
Value stream mapping in glide manufacturing: A case study of Insti-Tools in Zimbabwe

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Abstract: Value Stream Mapping (VSM) is a tool for Lean Manufacturing which is used in mapping and identifying of all the specific actions required to eliminate the non-value activities manufacturing processes. Glides are essentially plastic components manufactured for supporting beds and sofas (legs). Due to globalisation and rapid advances in manufacturing technology, Small to Medium Enterprises (SMEs) involved in the manufacturing of Glides also need to move with the times and be able to adapt to new situations and VSM is the tool for that. This paper seeks to address the application of Value Stream Mapping to the production line for Glides with the aim of eliminating wastes and improving quality in the production of Glides. The current state map (CSM) was designed, analysed and suggestions were then given to improve the operational process while the future state map (FSM) was drawn for lean implementation.

Keywords: Value Stream Mapping, Lean Manufacturing

1. Introduction

The goal of every industry throughout the world is of increasing production and limiting waste production. However, production and waste management and control pose the biggest challenge in achieving cleaner production. Organisations need to be globally competitive by producing quality products cost efficiently and providing the goods to the customer timeously. The production processes should be such that they eliminate none value adding processes or activities within the production system and any processes which generate excess waste. Waste takes many forms and can be found at any time and in any place. It may be found hidden in policies, procedures, process and product designs, and in operations. Waste consumes resources but does not add any value to the product. According to Singh and Sharma (2009), waste is anything other than the minimum amount of equipment, effort, materials, parts, space and time that are essential to add value to the product. Lean manufacturing methods are being increasingly implemented around the world, with aims to eliminate waste and inefficiency from the manufacturing process, leading to lower costs and greater competitiveness for manufacturers. The aim of this research

paper is to apply value stream mapping (VSM) for enabling leanness in the manufacturing of glides at Insti-Tools a division of Insti Holdings which belongs to the Harare Institute of Technology (HIT) in Zimbabwe.

It is hoped that through value stream mapping, the researchers will be able to map the activities of the firm, identifying opportunities for improvement and then undertake with the firm an improvement programme.

2. Aim

To improve value addition in the Glide production process by assessing all the information and the activities in the process and eliminating redundant and unwanted processes.

3. Objectives

- Reduction of Inventory in Stock for stock coming in from the supplier.
- Reduction of Inventory after Discharge.
- Reduction of Lead time to Inspection.

- Reduction of lead time to Trimming.

4. Methodology

The methodology used was a case study of Insti-Tools, a company in which is involved in the production of glides for SMEs who manufacture household furniture. The process of application of the VSM was thoroughly analysed.

5. Literature Review

Value stream mapping is a lean manufacturing technique used to analyze and design the flow of materials and information required to bring a product or service to a consumer. At Toyota, where the technique originated, it is known as "material and information flow mapping". Rother and Mike (2009)

Value stream mapping is a Toyota lean manufacturing visualization tool for recording all the processes that are required to bring a product to market.

A value stream map is typically created as a one-page flow chart depicting the current production path or design path of a product from the customer's request to delivery. Tapping and Shuker, (2003). An important goal of value stream mapping is to identify processes that do not provide value so they can be improved. In lean production, value can be thought of as anything the customer is willing to pay for. Processes that do not provide value are called waste. Value stream maps document the current state of the value stream as well as the future state of the value stream and defines any gaps between the two. Arbulu et al (2003)

Value stream mapping is often used to discover processes that could be streamlined and areas of waste that could be eliminated in keeping with Toyota's kaizen philosophy. The philosophy, which emphasizes continuous improvement, has been adopted by many other industries outside manufacturing including healthcare and software development.

There are three types of operation that are undertaken in a manufacturing system according to Rother et al (2003).

These can be categorized into:

- Non-value adding (NVA);
- Necessary but non-value adding (NNVA); and
- Value-adding (VA).

