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Lead Time Reduction for Manufacturing of Geared Coupling

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Abstract: - *This paper delves into the critical aspect of lead time reduction in the manufacturing process of large-sized couplings. By addressing the challenges associated with the substantial size of 1,10,000 Couplings, this study aims to optimize manufacturing workflows, enhance production efficiency, and integrate advanced technologies to reduce lead times without compromising quality. Through a detailed analysis of resource utilization, technology integration, and quality assurance measures, this project presents a strategic framework for achieving significant lead time reduction in the production of large-sized Geared Couplings. Through project implementation, the lead time for manufacturing geared couplings was reduced from 15 days to 9 days, resulting in a 40% decrease in production time and boosting operational efficiency.*

Introduction*:* -

Company is recognized for its expertise in the manufacturing of custom-made gearboxes for various industries, including steel mills, high-speed turbines, satellites for ISRO, and naval aircraft carriers. This paper focuses on the lead time reduction for the manufacturing of geared coupling at company.

The manufacturing industry, characterized by intense competition and evolving market demands, necessitates a continuous focus on operational efficiency and lead time reduction. Company, renowned for its expertise in industrial gear manufacturing, faces the challenge of optimizing lead times in the production of large-sized couplings. This paper aims to address this challenge by exploring key objectives such as size complexity, production efficiency, resource utilization, technology integration, and quality assurance in the context of lead time reduction for Geared Couplings.

Objectives: -

The primary objectives of this project include: -

1. Resource Utilization: Utilization of resources such as machinery, manpower, and materials during the manufacturing process. Identify opportunities for streamlining resource allocation to reduce lead times without compromising quality.

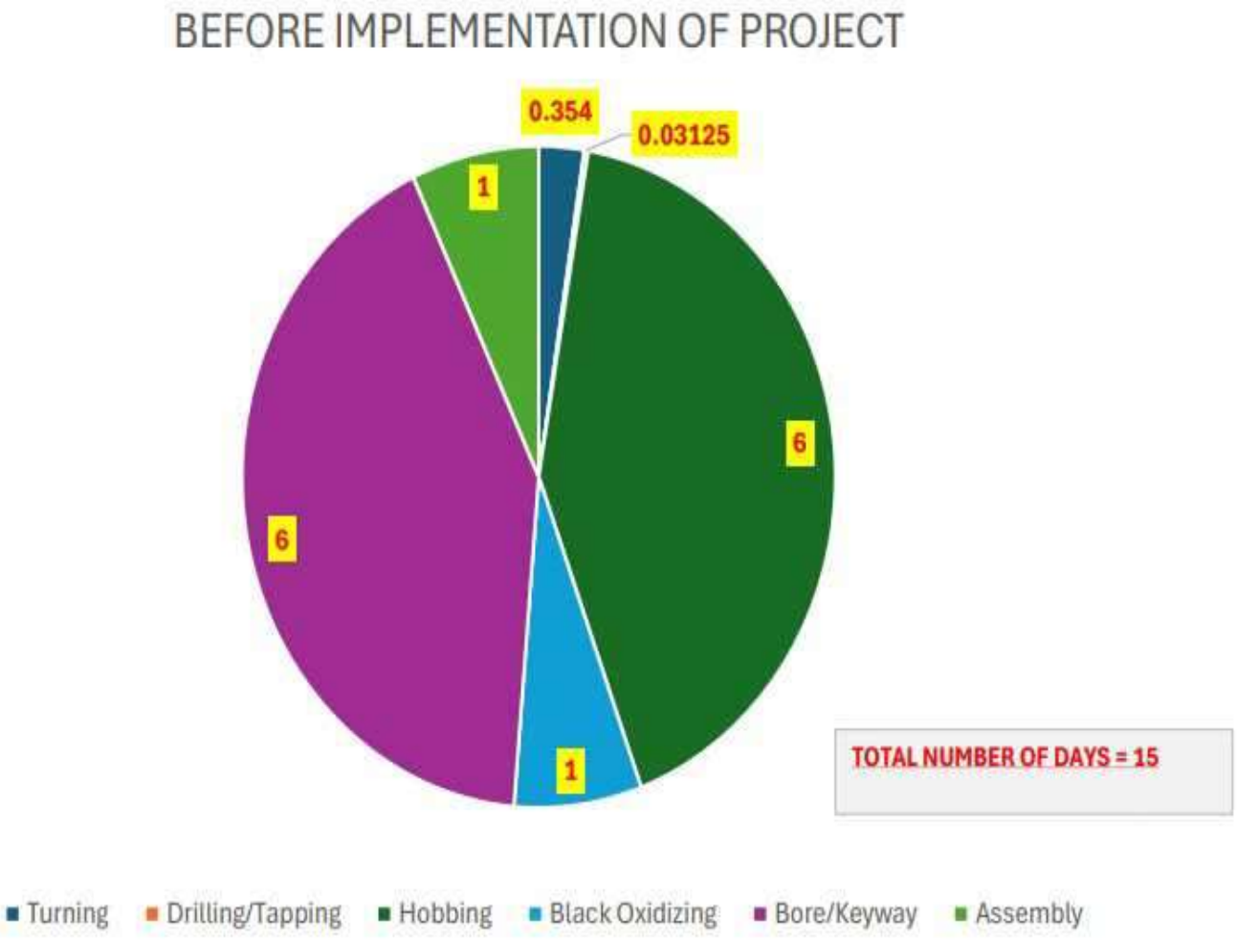
2. Technology Integration: Integrations of advanced technologies and automation to accelerate specific stages of the manufacturing process. This includes assessing the feasibility and benefits of adopting cutting-edge manufacturing techniques.

