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Productivity Improvement through Lean Manufacturing

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Abstract*: Traditionally operated manufacturing industries are facing lot of problems which includes manufacturing cost, longer manufacturing lead time, and quality of the product and customer satisfaction. Even though the lean tool has proven the process improvement consistently, SME's are not focused much on lean manufacturing philosophies. In this research work carried out in manufacturing industry, by improving productivity and process performance through lean tools such as bottleneck analysis, value stream mapping, kaizen and make or buy decision are used to identify the different problems and to address the variety of solutions. Loading and unloading time can be reduced by using kaizen tool, so that the productivity has been increased. Most of the companies primarily choosen to connect with lean manufacturing for four important reasons to reduce manufacturing resource requirements, to increase customer satisfaction level, and to reduce manufacturing cycle time, in which it increases the profit of the industry. This case study exhibits the various wastes in manufacturing industry such as inventory, lead time reduction and recycling of scrap to improve the productivity. Thus lean tools such as VSM, bottleneck analysis, Kaizen, make or buy decision helps in identify the different type of wastes producing in the organization and possibilities for eliminating/reducing them.

***Index Terms*: Bottleneck Analysis, Kaizen, Make or Buy decision, Value Stream Mapping.**

I. INTRODUCTION

The "Lean" principle has often successfully implemented in companies to achieve considerable savings in production line by means of improving the efficiency of the production process. The objective of Lean manufacturing is to minimizing the wastes and to adding more value to the existing process so that the system performance has been improved significantly. Lean manufacturing tools mainly focuses on reducing all types of wastes within the manufacturing process which will improve the manufacturing lead time and also the product quality. Upon the detailed analysis of the current scenario map with TAKT time calculation, the future state layout is proposed with the various possible improvements and an attempt has been made in the production line by utilizing the lean tools such as bottleneck analysis, make or buy decision and VSM tools.

A. *Research Gap*

Lean Manufacturing facilitates Small and Medium Enterprises has become highly competitive by means of improved maximum utilization of available resources, also it is to reduce human efforts and on-time delivery to the customer with the expected quality level. However, they revealed that the foremost step towards lean manufacturing implementation is started already but the transformation is very slow due to more demand of working capital requirement, still following traditional technology, very poor management skills and improper training to the employees. Based on the existing process study in the ABC industry, the current scenario layout has been developed.

B. *Literature Review*

Global competition in manufacturing sectors makes the industry as a most crucial and sensitive one [1].The latest trend which makes the manufacturing organization to look for the change in the manufacturing paradigm for fluctuating demand in market conditions. Thus the lean tools in manufacturing emerged as a new paradigm to make the industry as a more competitive by reducing the wastes [2]. Lean manufacturing which encompasses different tools and techniques to improve the performances, some of the tools are Bottleneck Analysis, Value stream mapping (VSM) and Make or buy decision [3].The production process in the manufacturing industry which involves eight main processes namely cutting, turning, assembly, drilling, slotting, coating and dispatch. The most important and critical process in the manufacturing industry is turning section which is the most time consuming process which is considered to be bottleneck process to reduce the manufacturing lead time[4-6].The application of bottleneck analysis and VSM tools are initially attempts to minimize the different kind of wastes, Non-value activities and found some possible improvements in manufacturing lead time, and raw material inventory level[7].The objective of this work is to identify and understand the mutual interaction between the driving waste and dependent waste[8].The understanding of the implementation part is more essential to adapt in similar kind of manufacturing industries to identify the improvements in small and medium enterprises [9].The main purpose of the research work was to analyze the most critical factors for successful lean implementation. [10]The main objective of this paper work is to study the process efficiency, and to implementing an independent system of maintenance in a workshop for improving.

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Overall Equipment Effectiveness with the support of 5S technique and TPM by using systematic approach.[11] This research work helps to showing the existing hidden potential in small and medium scale industries and also the selection of appropriate methods for improving the productivity and its objective is to eliminate or reduce wastes and non-value added activities at each stage in order to provide maximum customer satisfaction.[12] This research work has been considered a simple line balancing problem for assembly line with the fixed number of workstation with pre specified cycle time.[13] A detailed study has been made at an automotive industry to analyse the engine testing line to improve the productivity [14].

II. ABOUT THE ORGANIZATION

The study on lean tools implementation using VSM is carried out in a ABC Engineering private limited industry is located in Coimbatore, India. It is an ISO certified organization manufacturing products of bearing, housing, compressor rotor housing, gear box components, motor support, guide support, adapter support, gear housing, cater casing, knuckle, saddle and twister gear box etc. The ABC Engineering private limited has been started in the year 2017. Presently, they offer a number of services to a wide-range of manufacturing sectors which includes textile, automobile and general engineering. Their focus segments are steering, engine block, truck, precision apparatus and all kinds of precision components.

