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Value Stream Mapping-tool to Optimize the Process

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Abstract

Value stream mapping (VSM) is known for identifying and eliminating or streamlining non-value-adding activities in manufacturing, production, and business processes. To depict the current status of the operation, a flow diagram depicting the process is drawn. Non-value actions are detected by their waste of time and resources in each step and between each phase. With the use of simulation tools, the process is examined for the possibility of dramatically reducing and simplifying it to the bare minimum of steps. The fraction of value-adding time in the overall process increases when waste is reduced, and the process throughput speed improves. This improves the effectiveness (the right things are done) and efficiency of the revised process (needing fewer resources). With the use of Arena simulation software, this study illustrates how to use corrective procedures in the die casting sector to eliminate non-value added tasks. The future state of the reengineered process is flow charted, with process stages and information flows reworked, simplified, and made less expensive, as well as increased productivity.

Keywords: *Value Stream, Current Stream Mapping (VSM), Future State Mapping, Cycle Time, Lean Manufacturing, Simulation.*

1.0 Introduction

By identifying non-value-adding activities in manufacturing, production, and business processes, value stream mapping has its own way of eliminating waste. The process is visualized to see if there is any way to simplify it and cut down on the number of steps required. The fraction of value-added time in the overall process grows when non-value-added tasks are reduced, and the process output speed increases. VSM is a strategy for identifying squandered time and actions in the manufacturing process. VSM has been employed as a reusable tool for businesses in recent years since it identifies needless effort and resources, allowing for the reduction and streamlining of operations [1]. Managers and engineers that use VSM as a technique aim to gain a better understanding of their company's improvement efforts in order to achieve the company's goal. This strategy aids in the creation of jobs that add value to a final product and are efficiently linked to generate a continuous stream of value. VSM is a powerful tool for analyzing activities in a production flow with an emphasis on activity duration in order to reduce non-value added tasks. Aside from reducing lead times, every organization needs to cut costs, thus tracking and controlling production costs over time can be a motivator for improvement. The VSM process is examined for the possibility of dramatically reducing and simplifying it to the fewest possible actions. The proportion of value-adding time in the entire process increases as waste is reduced, and the process throughput speed increases. This improves the effectiveness (the right things are being done) and efficiency of the revised process (needing fewer resources). It is a lean manufacturing tool that is used in conjunction with line balancing to reduce cycle time in an assembly plant that incorporates non-value added activities and operations [2].

The value stream analysis and mapping (VSM) idea as applied to product development initiatives. Value Stream Analysis and mapping [3] is a technique for improving business processes. Combining value stream costing and a cost-time profile are to optimize the value stream. Value stream mapping is a powerful method for visualizing activities in a production flow with a focus on activity duration and the elimination of non-value contributed activities. VSM is used in all process steps, both value added and non-value added items are assessed, and VSM is used as a visual tool to discover hidden waste and waste sources [4,5].

2.0 Methodology

There is no better instrument than VSM to start improving productivity by identifying waste and then removing it by implementing lean principles in the sector. The value stream mapping method (VSM) is a visual tool based on Toyota's lean manufacturing methodology (Toyota Production System). It aids in the understanding and streamlining of work processes through the use of lean manufacturing tools and techniques. VSM's purpose is to discover, demonstrate, and reduce waste in the manufacturing process [6,7].

It begins with a review of relevant literature. Following that, the product's family was discovered. For the product [8] the current state map was drawn. Site visits, motion studies, observation, interviews, and document analysis were used to compile the current state map's data. After then, the present map was utilized to identify issues and potential solutions [8,9,10].

Before implementing the VSM technique, a thorough examination of the entire plant with the plant manager, supervisors, and operators is essential. Conducting interviews with these individuals will aid in identifying the crucial shop floor where we can boost efficiency. Design, foundry, machining (CAM/CNC), and assembly are the four primary divisions of the company. After speaking with firm personnel, it was discovered that the foundry shop floor is plagued by issues such as cycle time, poor equipment handling by operators, and material waste [11,12]. As a result, the choice is made to select foundry as a critical work floor, and technique is implemented as indicated in Fig.1.

This broad strategy is divided into five stages:

- Process flow analysis is a study of the flow of processes.
- Determining the type of wastage.
- An examination of whether the process can be reorganized in a more efficient order.
- A better flow pattern is being considered, which may involve a modified flow structure or transit routing.
- A consideration of whether everything being done at each stage is indeed important, as well as what would happen if non-essential tasks were eliminated.

