# Improvement of productivity in a manufacturing industry by Using lean manufacturing technique

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**Abstract: The present work focused on the application of lean manufacturing principles and lean technique in order to enhance productivity and customer value and at the same time minimizing the wastes to reduce the cost of the product. Lean manufacturing Concepts is one of the most effective methodologies which are a systematic approach to identifying and eliminating waste through continuous improvement by the flow of the product. This study was carried out at a small scale glass industry. This study is mainly focused on the application of lean manufacturing tools like KAIZEN Philosophy (Continuous improvement) and Value Stream Mapping (VSM) of quality management approaches used by the Indian manufacturing industry in order to survive in the challenging Global market. Kaizen is describes as continuously encouraging and implementing small improvements involving every employees right from low level management employee to bottom level workers. It is the method of continuous improvement in small efforts that make the process more efficient, effective, under control and adaptable. Kaizen emphasizes human efforts, moral, communication, training, teamwork involvement, and self discipline-a commonsense, low-cost approach to improvement. It mainly focuses on simplification by breaking down difficult processes into their sub-processes in glass manufacturing industry and then improving them. Kaizen is used as a lean tool for elimination of wastes and finding root causes of inefficiencies in glass manufacturing industry.**

**Value Stream Mapping (VSM) is a lean management tool that is used to map the current state of a production system and used to identify the sources of the wastes and inefficiencies and try to improving the flow of material by applying lean tools. The future state map is then designed after applying lean tools and a detailed simulation model is developed. This pictorial representation of material as well as information flow fasten the process of lean implementation by helping to identify the value-adding steps in a value stream and eliminating the non-value adding steps, or wastes (Muda). As a result, some improvements were made in productivity, quality and lead time and it also focus on lowering down the inventory levels.**

**Keywords: - lean manufacturing, kaizen, value stream mapping, improvement, wastes, productivity**

## I. INTRODUCTION

In production plants across the world, lean manufacturing techniques are being used to meet increasing demands placed on manufacturers. The main aim of the manufacturers is to increase the productivity, reduce cost and maximize customer value and to decrease waste at the same time. This practice is basically called “Lean”. Lean manufacturing techniques is often seen as a set of tools that decrease the total cost and improve the quality of manufactured products. As the name implies, lean is focused at cutting “fat” from production activities i.e. Lean manufacturing is the systematic elimination of waste. The basic philosophy of lean management system mainly targets waste elimination in every aspect of the production process. Although lean manufacturing is a relatively new term, many of the tools used in lean can be traced back to Fredrick Taylor and the Gilberts at the turn of the 20th century. Toyota is credited with being the birthplace of lean production (Shah & Ward 2007). Figure 1.1, provides the time line of the development in the management philosophy in business as a whole.

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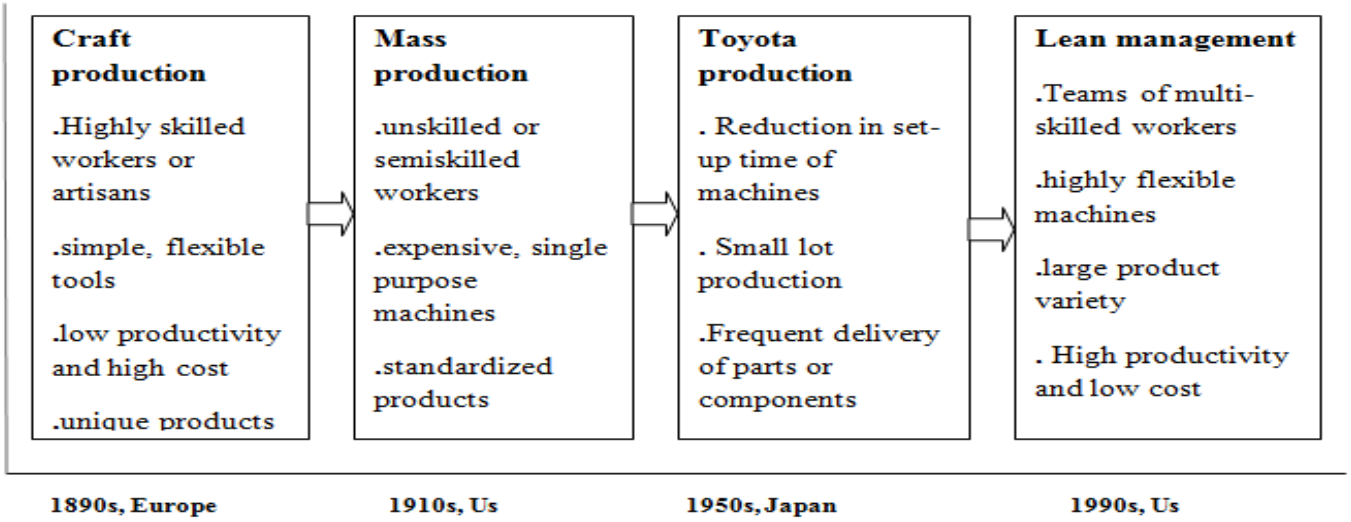


