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DESIGN AND IMPLEMENTATION OF LEAN METHODOLOGY & PROCESS IMPROVEMENT IN A MACHINING INDUSTRY

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Abstract - This Project aims to investigate the design and implementation of lean methodologies and process improvement in a machining industry. The study explores the benefits of lean principles, such as waste reduction and increased productivity in the context of a small-scale machining industry. The Project presents a case study of a small machining company that implemented lean principles to improve its operations. The case study focuses on the company's journey, from identifying the areas for improvement to implementing the lean principles and measuring the outcomes. Analyzing, Brainstorming ideas to change the machines and developing the jaws & fixtures for holding a specific components. The study provides insights into the challenges faced during the implementation of lean methodologies and process improvement in a small-scale machining industry and provides recommendations for overcoming challenges that arises. The findings of this study can be useful for small-scale machining companies looking to improve their operations by implementing lean principles & Process Improvements.

***Key Words*:** lean methodologies, Process Improvements, waste reduction, increased productivity, developing the jaws & fixtures.

1.INTRODUCTION

Industrial machine manufacturing and fabrication, providing high-precision solutions for industries such as automotive, aerospace, energy, and heavy machinery. We offer CNC machining, metal fabrication, millwright services, and process automation to enhance productivity and efficiency. Our expertise includes custom machine design, precision milling, welding, and assembly of industrial equipment. With a strong focus on quality, innovation, and Industry 4.0 technologies, we ensure cost-effective and high-performance manufacturing. By integrating advanced machining techniques and predictive maintenance.

2. LITERATURE REVIEW

The 5S methodology was used to cut down on operator movements and search times for materials and tools. Activities that could increase production and decrease downtime were grouped together. In this way, non-value-added operations were decreased while the production flow was optimized.

The 7Ms (man, machine, material, management, market, method, and Mother nature) are typically the sources of waste in an industry. The lean manufacturing process begins with the identification of the root causes, followed by the application of various tools for improvements, solving the problem, and finally analysing the causes of failure. Because a value-adding process is required to achieve perfection, implementing a lean manufacturing system is increasingly becoming a core competency for any type of organisation.

Industries can apply Lean Manufacturing in a variety of ways. Lean is the initial strategy and is a "set of tools" that helps find waste and gradually eliminate it (Muda). Quality increases when waste is eliminated, and production time and costs decrease as a result of the usage of technologies like 5S, Kanban, and Poka-yoke. When compared to the previous system of mass production, lean maintenance employs techniques and principles that increase efficiency in value, product development, operations, suppliers, and customer relations. These techniques and principles also reduce the amount of time, money, and human labour needed to produce goods.

3. PROBLEM IDENTIFICATION

In the MILL WRIGHT industry, some problems are noticed in BB20 and BB40 components after machining. This project aims to reduce and neglect the below problems in the BB20 and BB40 components.

1. Perpendicularity issue
2. Ovality

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3. Groove Vibration
4. High Cycle Time

3. BRUSH BRACKET 20

The Brush Bracket 20 is a critical component that undergoes multiple machining processes to achieve the required precision and quality. Initially, the component is machined on a VMC (Vertical Machining Center) milling machine, where various operations such as drilling, milling, and profiling are performed. However, after the first stage of machining, it is observed that the component does not achieve the required perpendicularity, which is essential for its proper function and assembly. To rectify this issue, a secondary machining operation is carried out on a CNC lathe machine.

The CNC lathe machine is primarily used for a facing operation, which takes only 4 minutes. To effectively hold the component in the CNC lathe, the jaw of the chuck is modified to provide a secure and stable grip. This modification is crucial because improper holding could lead to misalignment, affecting the accuracy of the machining process. Once the facing operation is completed, the component is returned to the VMC milling machine for the remaining machining processes. The VMC milling machine requires 40 minutes to complete all necessary operations, including precision milling, drilling, and any additional profiling required for the component.