The first of these is pure waste and involves unnecessary actions which should be eliminated completely. Examples would include waiting time, stacking intermediate products and double handling. Necessary but non-value adding operations may be wasteful but are necessary under the current operating procedures. Examples would include: walking long distances to pick up parts; unpacking deliveries;

and transferring a tool from one hand to another. In order to eliminate these types of operation it would be necessary to make major changes to the operating system such as creating a new layout or arranging for suppliers to deliver unpacked goods. Such change may not be possible immediately. Hines and Rich (1997)

Value-adding operations involve the conversion or processing of raw materials or semi-finished products through the use of manual labour. This would involve activities such as: sub-assembly of parts, forging raw materials and painting body work.

The enterprises that have successfully implemented lean production prove that VSM can eliminate 50% waste process/steps, shorten cycle time by 30%, reduce variation from 30% to 5% and improve product quality greatly. Chen and Meng (2010). VSM is now utilized throughout the world, in many businesses to strategically plan and it is the starting point to any lean transformation and implementation. Womack and Jones (1998, 2005), Daniel. T. Jones (2006) are some of the fairly recent researchers who studied the implementation of VSM successfully.

Goriwondo et al (2011) were able to use VSM for waste reduction in manufacturing. They used a case study for bread manufacturing in Zimbabwe. The VSM tool was used to identify and reduce defects by 20%, unnecessary inventory by 18% and motion by 37%.

6. Company Profile

The Ministry of Small to Medium enterprise runs a machineshop workshop which is situated at Harare institute of Technology, Ganges Rd, Belvedere, Harare. The machineshop was established in 2005 and produces various tools and equipment such as solar driers, incubators, shafts, moulds for various plastic products.

The SME workshop also runs an Injection moulding machine which produces various plastic products such as glides for sofa and bed manufacturers and ferrules for tables and chairs and supplies these to SMEs and companies which produce furniture and kitchen tables and chairs.

7. Current State Map

The Current State Map (CSM) in fig 1 below, shows the current activities involved in the manufacturing process of Glides. The CSM shows the production process of glides from the acquisition of raw materials, delivery to the production centre, the processes involved in the production of glides and their cycle times right up to delivery and shipment to the customers.