Pattern is made with the help of wood or metal depending on the availability of resources in the foundry, which includes separate work stations from component drafting of the product to dispatch which is to be cast. Depending on the size of the object and the number of products to be manufactured, temporary or permanent molds are created. After the molds are ready, molten metal is created in a melting furnace by heating it over its recrystallization temperature. Pouring molten metal into already prepared molds and sending it to solidification. Once the metal has solidified, the casting is separated from the molds by breaking the molds if

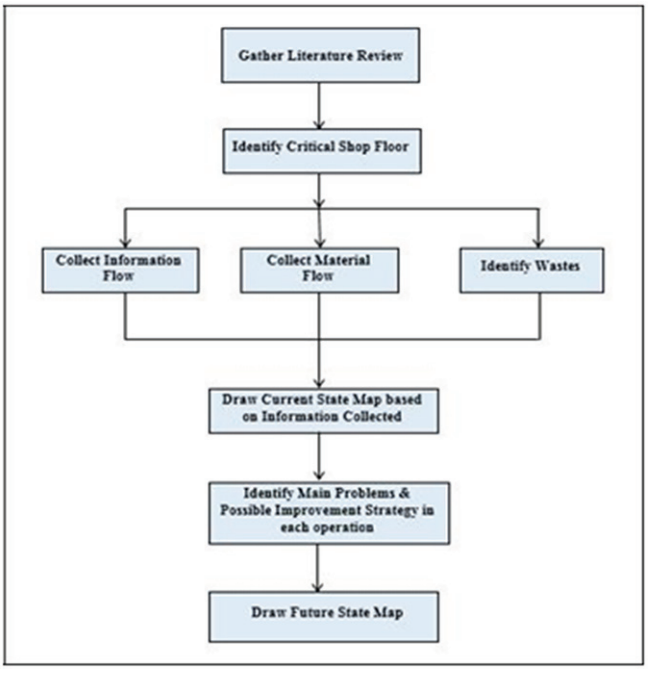

Figure 1: Methodology of Value Stream Mapping

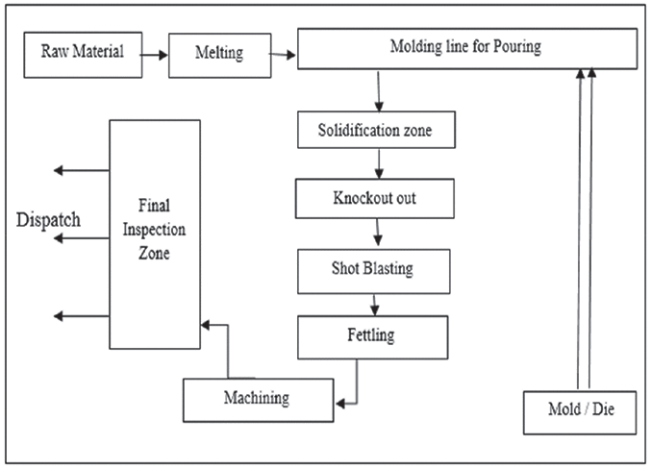

Figure 2: Current Foundry Production Lay out

Table 1: Cycle time of Bearing Housing

	Products	Pivot Housing		Number of Operators
	Steps	Day Shift	Night Shift	
1	Cleaning of Dies	12	19	2
2	Pouring Molten Metal	3	3.2	2
3	Knockout	1.6	2.6	2
4	Shot blasting	8	11	1
5	Fettling	18	22	1
6	Inspection & Oil Dip	4	4.3	1
7	Machining	5	7	1
	Total set up time	29	34	10

they are composed of sand, with the sand being utilized for future mold preparation as shown in the Fig.2.

Figure 3 shows the cycle time at each work station for processing particular operation and following calculations have made:

- Production's total value-added time: 48.4 min per part.
- Total non-value-added production time: 26 min per part.
- Total time spent on manufacturing: 74.4 min per part.
- Total amount of time available for production: 480-30= 450 min per shift.
- Takt time = Total production time available / customer demand.
  = 23400/430 = 54 min per product.

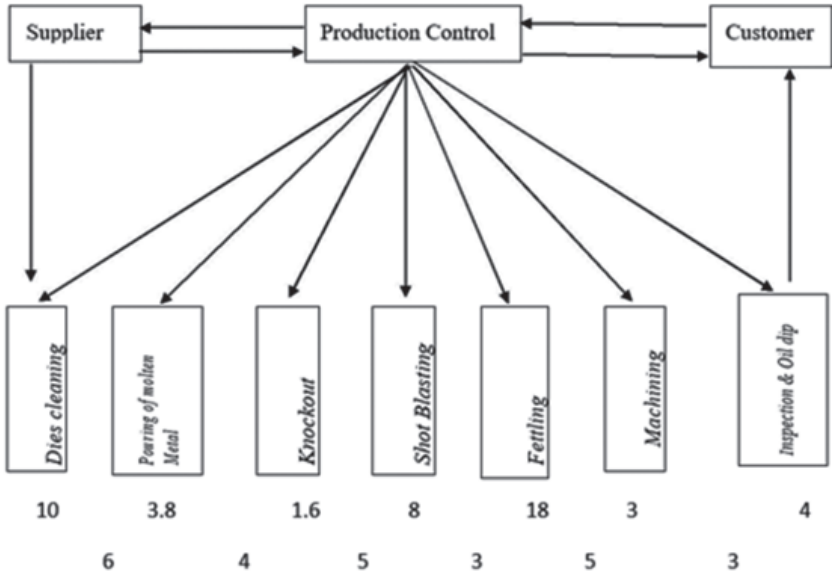

Figure 3: Current State Map

Production's total value added time is 89.6%. Production's total non-value added time is 48.14% (non-value-added activities such as waiting, unneeded transportation, overproduction, and so on are included).

