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Identification and Reduction of Waste in an Industry (Ventura Leatherware Mfy Bd Ltd.) Using VSM (Value Stream Mapping) – A Case Study

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ABSTRACT : *Manufacturing industries are always using lots of production processes for desired products. Out of these processes some do not add any value to the product. If a production line is observed, it we will be seen that there are a lot of in-process inventories and waiting time between almost every sequential operation. As a result, the productivity is hampered. So, a smooth, streamlined and continuous flow is really necessary to avoid all such unexpected occurrence. The objective of Value Stream Mapping (VSM) is to identify different activities and to reflect what actually happens rather than what is supposed to happen so improvement areas can be identified. The present study focuses on improving the overall productivity of Ventura Leatherware Mfy Bd Ltd. through VSM. Value added and Non-Value-added time ratios are compared between before and after implementing various technique. By implementing VSM the value-added ratio increased from 0.35% to 0.91%.*
KEYWORDS: *Lean Manufacturing, Value Stream Mapping (VSM), Lead Time, Current State, Future State..*

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I. INTRODUCTION

In this competitive world, manufacturing companies has to look at redefining and redesigning of their production systems to attack the competitiveness demanded by the markets [1]. Therefore, it is essential to have tools which help in redesign manufacturing process [2]. In this scenario, developed and presented value stream mapping tool as a practical method for redesigning the production systems [3]. Lean Production, a concept based on the Toyota Production System, has emerged recently as a global approach that integrates different tools to focus on waste elimination and to manufacture products that meet a customer‘s needs and expectations in a better way. The main aim of lean manufacturing is to reduce waste, time to delivery, produce the quality products with economical and efficient manner with response to customer demand [4]. The organizations which are practicing lean manufacturing have quality & cost advantages compared to the organizations that are still using traditional production methods.

A value stream is all the actions (both value added and non-value added) currently required to produce a product and analyze the current material and information flow necessary through the input to output. VSM is the process of representing all the flow of information from the raw materials to finished goods by using symbols and numbers [5]. It is also a technique for creating “one-page picture” of all the processes that occurs in a company. Companies are experiencing intense competitive pressure due to globalization; hence they cannot afford to operate with wastes in their processes. VSM is the key to understand all the flow of information for an organization and also to improve its efficiency. The use of VSM has been attributed to the success of the manufacturing process [6]. Nowadays, the VSM is being used to identify unnecessary efforts and resources to create simplification and streamlining of operations processes. Value is the information that comes from the customer perspective, and the customer is the person who uses the output. Value- added actions and resources are those created value for the customer. On-added value is anything that done to produce the output but no value for the customer, but they are perforce to pay when they buy the product or service. VSM shows the whole processes and activities that creates value for the customer, by using standard symbols and numbers its lead to the communication tool for both internal communication, techniques and results with the whole organization. VSM is the process of visually mapping the flow of information and material. Most of the

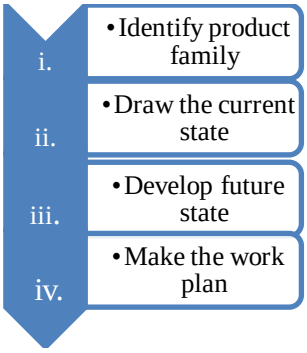
improvement comes from squeezing out a large number of non-value-added steps. In the process, the value-added time can also be reduced [7].

II. LITERATURE REVIEW

Lean manufacturing is a set of tools and methodologies that aims for the continuous elimination of all waste in the production process i.e. a system for improving productivity & product quality. Laconically more value with less work. In Lean Manufacturing many tools are used such as Kaizen, Poka-yoke, 5S, Andon, Bottleneck, Continuous Flow, Gemba, Heijunka, Hoshin Kanri, Jidoka and many more. To become lean enterprise VSM is the best tool [8]. Liker and Wu define "Lean" as "a philosophy of manufacturing that focuses on delivering the highest-quality product at the lowest cost and on time [9]. It is a system of production that also takes a value stream focus. The 'value stream' consists of all the steps in the process needed to convert raw material into the product the customer desires." Ferro defines Value Stream Mapping as "a tool capable of looking at the processes of adding value horizontally" [10]. Similarly, Womack and Jones define Value Stream Mapping as a process of identifying all the specific activities occurring along the value stream regarding a product or family of products [11]. Rentes consider this as an important tool because it illustrates how the flow of information within the work places showing the relationship with the material flow, making it easier to identify and eliminate waste [12]. In the internal manufacturing context, another major contribution was made by Monden. He suggested a new scheme of classifying operations into three generic categories as non-value adding (NVA), necessary but non-value adding (NNVA) and value adding (VA). This scheme proved to be more generic and was extended to different areas [13]