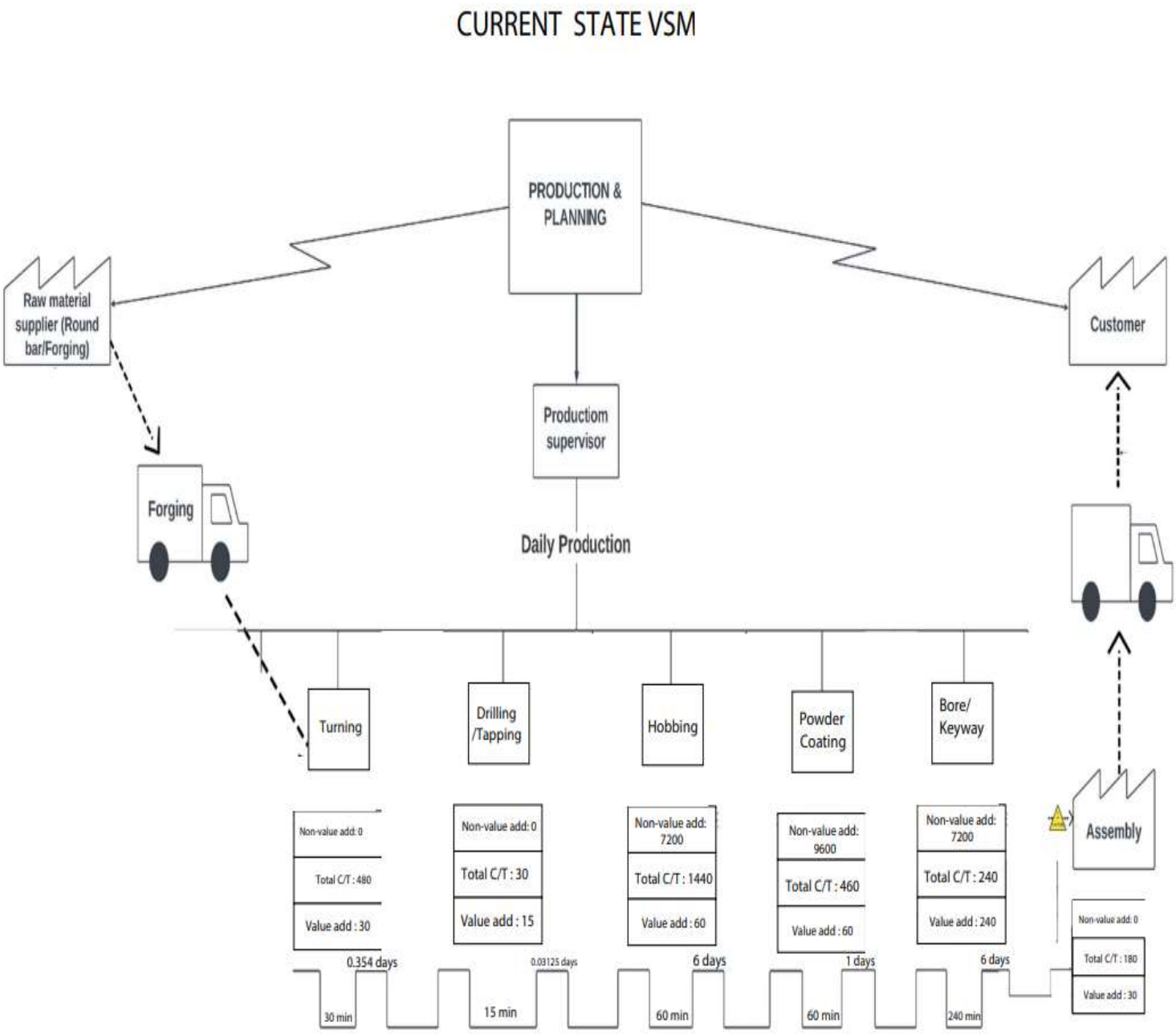
3. Quality Assurance: Ensure that lead time reduction efforts do not compromise the quality of the Geared Couplings. Implement measures for stringent quality assurance throughout the revised manufacturing process.