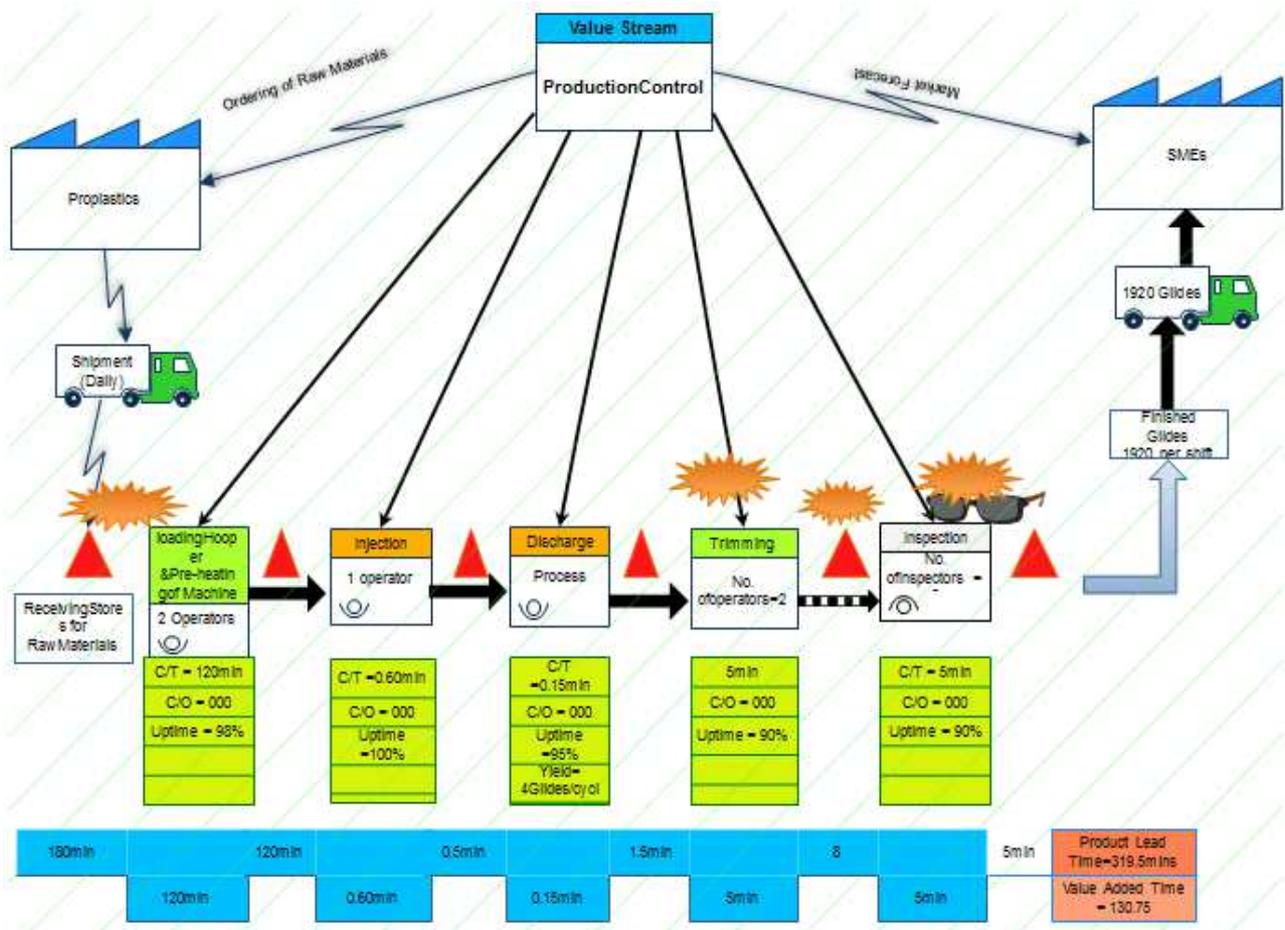


Fig 1. Current State Map

7.1. Current State Map

The data for the Current State Map was collected in consultation with personnel from the stores, operators of the Injection moulding machine and the current supervisor. The information provided was for the single injection moulding machine in the workshop which runs for 8 hours per day for a single shift with a single operator. The average unit production time needed to meet customer demand, which is called the Takt time was calculated as:

$$\text{Takt time} = \frac{\text{Available working Time/shift}}{\text{Customer per shift}} = \frac{8 \times 60 \text{ mins}}{2600} = 0.18 \text{ min}$$

From the above calculation it means that 0.18mins is the rate at which the injection moulding machine must produce a Glide to satisfy its customer demand.

Demand comes from the customers through telephoning the planning department at the SMEs workshop. The planning department sends its requirement to different suppliers manually. Currently the workshop keeps raw material inventory up to 3 days in their store, material moves from raw material store to finished items store through a number of processes/ machines. Raw material in the form of plastic granules is fed into the loading hopper and it is preheated. Once heated it is then put through the injection moulding where the heated and melted plastic is moulded into

components. From here the plastic components are then discharged and then trimmed to remove excess material. Inspection is then done to see if the products are of quality. The production lead time and value-added time were noted on the current state map.

Inventory storage points in between the stages are shown in triangles. The timeline at the bottom of the current state map has two components. The first component is the production lead time and second component is value-added time or processing time. Value-added time is calculated by adding the processing time for each process in the value stream. This current state map provides a picture of existing positions and guide about the gap areas. It helps to visualize how things would work when some improvements/changes are incorporated. The gap area in the existing state results in a road map for improvement.