**Fig. 1.1 History of production process, showing the manufacturing paradigms that started from craft production followed by mass production and now lean production.**

The concept of transfer lines or assembly lines developed by Henry Ford revolutionized the automotive industry on mass production concepts. This was subsequently transferred to the other segments. After World War II, Toyota and other Japanese organizations suffered from the effects of the war. Their resources were strained and Japan needed to rebuild its industries. After the first oil shock in late 1973, the Toyota production system attracted the attention of Japanese industries. Facing unprecedented cost push inflation, most of the Japanese companies, except Toyota, faced losses. Toyota however showed high level profit. It was during this period that the Toyota production system (TPS) became popular in the manufacturing sectors, as a means of overcoming the depression caused by the oil shock.

Small lot production, frequent delivery of parts and components, leveling of production volume, reduction in set up time of dies, which were practiced under this system through multi–skill training of workers and concentrated efforts to improve the quality of products, enabled the Japanese to recover from the prolonged recession. This philosophy, along with an effort to induce flexibility in the system and with effective application of robots, manipulators, NC machine tools and machining centers gave the Japanese a worldwide competitive edge, particularly in automobile and consumer electronics industries. The Japanese products were cheaper and of higher quality when compared to their western counterparts in the American and the European market. The Japanese companies achieved higher productivity and better quality using limited resources.

Value stream mapping is a lean manufacturing concepts used to analyze the flow of materials and information currently required to bring a product or service to a customer. The concept was initially originated at Toyota, where it is known as "material and information flow mapping". It can be used in any method that needs an improvement. This pictorial representation of material as well as information flow fasten the process of lean implementation by helping to identify the value-adding steps in a value stream and eliminating the non-value adding steps, or wastes.

Implementations of VSM are done in the following steps:-

1. Identify the target product, product family, or service
2. Sketch a current state value stream map, which shows the current steps delays, and information flows required to deliver the target product or service. This may be a production flow (from raw materials to consumer) or a design flow (from ideas to launch). There are 'standard' symbols tools representing supply chain entities.
3. Judge the current state value stream map in terms of creating flow by eliminating waste.
4. Sketch a future state value stream map.
5. Work toward the future state condition.

## II. RESEARCH METHODOLOGY

In order to collect the required amount of information and observing the different manufacturing processes performed in manufacturing shop floor site visits were conducted. There are various techniques from which Data can be collected from the industry. Data were collected in each site visit in order to capture the process flow and identify the production life cycle in working shift. To collect data, the researcher will go through manufacturing facility and recognized different manufacturing processed that are involved in producing a final products right from raw materials (receiving of the raw materials) to the finished goods (shipment of the final product), inventory/storage area will be observed between different manufacturing operations and consequently the no. of operators required in different manufacturing operations will be noted down and also calculate the cycle time; change over time used

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between each operation. Various tools like pencils, paper, eraser and stopwatch were used by the researcher for the data collection in the industry. One more method was adopted for the data collection in the industry was structured interviews was performed with manufacturing & production team, engineers, supply chain management team, purchasing team, shipping team and company workers.

