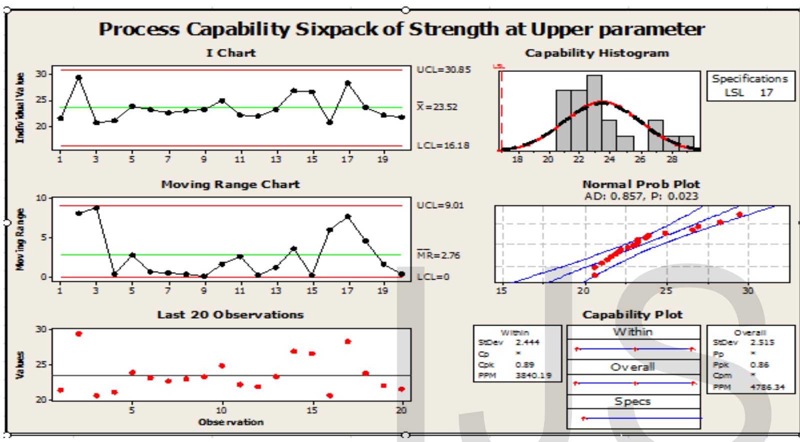
1. **Inventory level**: Milk run /Kanban implemented in Supplier place of manufacturing child parts in order to increase the delivery frequency and to match with the production batch size for this specific frequency
2. **Improved on-time delivery and time to market**: Made in to lower batch sizes and process made flexible
3. **Quality and Welding capability improvement**: Scrap and rework reduction made process

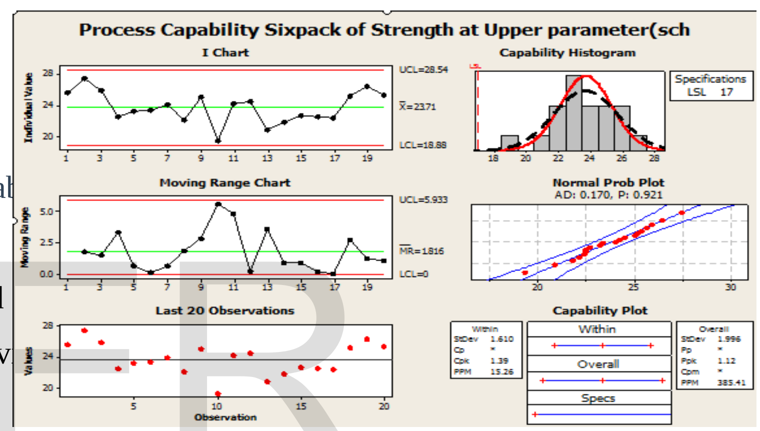
more reliable and save time and money

Welding capability improvement is characterized by:

- **Fixture design has been changed**
- **Process parameters has been optimized**
- **Parts Critical quality dimensions - Cpk improved to 1.35 (Refer minitab output in** Fig.6)

Cpk improved from 0.89 to 1.39





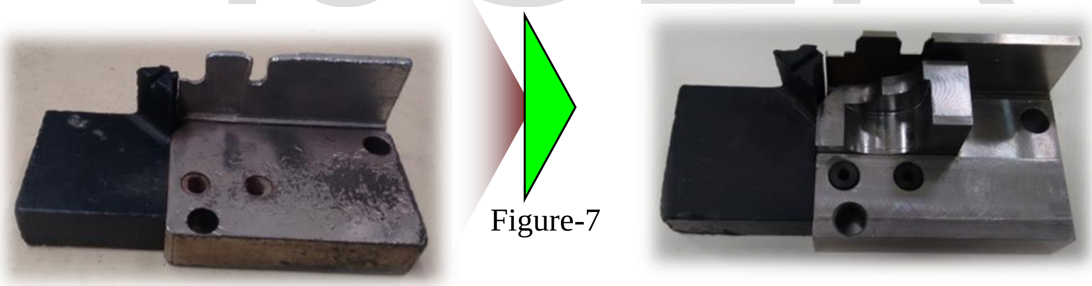


Figure-7

To avoid wrong placement of coil subassembly

The Pad printing machine change over reduced from 26 to 12.3 min and the Welding machine changeover reduced from 28 to 8 min with a variation reduction using Six sigma.