III. RESEARCH METHODOLOGY

The research methodology followed during the research project is shown in the below figure1. By summarizing the review, the appropriate organization for the implementation of various lean tools is selected to carry out the process study. Once the suitable organization has been chosen, the existing process and the products manufactured in the organization was classified. Based on the existing process, current scenario layout has been developed and various lean tools implementation for further improvements are discussed with the employees and executives of the industry to develop the future layout. Once the development has been done for future state map, then the lean tools such as value stream mapping, kaizen and bottleneck analysis is implemented in the process of organization.

IV. CURRENT LAYOUT

The current layout is developed for the manufacturing processes in order to identify the bottleneck process, to calculate the takt time and also to analyse the material wastages from the manufacturing processes. The current state map specifying that the number of units manufactured per week over the process is around 8400 units consistently. An average of eight processes is carried out to completing the process sequence. The main processes which includes of cutting, turning, assembly, VMC, coating, inspection and dispatch. The turning section is taken for the analysis since it is found to be a bottleneck process. The industry works on three shifts for every day in which each shift of 8-hour duration with forty minutes lunch break and the customer demand per day is around 1200 units. The outsourcing process leads to reduction of time and cost of the product so that the profit will be increased. The various processes done by these machines can also be manufactured by low expensive machines. By outsourcing few processes, the manufacturing cost and lead time of the product can be reduced to achieve more profit.

