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Implementation of Value Stream Mapping (VSM) in a Small Scale Organization

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***Abstract*-Lean tools and techniques are now a day's widely used in many manufacturing organizations around the world for elimination of wastages at various stages of manufacturing. Their implementation improves the overall performance of organization. Value Stream Mapping (VSM) is one of the lean tool can be used by small and medium scale organization for identification and visualization of value added and non value added activities. Therefore VSM can result in improvement in lead time also may help to reduce overall cost of production. This paper describes use of VSM in a pump manufacturing industry. All VSM measures are used to calculate current state map calculations. From current state and future map calculations corrective actions have been taken which leads in reduction of lead time by 3 %.Along with implementation of VSM principle additionally some other tasks related with lean are also carried out which helped to improve overall performance of manufacturing in the organization.**

Keywords-Lean;Value Stream Mapping;lead time;Cycle Time.

I. INTRODUCTION

In this global competition one must be able to meet unprecedented market changes, organizations must not only design and offer better products and services at the same time need to improve their manufacturing operations. One of the strategies is by deploying lean manufacturing practices that can be used to improve the operational performances. Lean manufacturing basically refers to manufacturing processes without waste. Waste is anything other than the minimum amount of equipment, materials, parts, and working time, which absolutely are vital to production [1].

Due to mplementation of modern manufacturing approaches many companies have to change business procedures in general in order to be compatible with new manufacturing philosophy. Internal and external information are the most important resources in today's manufacturing environment, so collecting information in the right way and in real time is big challenge for companies. Collecting information from manufacturing processes is mainly adapted for mass production, and product cost is the crucial fact for management. But, in modern economy customer value is the priority, as well as measuring the cost of resources usage. Many companies are not able to identify and recognize complete value stream [2].

Value stream mapping is a visualization tool used to analyze the flow of materials and information required to bring a product or service to a customer. This is basically a communication tool, but is also used as a strategic planning tool and a change management tool. The foundation of the Toyota way is based upon identifying and eliminating waste in all work activities. If we look each and every process as a time line of activities, material and information flows and chart the process from start to end, we will find a depressing amount of waste – usually far more waste than value-added activity. Apparently these reductions of waste are being handled with a short term strategy called the kaizen. A well executed kaizen workshop can be a step in teaching people what is possible. But this has to be handled as a longer term strategy for developing lean value systems and ultimately a lean enterprise. Value stream mapping is one such long term philosophy lean technique used to analyze the flow of activities and information currently required to bring a service to a consumer [3]. In manufacturing industries there are systems or process flows that cannot be seen or visualized easily by the naked eyes. Value Stream Mapping (VSM) can provide a good view. In VSM map identifies source of wastes and improves the system by eliminating the wastes as much as possible. From the MAP, appropriate action and planning to improve value-added steps and eliminate non-value added steps in the current system would be easier to do [4].

II. VALUE STREAM MAPPING TIME MEASURES

Takt Time (T/T): Takt time is a time within which a product needs to be finished according to customer demand.
Cycle Time (C/T): Cycle time is the total time required to complete a process.
Lead Time (L/T): It is a total time taken by suppier to deliver the finished product customer.
Value Added Time (V/A): It is a total time requires for all value added activities in a process.
Non-Value Added Time (NV/A) It is a total time requires for all value added activities in a process.

III. IMPLEMENTATION OF VSM PRINCIPLES IN PUMP MANUFACTURING COMPANY

Current study is carried out in a Pump manufacturing company. This Plant has a state of the art technology for pump manufacturing and instrumentation for pump testing. The current analysis for VSM is carried out for centrifugal pump. During this investigation a thorough study is carried out to detail the different processes carried out in the industry. After studying various processes in the industry

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a current state map is drawn also calculations are done for takt time, cycle time and effective capacity for every machine. From analysis of current state map it was found that a lot of reduction in the non-value added time is possible and this can result in an increase in the per hour productivity. These calculations are shown in Annexure I and II

In the factory, parts produced by the company and the components such as O ring, Ball Bearing etc coming from the subsidiary industry are combined together and packed after quality control and served to the market. There are 31 workers in the production line of the Industries. In the workplace, there are eighteen machines in the company and the production is made on the assembly line. Currently, the total area of the workplace is 4800 sq ft. The 900 sq ft part of this area is for the assembly line and the remaining 3200 sq ft part is for production line and buffer stocks. Remaining is the free space. The production of a Centrifugal pumps occurs in 6 steps and each step is performed by a different operator.