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Figure-9 Change over time Minimization and improve line efficiency

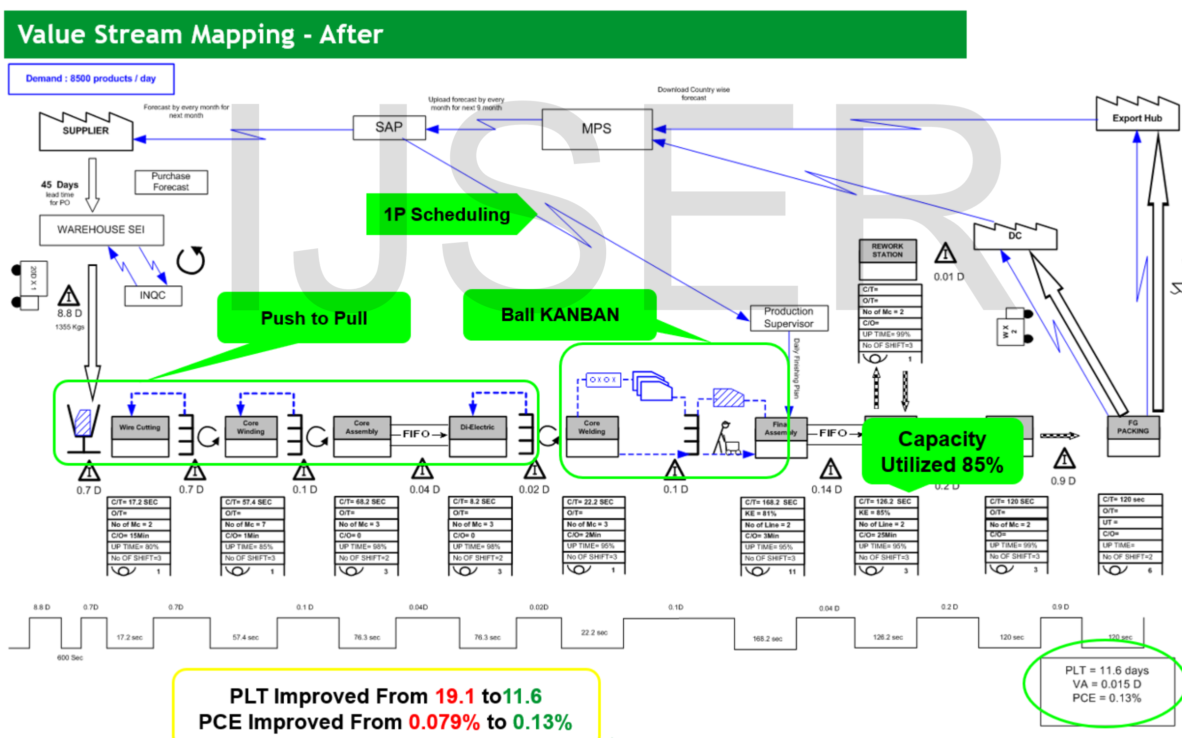

Figure-10 VSM output

Benefits out of this case study (Refer Figure-10)

1. Capacity realized improved from 6900 to 9000 nos.
2. Hourly rate improved by 25.7%
3. Industrial and line efficiency improved from 36% to 44%

4. Rework reduced from 1000 ppm to 300 ppm
5. Increase in Customer service level from 92% to 100%

Learning from this Case study:

1. Cross functional team Gemba brainstorming session blown out more realistic ideas
2. Operator feedback and involvement extremely helpful during implementation
3. Team improved knowledge on VSM, EPEI, KANBAN & SMED concepts
4. Systematic approach with CFT team

Conclusion:

This case study was considered as best practice and implemented across similar product group in the organization clusters. Through this case study, Lean implementation hourly rate improvement and capacity increased, industrial efficiency improved, change over time reduced, movement waste drastically reduced and all Customer orders were secured within short span of time. This case study results in a wider understanding and application of VSM, Lean six sigma tools and collaborative team work with all Cross functional team members.

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