**The following process flow diagram was observed in the current state**

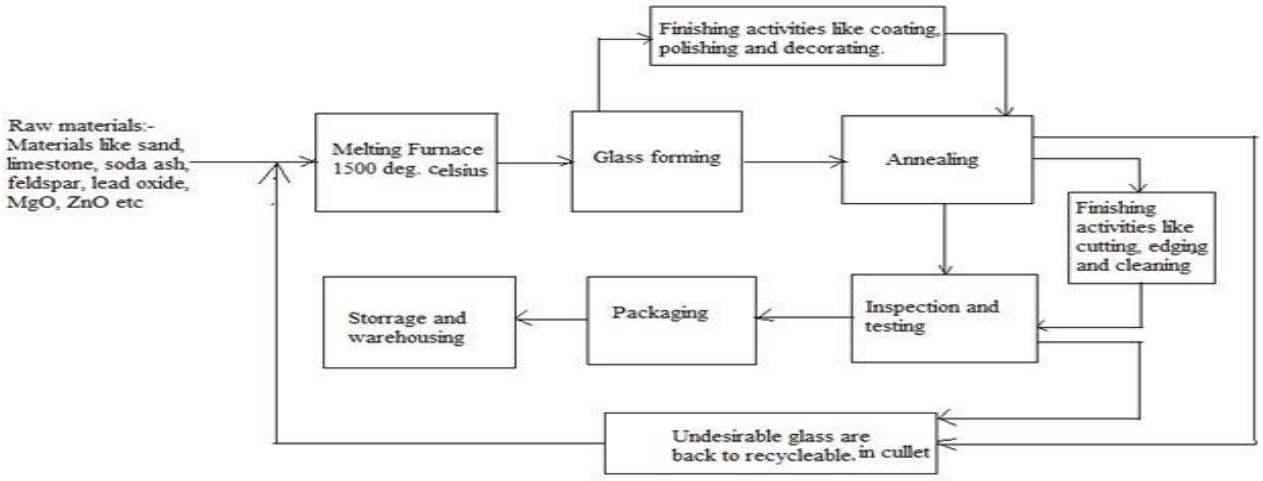
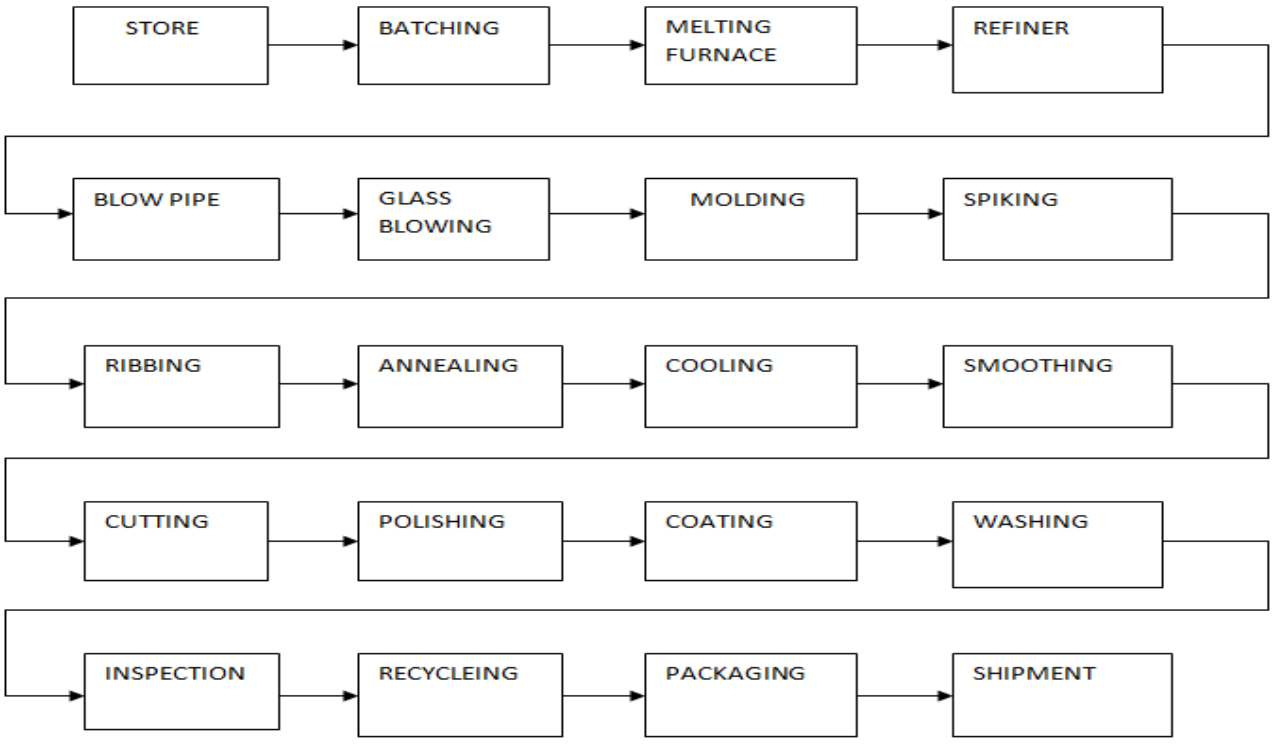