Comparative Analysis: - A comparative analysis of Lean, Six Sigma, and Theory of Constraints was conducted to evaluate their effectiveness in reducing lead times. The analysis revealed that while all three methodologies have their merits, VSM emerged as the most effective technique for lead time reduction in the manufacturing of geared couplings.

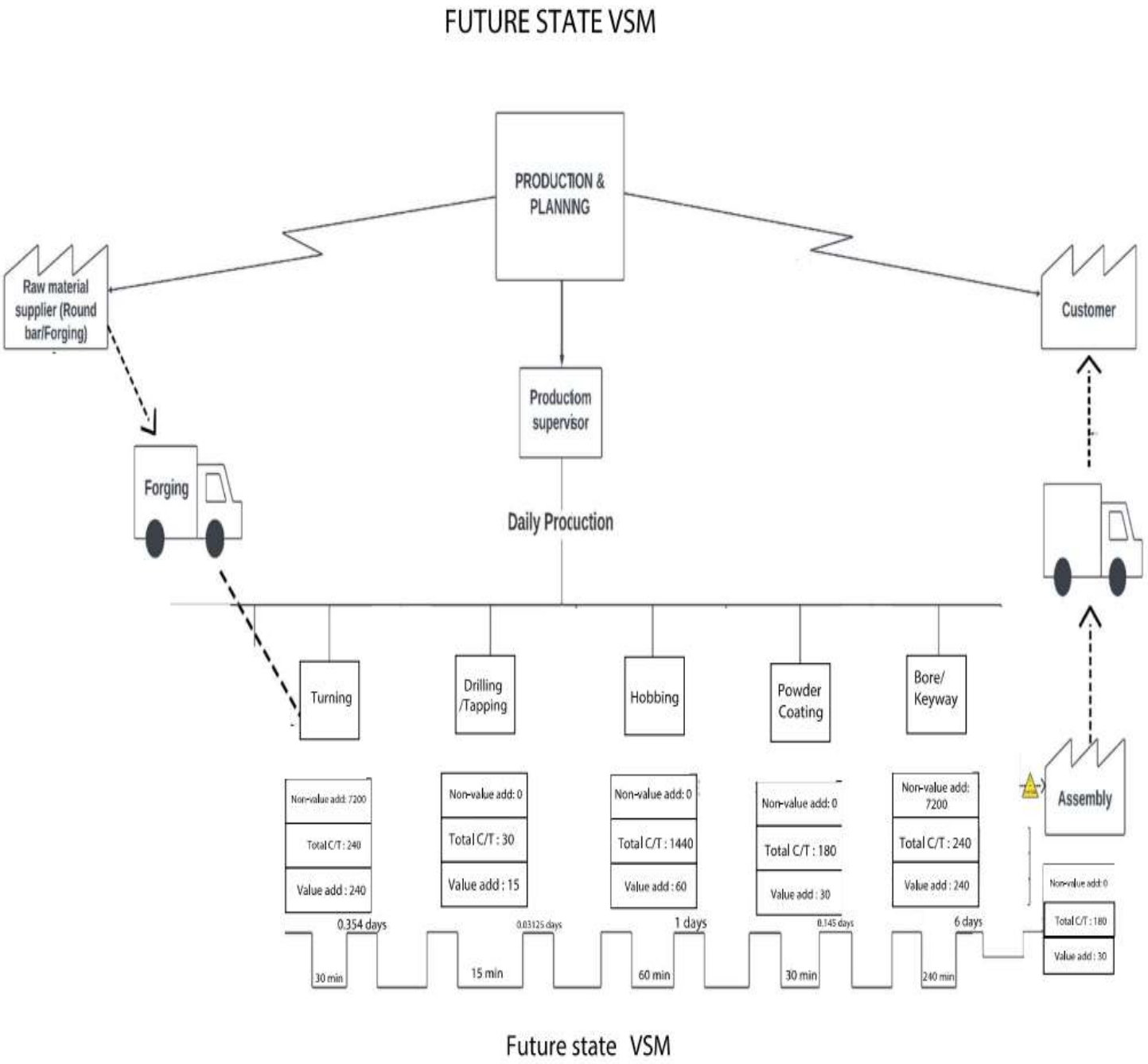
Methodology: - Quantitative data on lead times, production efficiency, and resource utilization were collected before and after implementing VSM. Clear metrics were defined to objectively measure the impact of VSM on the manufacturing process. Feedback from key stakeholders and the workforce was gathered regarding their experiences with VSM. Special attention was paid to the ease of implementation and perceived effectiveness of VSM in reducing lead times and improving efficiency.

