

Improvement of Productivity in Screw Blanks Manufacturing Industry

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ABSTRACT: Lean means creating more value for customers with fewer resources which has become the current trend for management of products and services. In the present scenario, it is necessary to be in track more efficiently and effectively to challenge the competitive market. Hence it is inevitable to introduce lean techniques which increases the productivity and reduces the lead time that ultimately results in customer satisfaction. Companies are able to respond to changing customer desires with high variety, high quality, low cost, and with very fast throughput times. Also, information management becomes much simpler and more accurate. The paper presents a case study of a manufacturing firm where the lead time is higher than necessary and hence customer satisfaction is low. VSM is drawn to check the present and future situation of production. 5S is introduced and SOP is used to standardize the production. Kanban is introduced with part number and part description to all work stations. Ranked Position Weight method in Line balancing is used to reduce the transportation time of products from one station to other.

KEYWORDS: VSM, continuous improvement, 5S, Kanban, bottle neck analysis, RPW

I. INTRODUCTION

Lean manufacturing is a business model and collection of tactical methods that emphasize eliminating non-value added activities (waste) while delivering quality products on time at least cost with greater efficiency. The primary goal of LM was to reduce the cost of product and improve productivity by eliminating wastes or non-value added activities [1]. As per Toyota Production system, Lean Manufacturing can be defined as: "A systematic approach to identifying and eliminating waste (non-value-added activities) through continuous improvement by making the product at the pull of the customer in pursuit of perfection." Waste can be eliminated and lean development can be achieved by various tools such as 5S, Kanban, Kaizen, Value stream mapping and standardized work. Lean philosophy helps the manufacturing sector to reduce the lead time, to increase the customer satisfaction and to reduce waste. Hence lean can be explained as a culture to be followed rather than set of tools to be developed and trained.

II. LITERATURE REVIEW

Lean production can be described at different levels of abstraction: it can be defined as a philosophy, as a set of principles and as bundles of practices. Womack and Jones (1996) define Lean production as a business and production philosophy that shortens the time between order placement and product delivery by eliminating waste from the product's value-stream [2]. Elimination of variable aids for reducing the overall cycle time is a core objective of Lean [3]. Reduction of waste can be attained by introducing the lean tools in the industry. Specific set of tools used in Lean Manufacturing play vital role in any productivity improvement event as they have a very high rate of success & also long lasting improved effect [4]. Lead time reduction in a value chain arises from reducing lead times such as operating times, idle times and transportation times [5]. Analysis of processing can be done by 5S practice. The 5S is the methodology of creation and maintaining well organized, clean, high effective and high quality workplace. Its result is the effective organization of the gemba, reduction of work's environment, elimination of losses connected with failures

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and breaks, improvement of the quality and safety of work [6]. An Inspection process has been executed on the basis of 5S check lists and the results analyzed to confirm great changes like increasing efficiency in production and quality, improves safety [7]. Another important area of analysis of Lean Manufacturing is Value Stream Mapping (VSM). It creates a common language for production processes, which facilitates more thoughtful decisions to improve the value stream [8]. Standard Work is the sequential method for defining the best practices and ensuring that every operator is strictly following them to endow the value to the customers [9]. Standard work procedure is followed to make lean implementation successful. The Kanban system is based on a customer of a part pulling the part from the supplier of that part [10]. Kanban is used as a document demanding product from the previous process.

III METHODOLOGY

Case study represents the scenario of a screw blanks industry where the application of lean tools is unavoidable due to the process lag. The methodology of the process has been flowcharted below (Fig 1).