The Company determines the number of pumps to be produced on a monthly base. The number is between maximum 26 and minimum 20 Centrifugal pumps. On the production line Centrifugal pumps are produced according to the demand. Therefore when demand is more there is load on production line. After assessment of current situation all the calculations related to current situations have been done. These calculations are shown in ANNEXURE I.

A. Future State Map and its Implementation

In following sections step by step it is elaborated how the VSM implementation is carried out and other lean related activities have been implemented is explained.

i) Change in Layout and Centralization of welding process

Due to the improper machine arrangement the component do not flow sequentially because of which lot more time is been wasted in internal transportation of components, so there is a need to minimize the distance between workstations. Due to the combination as well as elimination of operation some additional space can be spared. This space can be utilized for some machines in future.

During the study it was found that there is a need to centralize the welding process, so that increased non-value aided time can be reduced to a great extent. The centralization of welding also results in better space utilization.

Centralization of welding process also eliminates the need of second welding process carried out at the assembly station. Due to centralization the second welding also carried out at the same place and which also increases the utilization of the equipment.

ii) Regulation of Work Environment:

In order to create an organized, clean and high efficiency work environment, 5S technique is used. The materials that occupy unnecessary space are removed. Chairs and junk material are removed. The places and the sizes of the desks are changed. By creating an evaluation measure, the materials used in the production are rearranged. Only the materials necessary in a day or an hour are allowed to be present in the work area. The unnecessary space usage in the production area is prevented. As a result, the initial 11500 sq ft work environment composed of a line of 5400sq ft and a remaining part of 6100 sq ft is decreased to a 4800 sq ft area, composed of a 5400 sq ft line and a 4800 sq ft remaining part, as a result of the improvements made. Total space saved is 11.31 %.

Iii*) Utilization Of Space For Bar Storage*

There is a problem regarding the storage of the long bars WIP i.e. raw material in the storage section. Therefore there is a need to plan for a space for the storage. Due to the centralization of welding process the space near the hacksaw machine remains free same space is used for this purpose. It is also beneficial because first operation on these bar is cutting & also due to the closeness of the workstations the travelling time is been reduced.

iv) Installation of bridge crane-

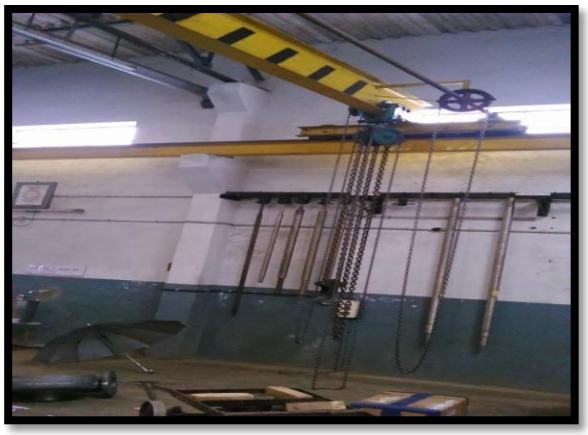

Fig 1: Installation of bridge crane

To reduce the handling time of the components which are heavier (approximately of a weight above 20 kg) are difficult to load & unload manually. That's why we suggested a bridge crane for the material movement. With this, the handling & travelling is done by the same worker so there is reduction in the traveling time which results in a large amount of reduction in lead time of product.

v) Combination of operation

To reduce the lead time of the overall process, we combined the operations together as it is also a primary purpose of the value stream mapping to eliminate the un-necessary operations. Here the two welding processes are combined together so that it becomes easy to work at both sides (production and assembly) & also as it is not much used in case of assembly, due to the elimination, its utilization is increased.

We have also suggested combining together the assembly & testing in a single setup so that there is a reduction in wastage of time. Due to combination of welding lot of time is saved.