III. METHODOLOGY

VSM is also called product flow analysis by means of which, analyzing all existing product flow is done to determine where the waste exists. The process involves tracking the complete product flow from customer order to product delivery, including all the materials movements and information flow. The analysis is done by physically following the product through all of its operations and recording data. The result is a complete and thorough map of product and information flow, as it currently exists. The next step is to develop a future state map that will show a reduction of non-value added steps in the process. VSM is a key tool in the Lean Manufacturing tool box that is effectively used for system design [14]. VSM is divided into 4 stages:



a. Methods of Designing a Value Stream Mapping

The steps of producing value stream mapping are:

Step Number	Description
Step 1	To begin with, draw the external (or internal) customer and supplier and list their requirements per month, e.g. in items, pieces, etc.
Step 2	Next step is to draw the basic processes in the sequencing order in the value stream by listing the process attributes, i.e. Cycle time, changeover time, quantity of operators, available working time, etc.
Step 3	Then, to draw queue times between processes, e.g. how many days or hours the components wait until the next process.
Step 4	The following step is to draw all communications that occur within the value stream, i.e. information flow.

Step 5	And finally, to draw push or pull icons to identify the type of workflow, i.e. physical flow.

When mapping, focus should be horizontal across systems and departments, from order to delivery, not vertical in the departmental silo.

b. Methods Applied for Designing Current State Map

Though the best field to apply VSM is RMG sector but it can be used in ship breaking, tanneries, food and agro-based industries etc. Since leather industries are earning are great deal of foreign currencies and a way better opportunity is being involved in this sector so the authors selected this field to apply VSM. A leading company Ventura Leatherware Mfy Bd Ltd has been selected to apply VSM and carry out the research perfectly.

The first step is to draw the current state value stream mapping to take a snapshot of how things are being done now. To collect data for VSM, core team was trained on how to collect data and exercise was carried out to ensure that core team was capable to collect date accurately. Material flow related data was collected by physically following the material from cutting to sewing to finishing [16].

Following are the steps how current steps are drawn:

I. First select the process of a product for which we want to design the VSM.
II. Collect the information; walk through and identify the main process (i.e. how many process boxes from store to delivery).
III. Note all data information.
IV. Mention value added and non-value-added works.
V. Fill the data box about non value added and value-added works.
VI. Mention non value added work- (Cycle Time, Actual Time, Defects, WIP, Transport, and Waiting).
VII. Calculate and make a process chart of value added and non-value added works.
VIII. Make a summary sheet with percentage of value added and non-value added.

c. Total Assembly, Preassembly and Cutting Cycle Times

For creating the current state map total assembly, preassembly and cutting cycle times have been calculated. Table 1 and 2 respectively show the whole current state finishing summary and preassembly section finishing summery.

Finishing Operation Cutting Cycle Time:

Table 1: Current State Finishing Summary

No. of Operations	**Finishing Operations Cycle Time (Sec)**	
Operation 1	Marking	108
Operation 2	Cutting and Punching	38
Operation 3	Small skiving	57
Operation 4	Gluing and Setting	157
Operation 5	Splitting in Big skiving machine and measure thickness	180
Total Cycle Time		180×5= 900 Sec

In Finishing section there are 05 of operations and the highest cycle time is 180 sec. So the total cycle time for preassembly is 180×05= 900 sec. For measuring cycle time take the highest cycle time and multiply it by total number of operations.

Table 2: Preassembly Section Finishing Summary

No. of Operations	**Preassembly Operations**	**Cycle Time (sec)**
Operation 01	Automated Gluing	199