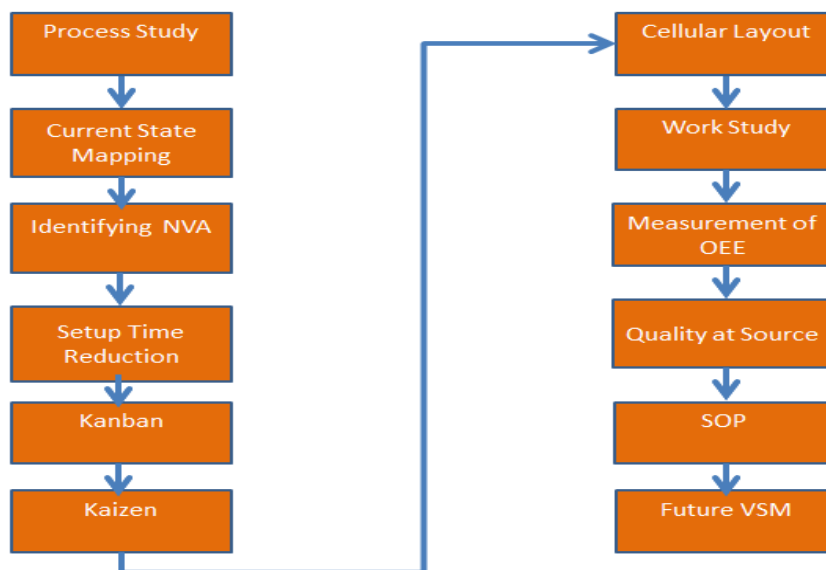


Fig: 1 Methodology

The product is screw blank which is used for extruding purposes. 2D and 3D diagram of screw blank is shown below.

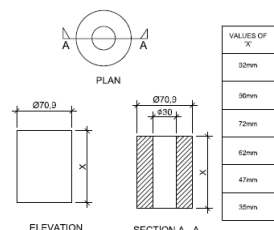


Fig: 2 AutoCAD drawing of Screw blank

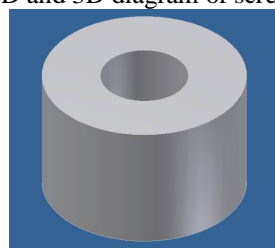


Fig: 3 3D drawing of screw blank

IV. ELEMENT PROCESS FLOW

Sequence of actions to be followed in the industry is given as the flow chart (Fig 2). Raw materials are received from the supplier as well as made in-house. Raw materials from supplier undergo less processing when compared to in-house materials.

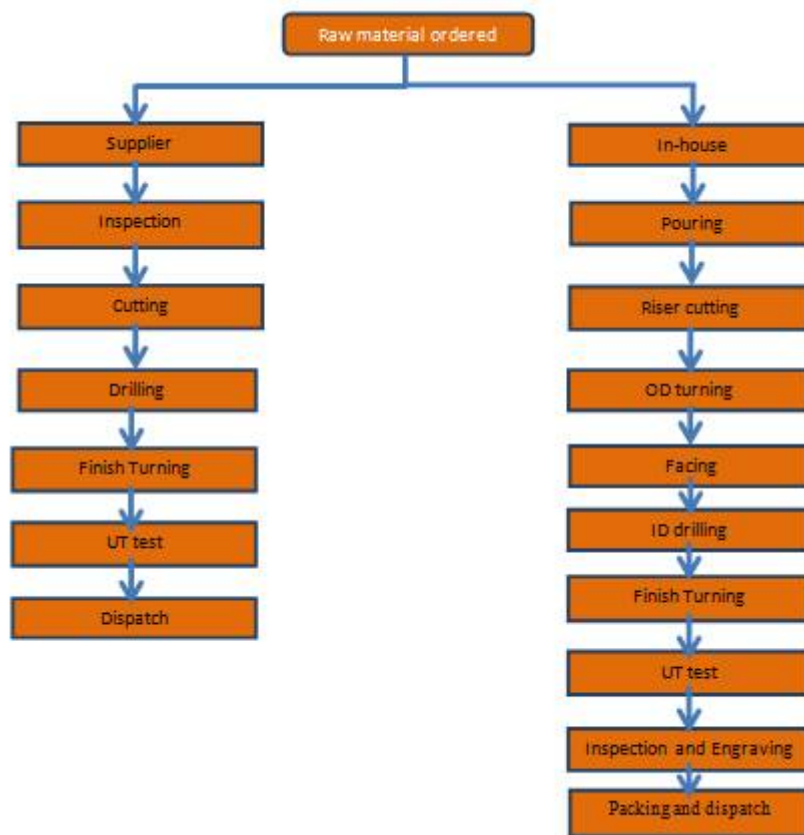


Figure: 2 Process Flow

V. CURRENT VALUE STREAM MAPPING

VSM provide optimum value to the customer through a complete value creation process with minimum waste in design, build and sustain [9]. With current state mapping and lean tools, future state mapping can be drawn which helps in increase of efficiency(Fig 3). The lean transformation with VSM should provide growth with improved margins, growth with minimal capital and growth without more employees.