Of major concerns were the following:

- a) There is a lot of inventory in the receiving store. Also the raw materials were spending a lot of time in the Receiving Store as after delivery was done, receiving had to be done and then unpacked again. Raw materials were spending from as little as 3hours to 3 days.
- b) The trimming process employs two operators who use old hacksaw blades which are no longer very sharp and they require constant manual sharpening thus the trimming process takes time.

- c) After trimming, is accumulation of inventory as a lot of components spend time at this station before moving to the next.
- d) The Inspection process is done by one employee as well

this means that components will spend more time again at this station before being inspected leading to the accumulation of inventory.

Table 1. Activity Classification for Processes.

Process	Process Time (minutes)			Comments
	VA	NVA	NNVA	
Receiving	60	120		Non Values time is due to unloading and packing of raw material
Loading and Preheating	60	60		Heating and WIP are NVA
Injection	0.6	0.2		Delays due to machine stoppages and breakdowns
Discharge	0,15			
Trimming	5		1	Delays due to sharpening of blades
Inspection	5	2		Delays due to accumulation of Inventory

Key: VA-Value Adding Time; NVA-Non-Value Adding; NNVA-Necessary Non-Value Adding Time

$$\%NVA = \frac{\text{Total NVA}}{\text{Total Time}} = \frac{319.5}{319.5 + 136.75} = 70.96\%$$

70.96% is the percentage for Non Value Adding Time. This means that there are a lot of activities involved in the manufacturing processing of Glides that is unnecessary.

Fig 2 below shows the analysis of percentage value added time ratio. It shows that more time is spent doing non-value adding activities. These are then the focus of elimination.

Percentage VA vs NVA

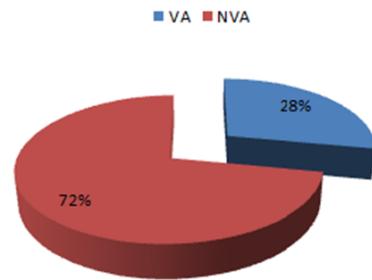


Fig 2. Analysis of percentage value added time ratio.