Value Stream Mapping (VSM) Implementation: - The implementation of VSM in the manufacturing process of 1,10,000 Couplings resulted in significant lead time reduction and efficiency improvements. The VSM process involved mapping the current state of the manufacturing process, identifying non-value-added activities, and implementing changes to streamline the process.

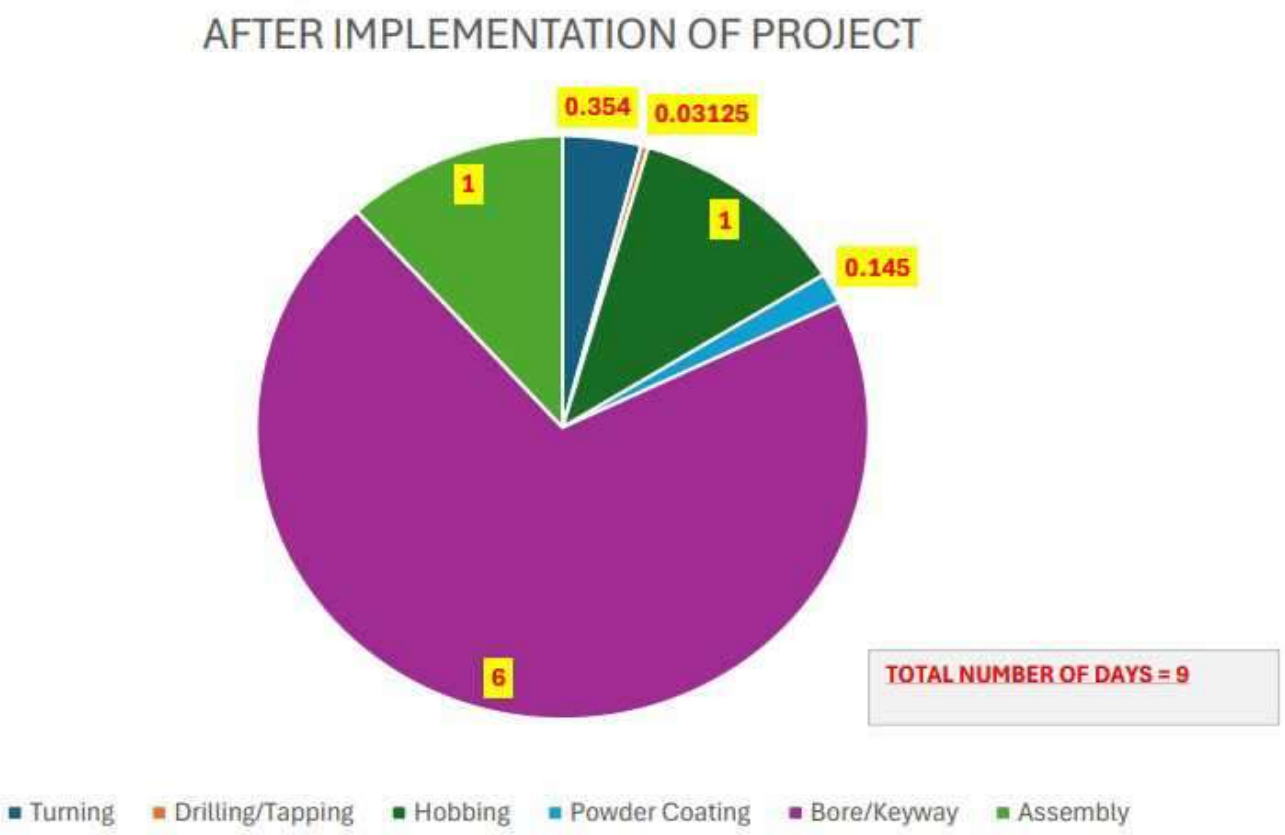




Current state VSM



Future state VSM



Value Stream Mapping (VSM) is a powerful tool used in lean manufacturing and process improvement to visualize and optimize the flow of materials and information in a specific process or system [1][2]. It is a graphical representation that provides a comprehensive view of how value is created and delivered to customers, helping to identify areas for improvement and waste reduction. VSM consists of three main components: the value stream, the current state map, and the future state map.