Operation 02	Folding + Gluing & Front part gluing	212
Operation 03	Back part gluing	137
Operation 04	Handle gluing	176
Operation 05	Long + short shoulder gluing & Top + bottom gluing	199
Operation 06	Top and bottom joining	152
Operation 07	Net cut	162
Operation 08	Grinding	208
Operation 09	Coloring (top bombey, short shoulder, long shoulder)	163
Operation 10	Tenus	211
Operation 11	Coloring (front part trim, front part, back part, bottom)	162
Operation 12	Coloring (logo, puller, patch, Zipper)	133
Operation 13	Tenus/Primer	152
Operation 14	UA-400H (spare parts edge painting drying)	139
Operation 15	Logo sewing, loop sewing, long+short shoulder hardware setting, polythene set on hardware	197
Operation 16	Long+short shoulder side sewing, Glue sewing	170
Operation 17	Leather handle gluing, pipe setting and sewing	198
Operation 18	Logo sewing, hardware set on the pipe and sewing, short shoulder sewing	172
Operation 19	First UA-400H, Then Tenus (overlap)	220
Operation 20	UA-400H (spare parts edge painting drying) & 2nd time tenus, then color	182
Operation 21	sewing hardware on the top of handle (thread-30)	201
Operation 22	sewing on top of handle (thread 20)	149
Operation 23	Soldering excess thread from top of handle	226
Total Preassembly Cycle time		226×23= 5198 sec

In preassembly section there are 23 of operations and the highest cycle time is 226 sec. So the total cycle time for preassembly is 226×23= 5198 sec. For measuring cycle time take the highest cycle time and multiply it by total number of operations.

No. of Operations	Assembly Operations	Cycle Time (sec)
Operation 01	Handle (setting and sewing)	164
Operation 02	Cut excess thread from handle after sewing+ gluing on thread (front + back part)	188

Operation 03	Folding (liling panel and body part panel) & Adding hardware on the front part	120
Operation 04	Cutting excess thread and gluing	180
Operation 05	Sewing bottom part & zipper with the liling	181
Operation 06	Sewing zipper and top bombay	197
Operation 07	Sewing back part, zipper, puller	177
Operation 08	Top and zipper setting with the inner liling	187
Operation 09	Sewing (backpart & interliling) (top+zipper)	181
Operation 10	Bottom setting+sewing with front+back	201
Operation 11	Gausset setting on bag via 2sided tape- M1	129
Operation 12	High cost Gausset sewing machine	170
Operation 13	Machine- Foam for top bombey cut and sent from here	175
Operation 14	Upper top bombey + Zipper+ Liling sewing together	200
Operation 15	Final setting on the liling	143
Operation 16	Tighten top loop sewing thread manually, Glue on top loop, Join hardware & Top loop sewing	147
Operation 17	Gluing the inner sewing + top bombey sewing & Scissoring excess thread+taping on top bombay	198
Operation 18	Hammering the bag edges as per pattern	138
Operation 19	Hardware puller and stable set on zipper Long shoulder and short shoulder join	200
Operation 20	Cleaning 1& 2	168
Operation 21	FQC (finished good quality control of bag + final check)	118
Operation 22	Paper,silica gel, tissue, white board, foam into finished bag(attach tag pin and care card)	137
Operation 23	Wrapping on the puller and logo	175
Operation 24	Wrapped white board support under bag handle	120
Operation 25	Packing in carton and pallets	110
	Total Assembly Cycle Time (Sec)	201×27= 5427 sec

In assembly section there are 27 of operations (two of the operations have another work station) and the highest cycle time is 201 sec. So the total cycle time for assembly is 201×27= 5427 sec. For measuring cycle time take the highest cycle time and multiple it by total number of operations.