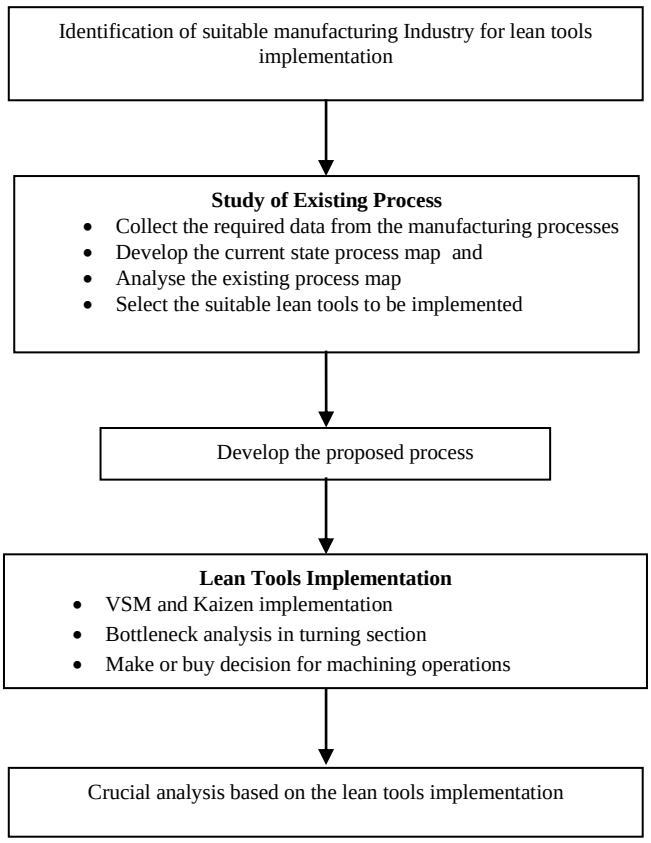

Figure 1- Research Methodology

A. Cost of machines (Cutting Machine):

Turn (1)	=	Rs.10,00, 000
VMC	=	Rs. 8,00, 000
Total	=	Rs.18,00, 000

B. By Outsourcing process (Cutting process)

Turn (1)	=	Rs.60,000
VMC (Drilling)	=	Rs.50,000
Total	=	Rs 1,10,000

C. Existing Wastage:

Length of the existing shaft = 214 mm

Total length of the existing rod = 6100 mm

Total No. of products obtained from a rod = 28 pcs

Total wastage of material per single shaft = 2 mm

Length of the proposed shaft =212 mm

Total wastage of materials produced =56 mm

Proposed length of rod = (6100+214)-56 = 6258 mm

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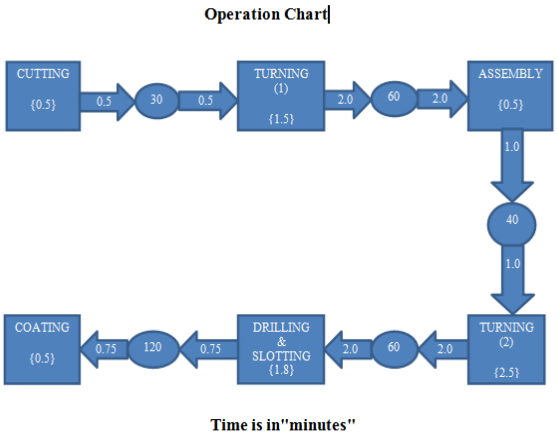
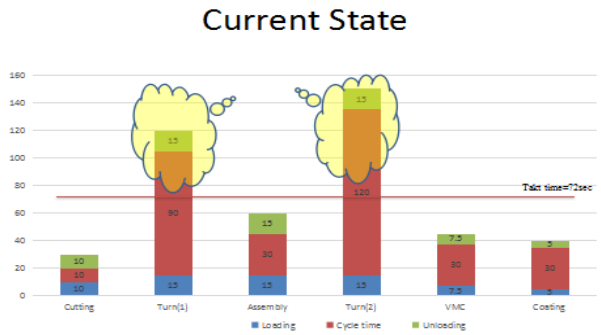
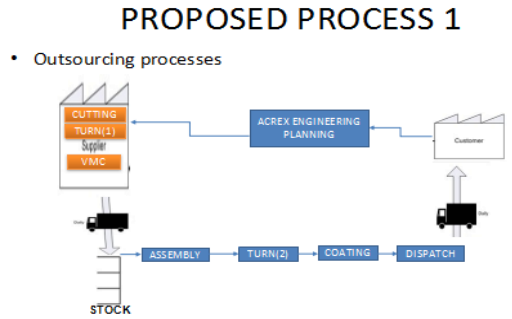


Fig 1. Cycle time of different processes

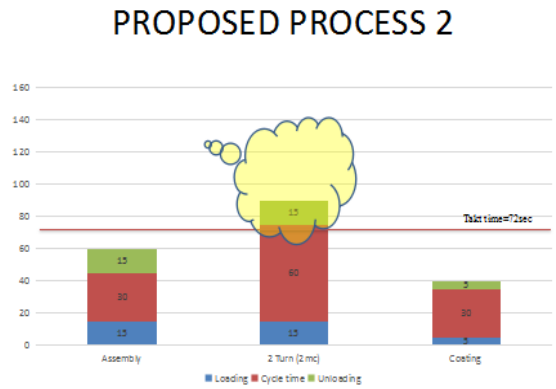
V. TABLE .1 PROCESS PERFORMANCE METRICS:

Time for operations	Outsourcing Process (Cost in thousands)		Cycle time (sec)		Productivity (Units/day)	
	Current Process	Make or Buy Decision	Current	Proposed	Current	Proposed
Turning	100	60	270	150	1200	1330
VMC (Drilling)	80	50	45	30	-	-
Total	**180**	**110**	**320**	**180**	**1200**	**1330**

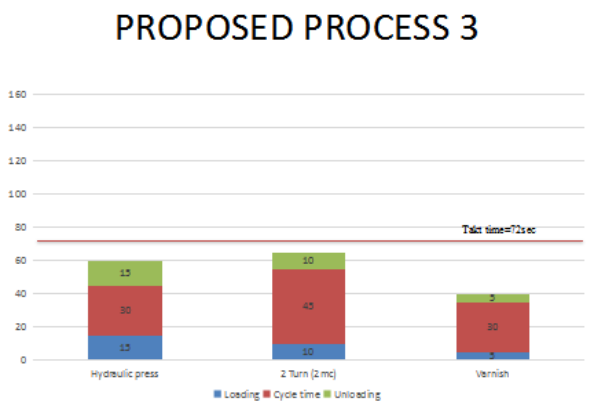




By outsourcing the above processes specified in proposed process 1 layout (i.e.cutting,turning and VMC operations) the existing operating cost and operating time of single product has been reduced.(Table.1. Process performance metrics).



Bottleneck analysis is used to reduce the cycle time of the turn1and turn2 operations as specified in proposed process 2 and proposed process 3 to increase the productivity of the process.(Table.1 Process performance metrics).



VI. RESULTS AND DISCUSSION:

The future state layout is initiated with the replacement of current state map. The various gaps and possible improvements are identified from the current scenario map to propose the various future state maps. The difference made in the existing productivity is improved to 1330 units per day from 1200 units per day. So it shows the productivity improvement to 3900 additional units per month. The bottleneck process time is reduced to 65 seconds from 270 seconds. The cost of the production is reduced to 110000 from the investment of 1800000 by utilizing the make or buy decision model. From the proposed process 1, few processes like drilling, cutting, slotting and turning has been outsourced and thus the maximum lead time of process has been reduced. The several improvements were identified based on the existing map with the future state map for implementation.

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The significant changes are developed in the future state such as reduction in manufacturing lead time, eliminating non-value added activities and improving the productivity as shown below. The change-over-time benefits the industry in shifting to new proposed model and helps in delivery schedule. The comparison of productivity, lead time reduction and outsourcing process has been modified and shown in the above table. Based on the possible potentials identified during the analysis of current state map, some of the few major changes are proposed with the above maps and implemented to observe the different changes made during the lean tool's implementation.