**Fig 1: Process Flow Diagram of glass industry**

The process flow diagram of the crystal ware glass is:




| Different Shifts timing | Schedule of working hours |
|---|---|
| Shift 1:- 6:00 am- 2:00 pm | Breakfast break for 1 hours and 30mins tea break |
| Shift 2:- 2:00 pm- 10:00 pm | Twice tea break for 30mins |
| Shift 3:- 10:00 pm- 6:00 am | Twice tea break for 30mins |

No. of working days in a month=30

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No. of working shifts per day=3
Total available time for production=1440mins
Total lunch break in each shifts=210mins
Net available time for production per day=1230mins
Actual production of products per day=14 tons/month (88 min per ton)
Customer demand per annum= 5000 tpa

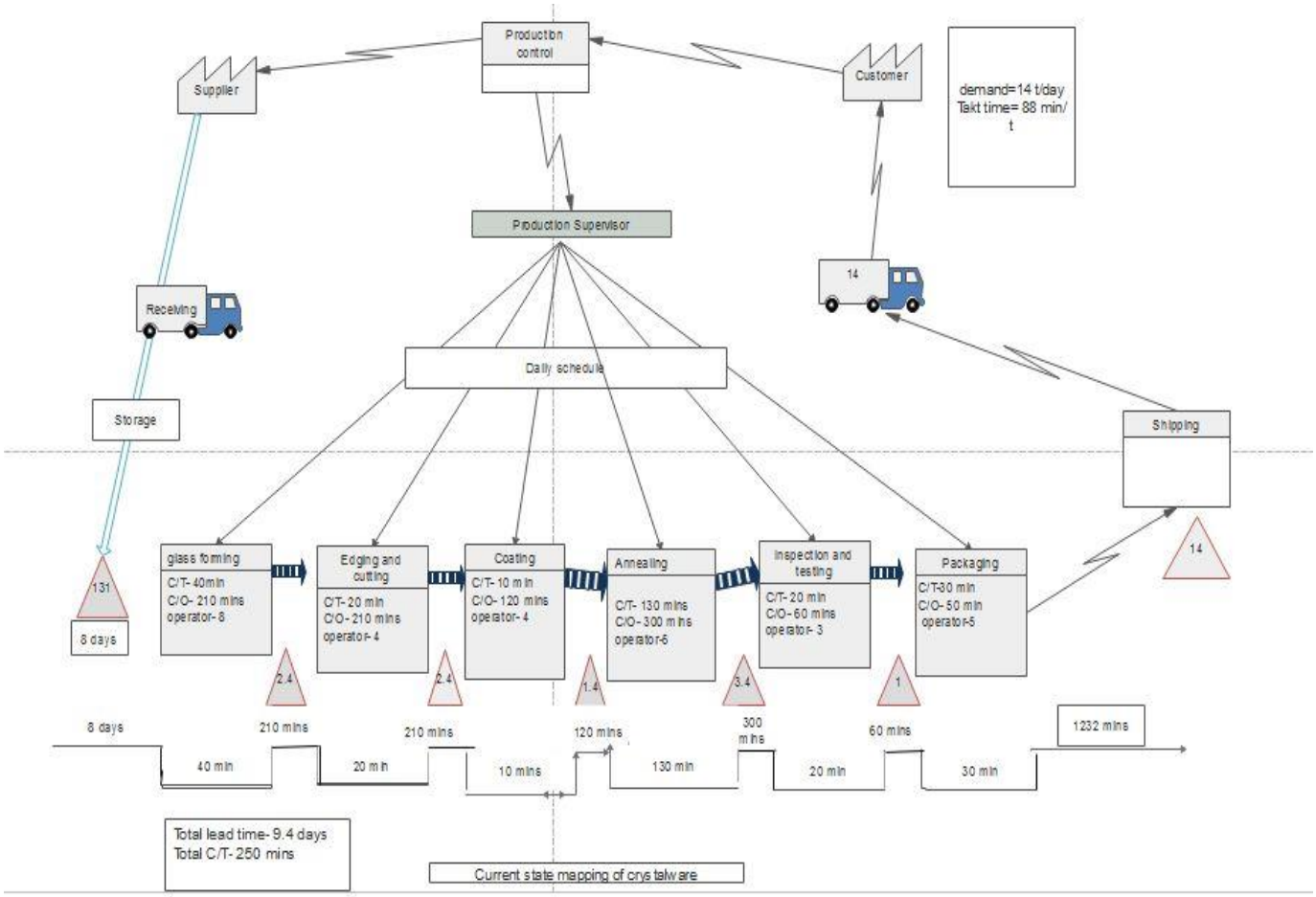
**Takt time calculation:-**

Takt time calculation= Net available time for production per day/ customer demand per day

= 1230/14

= 88 mins/ton

**Current state mapping for the production of the glass**




## III. FUTURE STATE MAP

While creating current state map the target areas for improvement is highlighted to create future state map. Looking at the current state map for the glass industry several things stand out: a) large inventories b) large gap between value added time (4.2 hours)and production lead time (9.4 days).in our current state map we point out large inventory and lead time of the production process and try to reduce non value added time and developed the future state map. It is the time for the senior manager and team members to list out the non-value added activities and try to eliminate the wastes by using various lean tools and techniques, and list out all the improvement ideas and actions required to draw the Future state map of the production line. In order to design future state map, the current state map is analyzed using the strategy given by Rother and Shook.