Fig. 1. Total Assembly, Preassembly and Cutting Cycle Times

d. Value Stream Mapping (VSM) for Current State Mapping

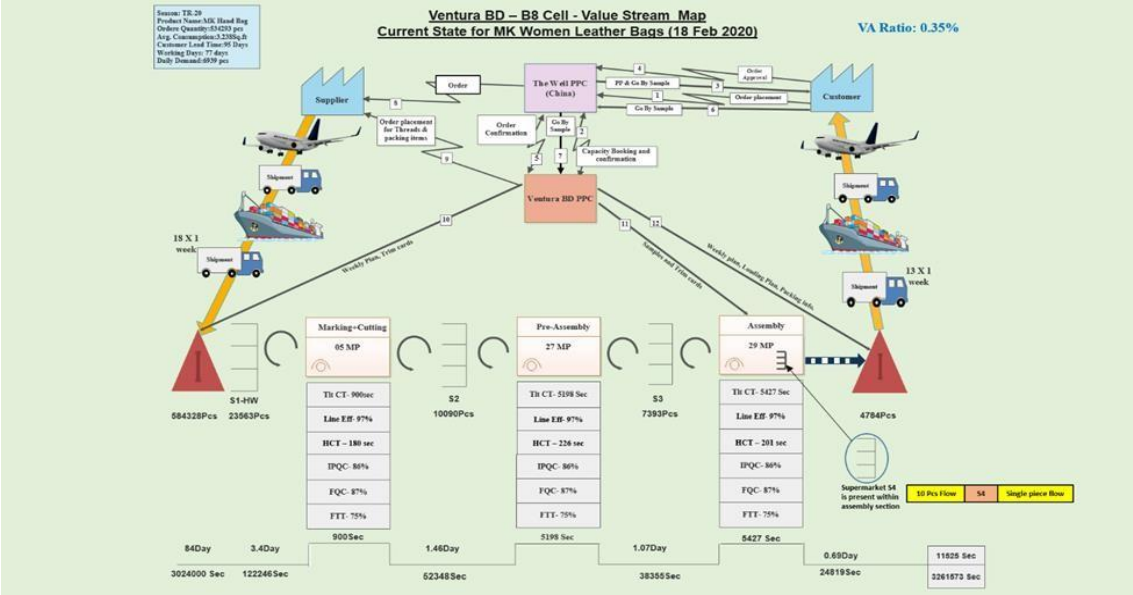


Fig. 2. Current VSM Map

The Value Added Ratio has been calculated as 0.35% from the current state map.

e. Improvement Areas of Current State

After a thorough investigation all over the current manufacturing process is from raw material collection to finished product delivery, following areas have been identified for further modification. Table 3 is showing the summary.

Table 3: Areas for Modification

Serial Number	Modification Area
01	Do not use laser for marking
02	Less Job-sharing practices
03	No multi-machine operation by one worker

04	No machine cleaning by operator
05	There is transportation and waiting time from cutting to pre-assembly
06	No visualization of defects
07	Measurement checking by normal measurement tape
08	Reverse Flow occurs in many processes
09	Excess movement and transportation occur in line
10	Line Balancing is not proper
11	QCO time is high
12	Excess workstations for quality check
13	Workstations are not ergonomically designed
14	Working in hot environment
15	Use of daylight is poor.

f. Future State Mapping and Implementation

Value stream mapping is important to identify non value adding tasks and times. Non value adding activities can be reduced by increased value adding activities through a future state mapping. All the activities which are to be implemented in future are given in the future state map.

g. Drawing Value Stream Mapping (VSM) for Future State Mapping

For designing a future state map, it is required to prepare and begin actively using an implementation plan that describes, on one page, how to achieve the future state plan. The proposed Future State VSM has been drawn by showing different types of Lean concept of kaizen, process merging, job sharing, multitasking, multi-machine operating and operation change, reduce transportation on the improvement areas of Current State VSM. The Production unit needs to work with the required rate of production and to maintain the quality and efficiency also.

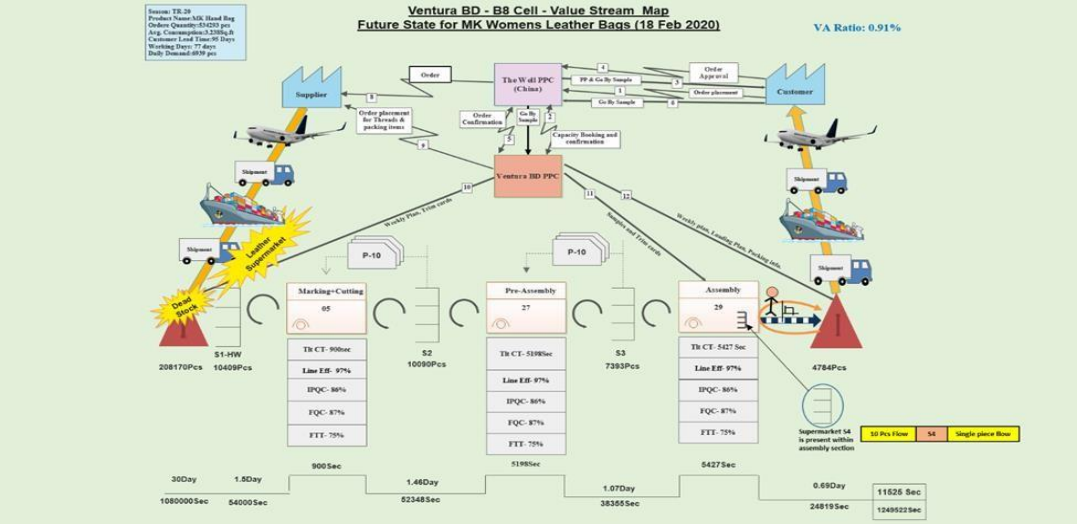


Fig. 3. Future VSM Map

The Value Added Ratio has been calculated as 0.91% from the future state map.

h. **Comparison between Current State and Future State Mappings**

Figure 3.4 shows the comparison between the current and future sate mappings.