VII. CONCLUSION

The lean tool is the effective tool which is used for reducing the different types of wastes in the industry and it is also the recommended methods for identifying the possible improvements in an organization. During this implementation of various lean tools in manufacturing industry many potential has been identified with the analysis of current state map. Those possible improvements are mapped with the proposed future states map. VSM and bottleneck analysis in manufacturing sector is implemented in turning section as a trial run which shows a considerable improvement in the manufacturing industry. As a result, the overall productivity of the manufacturing process is increased by 10.83%. It is achieved by reducing the non value added activities and improving the proper communications among the employees and also outsourcing the few process for shorter lead time with lower the product manufacturing cost in turning sections.

Depending on the outcomes attained from the lean implementation, the below results were made:

1. The significant achievement in productivity is increased by 10% and the reduction in turning cycle time is 45%.
2. It has been identified that production cost is reduced by 38% while the turning and cutting process has been outsourced through make or buy decision.
3. The raw material wastage has been reduced by 3% while applying kaizen tool in cutting operation.

Lean tools are employed to identify the different set of wastes and it is well-known tool for implementation to improve productivity and reduce wastages. Further research can be extended on the other lean tools can also be implemented for the same process which may provide even better improvements for the organization.

REFERENCES

1. A. Goh, "Evolution of industrial policy making in support of innovation, the case of Singapore," Int. J. Innov. Learn., vol. 3, no.1, pp. 110–125, (2006).
2. T. Mcdonald and E. M. Van Aken, "International Journal of Applications : A leading journal of supply chain utilising simulation to enhance value stream mapping : A Manufacturing case application," Int. J. Logist. Res. Appl., vol. 5, no. 2, pp. 213–232, (2002).
3. A. J. D. Forno, F. A. Pereira, F. A. Forcellini, and L. M. Kipper,"Value stream mapping: A study about the problems and challenges found in the literature from the past 15 years about application of lean tools," Int. J. Adv. Manuf. Technol., vol. 72, no. 5–8, pp. 779–790, (2014).
4. R.Sundara,A.N.Balajib,R.M.SatheeshKumar,"A review on lean manufacturing implementation techniques," pp. 97 (2014) 1875 – 1885 April, (2014).
5. Kumar,V.S..P.Anbuudayasankar, and M. Thenarasu. "Design and development of simulation based model to rank job flow strategies."ARPN Journal of Engineering and Applied Sciences. Vol.11,no9,pp.6082-6086 (2016).
6. J. Bhamu and K. S. Sangwan, "Lean manufacturing: Literature review and research issues," Int. J. Oper. Prod. Manag., vol. 34, no. 7, pp. 876–940, (2014).
7. Lakhan Patidar1, Vimlesh Kumar Soni1,Pradeep Kumar Soni1, "Manufacturing wastes analysis in lean environment:an integrated ISM-fuzzy MICMAC approach,"IntJ Syst Assur Eng Manag 8 (Suppl. 2):S1783–S1809DOI10.1007/s13198-017-0669-6 (2017).
8. Eirin Lodgaarda, Jonas A.Ingvaldsen, Inger Gamme, Silje A schehoug,"Barriers to lean implementation: perceptions of top managers, middle managers and workers," Elsevier. Procedia CIRP57 595–600 (2016).
9. Antony Pearce, Dirk, Thomas Neitzert, "Implementing lean-Outcomes from SME case studies," Elsevier, Operation Research Perspective,5 94–104 (2018).
10. S.Nallusamy,"Enhancement of productivity and efficiency of CNC Machines in a small scale industry Using Total Productive Maintenance," Int. J. Eng. Res. Africa, vol. 25, no. August, pp. 119–126, (2016).
11. D. Shah and P. Patel, "Productivity Improvement by Implementing Lean Manufacturing Tools In Manufacturing Industry," pp. 3–7, (2018).
12. S.Nallusamy, "Productivity enhancement in a small scale manufacturing unit through proposed line balancing and cellular layout," Int. J.Performability Eng., vol. 12, no. 6, pp. 523–534, (2016).
13. Jiby Johny and M.Thenarasu, "Productivity Enhancement In A Pressure Vessel Manufacturing Industry Using Lean Principles", Int.J.Innovative Technology and Exploring Engineering. ISSN: 2278-3075Vol.8, Issue-8, June (2019)
14. Sreejyothi. R, Thenarasu.M & Gokulachandran. J, "The Engine Testing Work-Flow Analysis Through Value Stream Mapping And Simulation" Int.J. Mechanical and Production Engineering Research and Development. ISSN(P): 2249-6890; ISSN (E): 2249-8001 Vol.9,Issue-2, April (2019).

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