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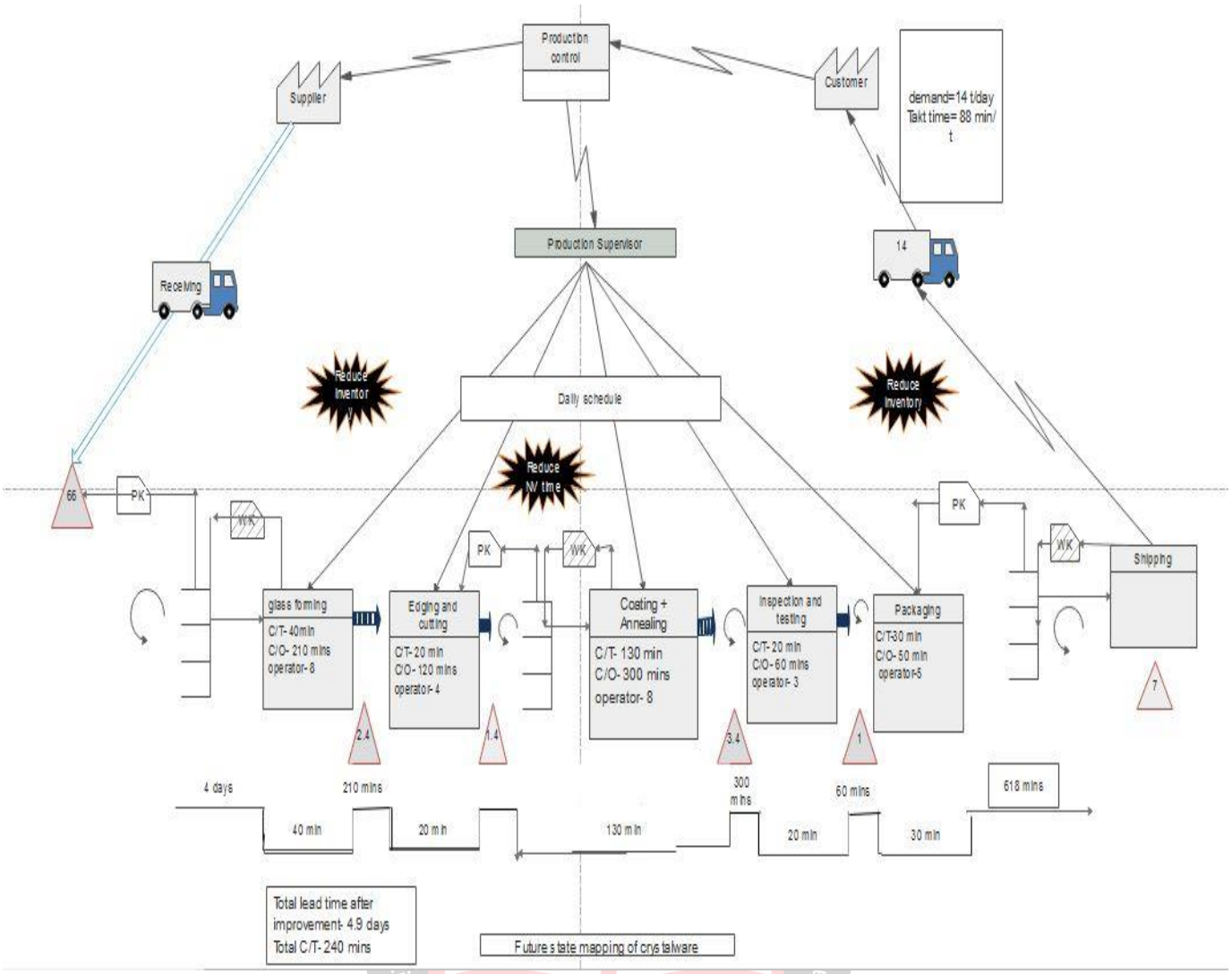