The value stream represents the entire sequence of processes and activities involved in delivering a product or service to the customer, including all steps from the initial concept or order to production, distribution, and delivery [4][6]. The current state map provides detailed information about each step in the process, such as cycle times, work in progress, and process bottlenecks. This helps in identifying areas of waste, delays, and inefficiencies [4][6]. The future state map represents an improved and more efficient version of the process, which may involve eliminating waste, reducing lead times, and improving overall flow [4][6].

VSM distinguishes between value-added and non-value-added activities. Value-added activities directly contribute to meeting customer needs, while non-value-added activities are considered wasteful and should be minimized or eliminated[1][2]. The flow of information within the process or system is also captured in VSM, including communication between departments, orders, schedules, and any paperwork or digital information that accompanies the product or service[3][5].

Key Performance Indicators (KPIs) are often included in VSM, such as cycle time, takt time, and inventory levels, to assess the efficiency and performance of the value stream [1][2]. VSM is closely tied to the concept of continuous improvement, known as Kaizen in lean manufacturing. By identifying areas of improvement in the current state map and working towards a more efficient future state, organizations aim to continuously enhance their processes and deliver more value to customers [4][6].

There are different types of value stream mapping techniques, each with its own focus and application. Process VSM is the most common and basic type, focusing on the physical and operational aspects of the value stream. Information VSM emphasizes the flow of information and communication between the processes and the stakeholders. Service VSM focuses on the service delivery and customer experience aspects of the value stream. Supply Chain VSM covers the entire supply chain network and the relationships between the suppliers, manufacturers, distributors, and customers.[2][3]

Choosing the right VSM technique depends on the scope, goals, stakeholders, data, and resources of the project. By identifying the purpose of the VSM project, the customer and supplier relationships, the processes and activities of the value stream, the information and communication flows, and the challenges and opportunities that affect value stream performance and outcomes, organizations can select the VSM technique that best fits their situation and needs.

In the context of the research paper, VSM is implemented in the manufacturing process of 1,10,000 Couplings to reduce lead times and improve efficiency [1]. Data collection and metrics are defined to objectively measure the impact of VSM on the manufacturing process [1]. Stakeholder feedback is gathered to assess the ease of implementation and perceived effectiveness of VSM [1]. A cost-benefit analysis is performed to evaluate the financial viability of VSM [5]. The findings are documented in a concise report, demonstrating the superior effectiveness of VSM for reducing lead times in the manufacturing of large-sized Geared Couplings [5].

Before Implementation of Project		After Implementation of Project	
Process	**Number of Days**	**Process**	**Number of Days**
Turning	**0.354** Days	Turning	**0.354** Days
Drilling & Tapping	**0.03125** Days	Drilling & Tapping	**0.03125** Days
Hobbing	**6** Days	Hobbing	**1** Days
Blackoxidizing	**1** Days	Powder Coating	**0.145** Days
Bore & Keyway	**6** Days	Bore & Keyway	**6** Days
Assembly	**1** Days	Assembly	**1** Days
Total	**15** Days	**Total**	**9** Days

Result And Discussion

The project's success is evident in the data, with the lead time for manufacturing geared couplings slashed from 15 days to just 9 days, marking a remarkable 40% reduction in production time and demonstrating a substantial increase in operational efficiency. Solution

1: Optimization of Machining Processes Relocating Hobbing Machine Solution

2: Investment in Specialized Machinery Acquisition of Dedicated Hobbing Machine Solution

3: Streamlining External Processes Dedicated Transport Vehicle for Surface Treatment Solution

4: Adoption of Advanced Surface Treatment Methods Transition to Powder Coating

Conclusion

The paper emphasizes reducing lead times in manufacturing and the benefits of implementing lead time reduction strategies. It recommends implementing VSM in the 1,10,000 Couplings manufacturing process. Future research areas were also suggested, the implementation of VSM in the manufacturing process of 1,10,000 Couplings resulted in a significant reduction in lead times and improvements in efficiency, productivity, and resource utilization. The findings demonstrate the superior effectiveness of VSM in reducing lead times compared to other lead time reduction techniques. The project's success underscores the value of implementing lean manufacturing principles and VSM in the manufacturing process of geared couplings, contributing to enhanced efficiency and competitiveness in Company's Coupling Division.

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