7.2. Future State Map

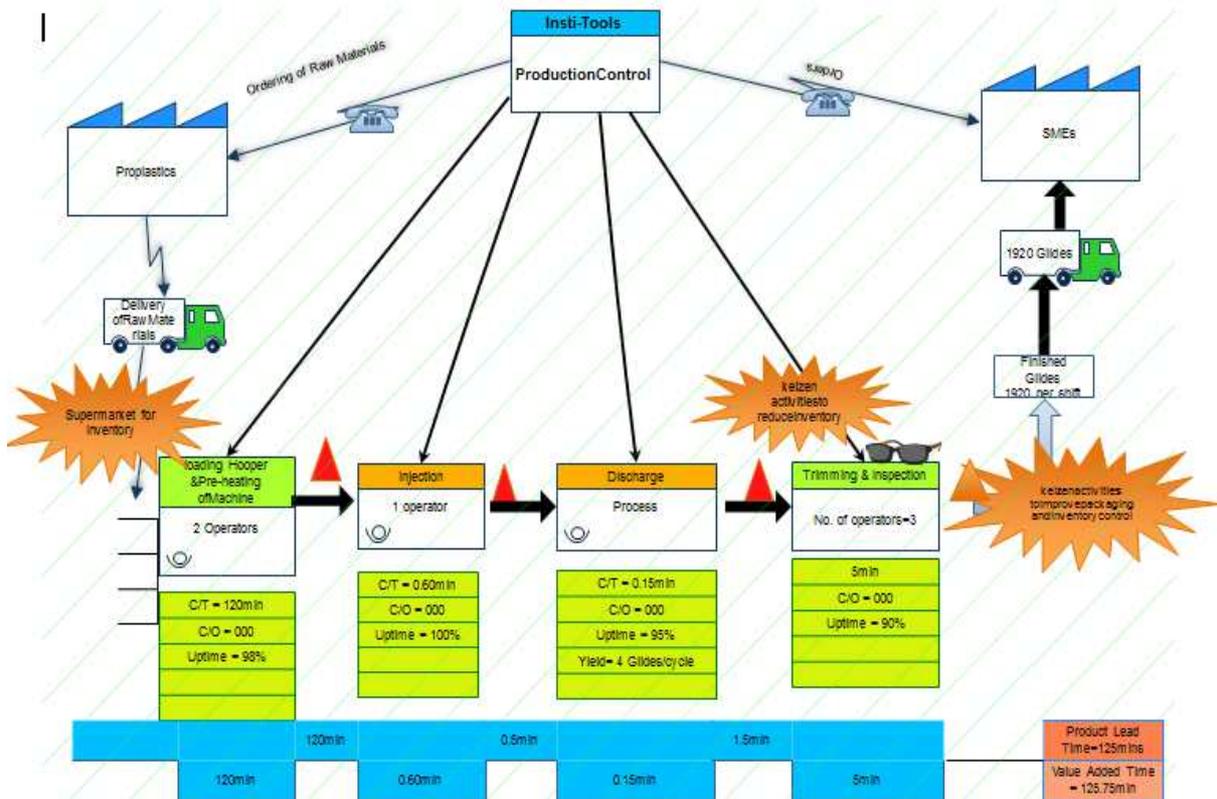


Fig 3. Future State Map

Table 2. Comparison of Activities in CSM and FSM.

Process	Initial Time Taken	Final Time Taken	Comment
Receiving ,Inventory	3hrs	0	Supermarket Inventory was introduced
Loading Hooper and Pre Heating	2hrs	2hrs	No change
Injection Moulding	0.6min	0.6 min	No change
Discharge	0.15 min	0.15min	No change
Trimming, Inventory and Inspection.	18min	5 min	Initially trimming and inspection were separate stations and there was inventory now they have been combined into one work station and there is no inventory

The future state map which was drawn was based on the assumption that all the issues in the problematic areas will be completely resolved. However, in practice, the entire problem may not be completely resolved.

Table 3. Comparison of Product Lead Time and Value Added time In CSM and VSM

	CSM	FSM
Product Lead Time	319.5mins	125 mins
Value Added Time	130,75mins	125,75mins

It can be seen from the Table 3 that Product Lead Time has been reduced by 194.5 mins and Value Added Time by 5mins. High demand at SMEs is easily achievable with reduction in both WIP and finished goods inventory in the supply chain. All these proposed changes will lead to a significant cost reduction at SMEs workshop, and hence it will also help in reducing overall costs in the supply chain. Now the SMEs workshop will be in a position to deliver at an hourly rate, and high quality glides at lower cost, which is also the requirement of a lean and responsive environment.

The lead Time was reduced by 60.88%, there was no reduction in WIP, Processing time was reduced by 4% and there was a reduction in manpower of 25%.

8. Conclusion

Lean production means continuous improvement, we must keep on changing future state into current state that will not end during our life. VSM have been proven to be a greatly useful tool to eliminate some waste in a cycle and find there are more waste for you to eliminate in next cycle, during which lean becomes a habit or culture. The CSM helped identify areas of potential improvement while the FSM suggested ways to reduce waste and increase throughput. The lead Time was reduced by 60.88%, there was no reduction in WIP, Processing time was reduced by 4% and there was a reduction in manpower of 25%.

Limitations and Future Research Direction

This research was limited to a single injection moulding machine running a shift of eight hours a day run by the

Ministry of Small to Medium enterprise workshop. It was also limited to the production of a single product, the glides used as feet of furniture such as sofas and beds. In order to meet customer demand, it was recommended that the SMEs workshop introduce a night shift so that at least the machine would be operated continuously without stopping thereby also cutting on the two or so hours for start-up and pre-heating of the injection moulding machine. In future, the VSM can be developed for other different product lines that are manufactured by the SMEs.

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