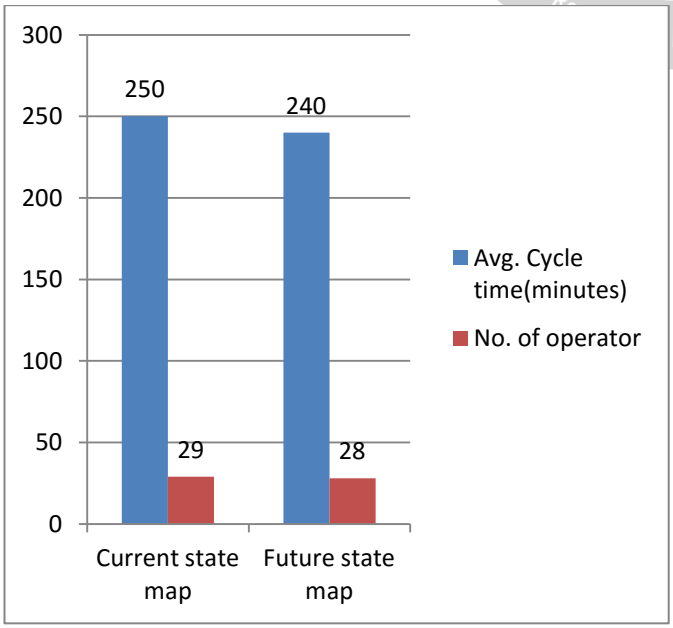
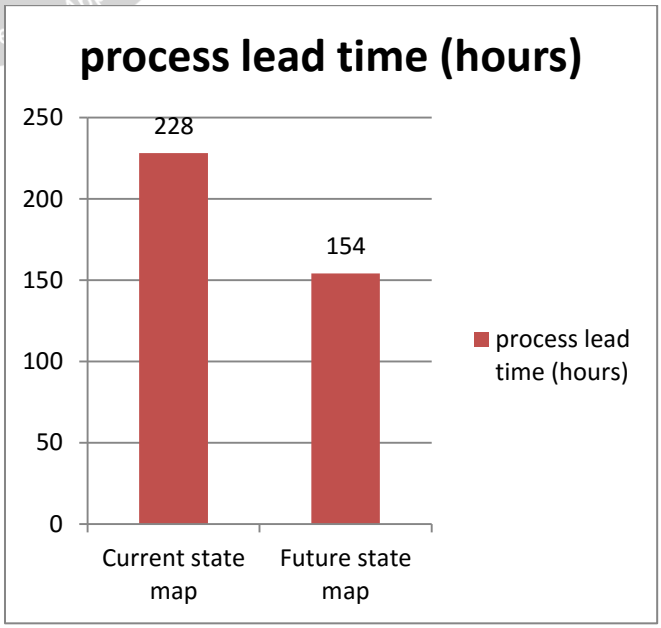