3.0 The Critical Shop Floor Layout has been modified

Shot blasting, fettling, machining, and inspection procedures all have superfluous motion of dies and queues, according to the existing state map. Work stations are rearranged in a cellular layout to avoid superfluous die motion and maximise floor space. Merging two operations, such as machining and inspection of cast items, to decrease delays. As demonstrated in Fig.4, improvements in the plant structure resulted in a cleaner and safer working environment.

Corrective actions made based on current state map information, such as modifying plant structure and integrating machining and inspection operations, as well as the use of Kaizen in the die casting business, will improve future state as shown in the Fig.5.

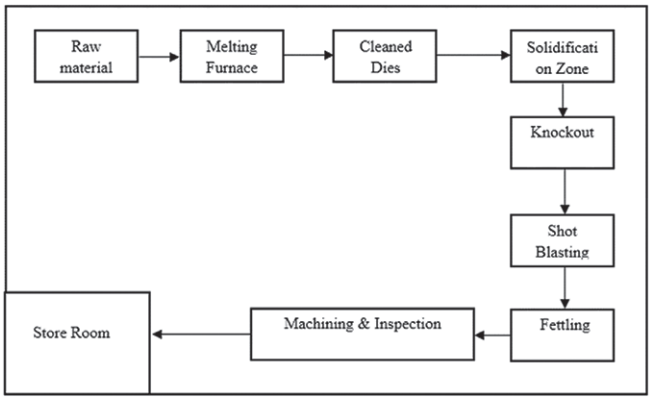

Figure 4: Changes to the Plant Layout

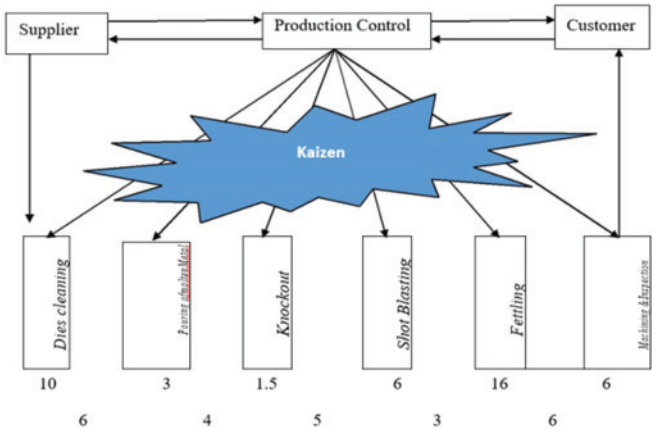

Figure 5: Future State Map

4.0 Result and Discussion

We all know how filthy and smoky the casting process is. As a result, the first priority should be to improve the working environment for employees in order to encourage them to work as efficiently as possible. As a result, the first thing that must be done is housekeeping. The 5S approach is a useful tool or methodology for proper housekeeping. The phrase "Five S" comes from the first letters of five Japanese terms that all used to do five activities that lead to a clean and controllable work environment: seiri (organisation), seiton (tidiness), seiso (purity), seiketsu (cleanliness), and shitsuke (organisation) (discipline). Sort, straighten, sweep, sanitise, and sustain are the English equivalents of the 5S's. There are checklists for manufacturing and nonmanufacturing environments that include a variety of criteria, such as cleanliness, safety, and ergonomics, and 5S evaluations provide measurable insight into the orderliness of a work area. The Five S evaluation affects how employees feel about the product, the company, and themselves, and it has now become a must for any manufacturing company.

According to the current state map Waiting is a non-value-added activity that occurs when an operator's hands are idle, when an operator's task is put on hold due to line imbalances, a lack of parts, or machine downtime, or when the operator is just observing a machine while it does a value-adding job. Observing the machine and waiting for parts to arrive are both muda and a waste of time. In this region, muda removal is a fantastic chance for Kaizen. The operators are semi-skilled in the company, thus skill training is required, as indicated in Fig.5.

5.0 Conclusion

As a world-class manufacturing tool, the value stream mapping tool can be used efficiently in a variety of industries. The subject under consideration is a case study in the die casting business. The primary goal is to eliminate waste from a value stream. The value stream analysis tool is being utilised in this study to detect non-value contributed activities. The current state map is used to evaluate the current situation. Techniques for waste minimization are described, and a future state map is also recommended for improvement. The study's findings demonstrate a 7.6% waste reduction in non-value added operations from the value stream, resulting in a 10.6% reduction in overall cycle time.

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