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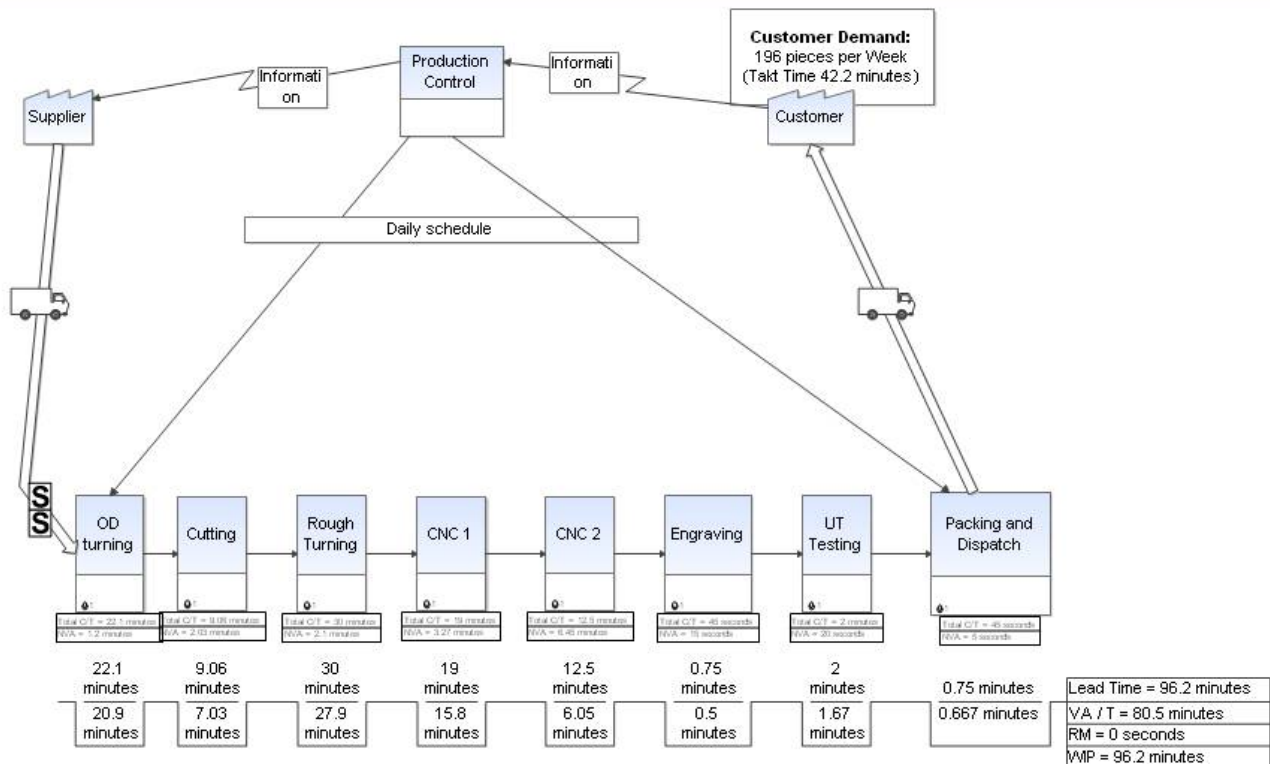


Figure: 3 Current VSM

Table: 1 Observations of current VSM

1	Customer's Demand	120/week
2	Working Days	6 days/week
3	Customer's takt time	8036 sec/ batch
4	Cycle time	10010 sec/batch
5	Number of operators	13

Table: 2 Time for each operations

No:	Operations	Process Time (sec)	Setup Time(sec)
1	OD turning	1254	72
2	Cutting	422	122
3	Facing	1674	126
4	Drilling	948	192
5	Finish Turning	363	360
6	UT test	100	20
7	Engraving	30	15
9	Packing	15	5

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VI 5S

5S is a reference to five Japanese works which described standardized clean up[10]. 5S was implemented in the industry and the time between **before and after 5S** was recorded. It showed significant difference which helped in setup time reduction. One example of 5S is shown below(Fig 4). Hence it is clear that with 5S cleanliness and order can be improved.



Figure 4: 5S

VII LINE BALANCING METHODOLOGY

The main objective of the line balancing in this case study is to effectively use man power, without much compromise in machine utilization and output. Workplace layout was studied to reduce the transportation time between stations. **Ranked Position Weight** method is used to reduce the number of workstations. Workstations of 8 were reduced to 5 with the help of RPW. Lead time was reduced to 9500 seconds just by reducing transportation waste.

VIII. WORK STANDARDIZATION

Standardization of the operations is carried out (Fig 6). Three cycles are performed for time study. Improvement ideas and kaizen were identified and implemented during the process. Reduction of about 500 seconds in cycle time and 1800 seconds in setup time is achieved through standardization. Standard operating procedure is then drafted and is validated. A copy of the standard operating procedure is placed on all machines of the line for easy access of the operator.