**Future state map of crystal ware products**

**Results and discussion**




**Average cycle time and no. of operator for Current state and future state map**




**Process lead time of Current state and future state map**

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## IV. CONCLUSION

After referring many papers we get to know that Value stream mapping (VSM) is the most essential lean technique which is used in the production industry. This paper describes the value stream mapping which is used for visualizing the flow of material and gathering the information and representing it graphically right from the customer end till the end process is fulfilled. The available thesis is presented as Methodology of VSM, implementation procedure of VSM, VSM Symbols and VSM Measures, current state to future state map, VSM Tools and some previous work on VSM. The main aim of this research is to reduce the cycle time and to eliminate the non value added activities that are involved during the production of products. The primary goal of value stream mapping is to eliminate the non value added activities i.e. the wastes produced in the industry. Current state map is drawn to map the current state of a production system and used to identify the sources of Waste and try to improving the flow of material by applying lean tools and future state map is designed after applying lean tools. This visual representation of material as well as information flow fasten the process of lean implementation by helping to identify the value-adding steps in a value stream and eliminating the non-value adding steps, or wastes. As a result, some improvements were made in productivity, cycle time and lead time. The philosophy of value stream mapping is used to spot the bottlenecks in current state map and remove the bottleneck by drawing future state map by the introduction of supermarket at various location, kanban signal system and kaizen burst. The cycle time of crystal ware products using current state map is 250 minutes and process lead time is 228 hours. When removing bottlenecks from current state map and drawing future state map then cycle time is 240 minutes and process lead time is 154 hours. Thus, there is a decrease in cycle time of products by 10 minutes due to the combining of two processes coating and annealing in a single job floor. The process lead time decreased by 32%. The results indicate that industry should implement production kanban, pull system and supermarket wherever possible according to the customer need.

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