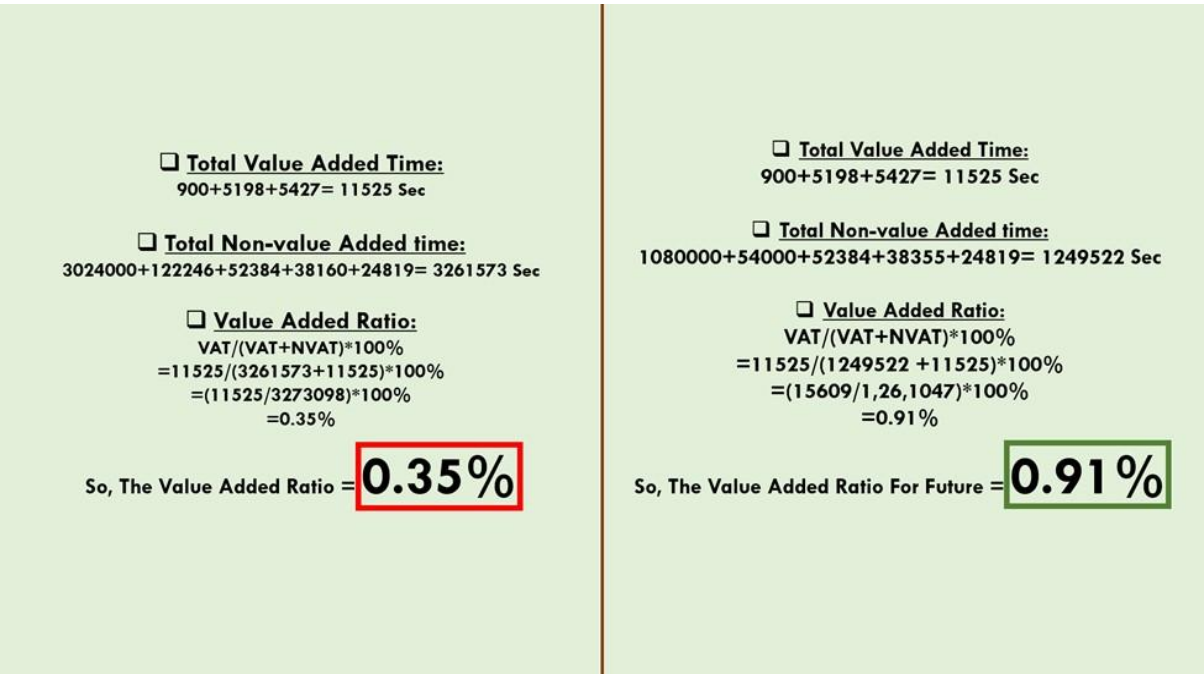


Fig. 4. Present and Future VSM Map Ratio

IV. RECOMMENDATIONS

The study was done with a limited scope. The future works may include super market pull between warehouse and cutting section. Implementation of JIT and Kanban systems can be implemented to keep WIP at minimum level.

The future works may also include Zero defect line where each operator will ensure proper quality at the source and finally to the delivery. Also creation of Standard Operating Procedure (SOP) for each section will help to maintain an accurate incentive policy.

V. CONCLUSION

Value Stream Mapping has been assessed in a leather manufacturing industry (Ventura Leatherware Mfy Bd Ltd). Based on the current state assessment, value-adding ratio was found at 0.35%. The lines were not properly balanced and lots of transportation trips also occurred in the current state. Firstly, wastes were identified from the current map. A huge number of stocks were found in the warehouse with deadstock and a leather supermarket was set in the warehouse. Besides, a large number of excess transportation trips were identified in preassembly and assembly line. Production Kanban and withdrawal Kanban were also suggested in preassembly and assembly section. Milk run system was implemented between assembly ends to finished good warehouse. Before the implementation of tools and techniques of lean manufacturing, supervisors were needed to be trained about the identification and elimination of waste. Operators were also needed to be trained about how to handling the garments and operating or stitching. It has started 10 pieces bundling system from cutting. Then follow up the line regularly and capacity study from time to time. Also, training on kaizen revealed how small changes make their work simple and improve visibility of off-standards and they were introduced to changing for better. After the implementation of teamwork, different kaizen blitz, process integration, job sharing, multi-machine operating, and balancing the task with the elimination of unnecessary activities it has achieved a value-adding ratio of 0.91%.

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