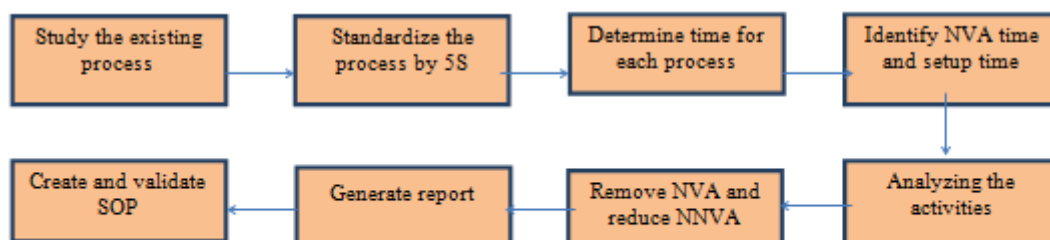


Figure 5: Standard Work

IX. KANBAN

Kanban cards have been introduced with part number and description to each work stations. Pull system is followed with the help of kanban. This card acts as a customer for the previous workstation and supplier for next workstation. This is explained below (Fig 6).

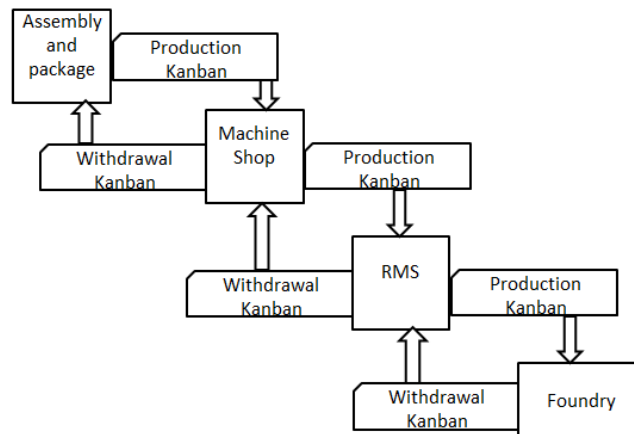


Fig 6: Kanban flow diagram

Kanban helped to reduce the confusion between operations' dimensions and the process flow. Queue was reduced due to kanban since the product needed by customer fast was given more importance. This helped to meet customer needs more specifically. Customer satisfaction was increased and they were ready to give feedback.

X. FUTURE STATE MAPPING

Future state map has been drawn with the results obtained from the implementation of various lean tools. Lead time has been reduced from 5718 seconds to 4128 seconds.

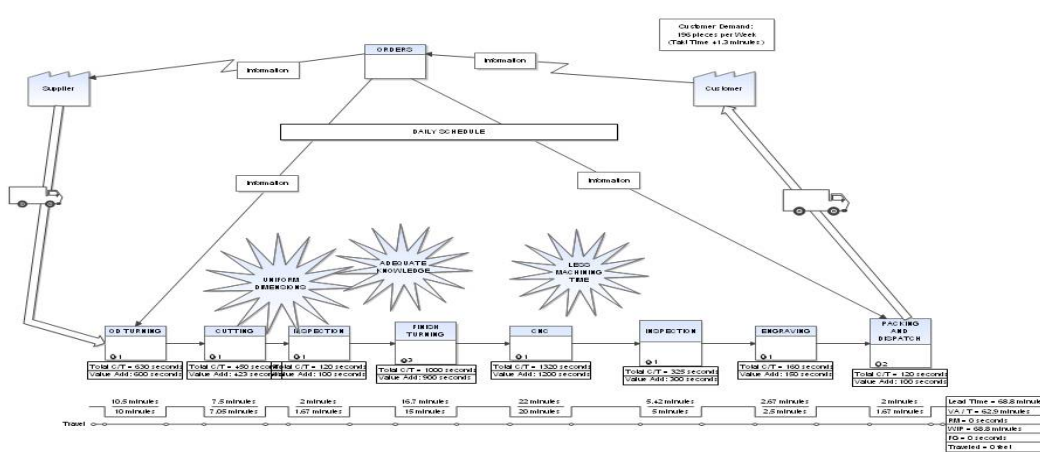


Fig 7: Future State Mapping

XI. CONCLUSION

This case study details described that with lean implementation setup time and transportation time can be reduced. 5S helps to reduce setup time and line balancing helps to reduce transportation time. Major lean tools have been applied in this industry and significant changes have been found in the lead time. When the delivery of products have been made faster, customer satisfaction increased and hence the productivity. Kanban helped to reduce the operators' conflicts due to parts description and also helped to increase customer satisfaction.

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