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vi) Material carrying equipment

Fig 2: Material carrying equipment

Due to the use of the handling equipments like hand truck there is a reduction in time of the internal transport of materials within the organization which results in reduction of non-value added time of the product. Now they are using hand truck for internal transport. They have manufactured their own hand truck for material handling from the waste material available there.

IV. CONCLUSION

Use of Value Stream Mapping (VSM) in a small scale organization is described in this paper. Current investigation reveals that VSM tool is very important technique to visualize the current scenario which in turns helps to remove unnecessary things from the manufacturing set up.This can help manufacturing organization to improve and regulate work environment. From current state and future map calculations corrective actions have been taken which leads in reduction of lead time by 3 %

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ANNEXURE I Current State Map Calculations

	Formule	HS	L	D	VTL	S /M	B	W1	W 2	A	T	P
Effective Capacity	Cycle Time*EPEI	5	54	27	7	33	8	30	1	1	4	1
Takt Rate	Demand/Available Time	0.7	0.21	0.4	0.14	0.28	0.12	0.28	1	0.27	2	1
Takt Time	Available Time/Demand	1.41	4.61	2.5	6.83	3.52	8	3.46	1	14	0.5	1
Utilization	Takt Rate/Effective Capacity	14%	38%	100	100	84.84	100	93.34	100	70	50	100
Lead Time	Cycle Time + C/O Time	1.9	6.2	3.49	7.18	3.09	8.35	3.62	1.15	14.15	0.75	1.15
Yield	Demand/(Available Time+Takt Rate)	100	100	100	100	100	100	100	100	100	100	100
Uptime	M/c Utilization Rate	83	91.66	66.67	58.34	91.66	66.67	25	8.3	100	4	8.3
EPEI	Effective Capacity/Cycle Time	3	9	9	1	11	1	10	1	1	2	1
Cycle Time		1.71	6	3.34	6.83	2.74	8	3.37	1	14	0.5	1
C/O Time		0.15	0.2	0.15	0.35	0.35	0.35	0.25	0.15	0.15	0.25	0.25
Available Time		10	240	70	41	120	56	104	1	14	0.5	1
Demand		7	52	28	6	34	7	30	1	1	1	1

Terminology

H-Hacksaw
D-Drilling
SM- Shaping Machine
MM- Milling Machine
W2- Welding Machine 2
T- Testing
WC – Work-cell

L-Lathe
VTL-Vertical turret lathe
BM-Boring Machine
W1- Welding Machine 1
A- Assembly
P- Painting

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ANNEXURE II Future State Map Calculations

	Formule	H	L	D	VTL	S/M	B	WC	P
Effective Capacity	Cycle Time*EPEI	7	54	29	7	35	8	15	1
Takt Rate	Demand/Available Time	0.7	0.22	0.41	0.17	0.29	0.14	0.06	1
Takt Time	Available Time/Demand	1.42	4.45	2.41	5.85	3.42	7	15	1
Utilization	Takt Rate/Effective Capacity	100%	40.74%	100%	100%	82.85%	100%	40%	100%
Lead Time	Cycle Time + C/O Time	1.75	6.2	3.3	6.9	2.75	7.95	17.15	1.25
Yield	Demand/(Available Time+Takt Rate)	100%	100%	100%	100%	100%	100%	100%	100%
Uptime	M/c Utilization Rate	100%	98.48%	97.56%	86.08%	97.70%	89.28%	86.67%	100%
EPEI	Effective Capacity/Cycle Time	4	9	9	1	14	1	1	1
C/O Time		0.05	0.2	0.1	0.15	0.15	0.2	0.15	0.25
Cycle Time		1.71	6	3.2	6.75	2.5	7.75	15	1
Available Time		10	240	70	41	120	56	15	1
Demand		7	52	28	6	34		7	1

ANNEXURE III Comparison of Current and Future State Map

Process	Current	Future
Inventory-Cutting	10min	10min
Cutting-Lathe	1hr	1hr
Lathe-Drilling	12min	5min
Drilling- VTL	2hrs	8min
VTL-Shapping/ Milling	1hrs	4hrs
Shapping/ Milling-Boring	12hrs	8hrs
Boring-Welding 1	1hr	
Welding 1-Welding 2	4hr	1hr
Welding2-Assembly	-	
Assembly-Testing	10min	
Testing-Painting	10min	5min