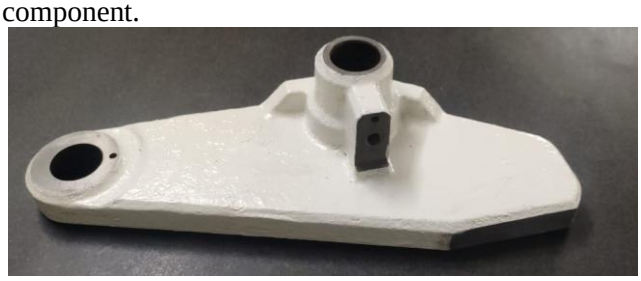

Fig -1: **Brush Bracket 20**

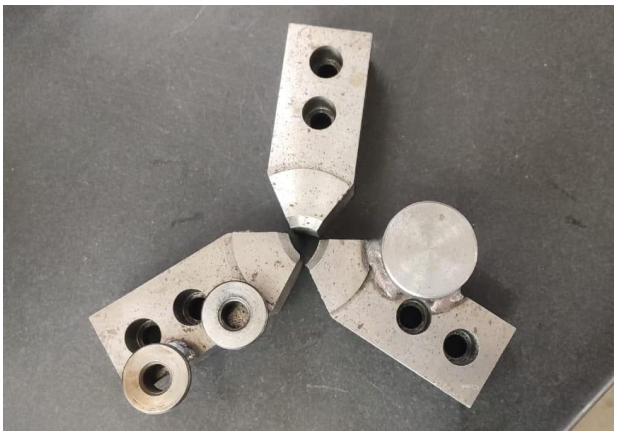

Fig -2: Developed Jaw

The BB20 component previously underwent a complete machining process on a VMC milling machine, taking a total of 40 minutes to finish. To improve efficiency and reduce cycle time, the machining operations were strategically split between a CNC lathe machine and the VMC milling machine. In this revised method, the CNC lathe performs the facing operation in 4 minutes, while the VMC milling machine completes the remaining operations in 14 minutes. As a result, the total machining time is now reduced to 18 minutes, effectively cutting the cycle time in half.

4.BRUSH BRACKET 40

In the manufacturing process of the Brush Bracket 40, the initial operation was performed entirely on a VMC milling machine, which led to issues with 52mm bore ovality and groove vibration during machining.

Fig -3: Brush Bracket 40

Additionally, the total machining time was 35 minutes, making it a time-consuming process. The ovality issue was primarily caused by the limitations of the milling process when boring large-diameter holes, as well as the vibration due to tool engagement and material rigidity.

Fig -3: Bottom Surface Finishing in VMC Milling Machine

The Brush Bracket 40 (BB40) component is securely fixed in a CNC lathe machine for surface finishing to achieve high precision and superior surface quality. Proper work holding is critical to ensuring the accuracy of the machining process.

Fig -5; Jaws for Brush Bracket 40

In this setup, a customized three-jaw chuck with modified jaws is used to securely grip the component without causing deformation. The fixture is designed to provide a firm and stable hold while allowing access to the required machining areas, ensuring minimal vibrations and optimal machining accuracy.

The Brush Bracket 40 (BB40) component is securely fixed in a VMC (Vertical Machining Center) milling machine to perform drilling, boring, and threading operations with high precision. Proper fixturing is essential to ensure stability, minimize vibrations, and maintain accuracy throughout the machining process.

Fig -4: Bottom Surface Facing in CNC Lathe Machine

The component is carefully clamped using custom-designed fixtures or precision vises to prevent any movement during machining. Soft jaws or dedicated clamps may also be used to avoid workpiece deformation while allowing full access to the machining zones.

The drilling operation is performed first to create the required holes at specific locations on the BB40 component. High-speed carbide or HSS drill bits are used to ensure clean and accurate hole formation. The spindle speed and feed rate are optimized based on the material properties to prevent tool wear and heat buildup. After drilling, the holes undergo boring operations to achieve precise diameters and improved surface finish. A 32 mm ID boring bar may be used for enlarging and refining the drilled holes to meet tolerance specifications.

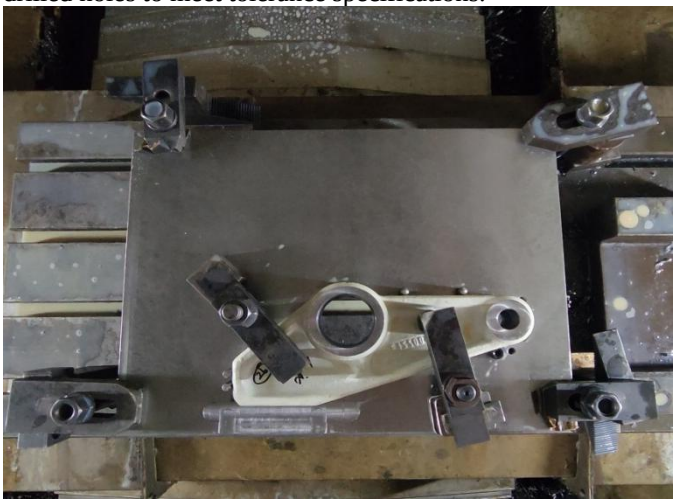

Fig -5: BB40 Fixed in VMC Milling Machine Operation

5.CONCLUSION

The Lean methodology & process improvement can be used in any organization, regardless of its size, and has been widely adopted in various functional areas of the manufacturing sector. However, the degree of implementation may differ depending on the sector and organization size. The primary objective of Lean is to identify and eliminate any activities that do not add value to the final product during the manufacturing process, as well as to reduce the overall lead time. To achieve these goals, Lean tools such as 5S, waste elimination, and line balancing are used to identify and eliminate non-value added activities, thereby reducing cycle and lead times. In this case, we changed process from VMC machine to CNC lathe machine by developing dedicated jaws for holding the workpiece tightly and to eliminate the issues in the both the components. As a result of this analysis and implementation of Lean methodology & process improvement, we increased the production rate and increased the quality of the components.

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