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Waste Elimination Using Leantechniques In Gearboxmanufacturing Process

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Abstract: In today's world, shorter lead times and greater customer satisfaction necessitate our preemptive duty of responsiveness. Almost everything is being done faster and just in time, where manufacturers must produce faster without sacrificing quality and deliver to customers on time in order to compete in this globalized world. Manufacturers must find ways to minimize lead-time and costs in order to increase operating efficiency while maintaining the highest level of product quality. To achieve this product diversification, manufacturers must concentrate more on making setup quicker to keep machines running with less idle time and converging to minimize nonadded value activities. Adopting lean tools Single Minute digit Exchange of Die (SMED) and Kaizen can help reduce setup time when transitioning from one product to another. The main goal of this paper is to use SMED method to minimize idle time of machine during setup operation. This study is carried out in a gearbox manufacturing industry. This research work demonstrate the need to overcome most of bottleneck of equipment's unavailability for resource utilization to run production more efficiently. The projects objective were met, and the change over time was decreased from 80-24 mins (70%), result in improved efficiency and lesser machine idle time. A comparative analysis of the results is then performed using charts and tables to supplement the improvement achieved through the SMED and kaizen approaches. As a result product diversification and production output has increased.

Keywords— SMED, kaizen, bottleneck, internal and external activity, 5s.

1. INTRODUCTION

In today's business and globalized environment of competition, manufacturers are adopting new tools and techniques to produce goods in order to compete and survive in the market. The most difficult challenge that manufacturers face today is delivering their products or materials on time, at a low cost, and in good quality. The adoption of lean manufacturing principles and techniques is one promising method for tackling this issue. The primary goal of lean manufacturing is to meet customer demands for high quality at a low cost. The technique not only identifies the causes of waste, but it also assists in its removal through clearly defined principles and guidelines. In the world of competition, Lean Manufacturing is an efficient and rapidly growing approach. Lean manufacturing employs a diverse set of tools and techniques; the tools used are determined by the problem at hand. Lean manufacturing, also known as lean production, is a production method that considers the optimal usage of resources in the vision for the creation of value for the customer by identifying waste and therefore a goal for elimination.

Value stream mapping, TPM, 5S, SMED, Kaizen and Poke-Yoke are the most important tools in a manufacturing process. These tools concentrate on specific aspects and areas of the manufacturing process in order to minimise waste and increase quality and minimize production time and expense. Change over time is seen as a non-value adding task in the waste reduction philosophy. The method of analysing and minimising the time required to adjust a process from producing one good part to producing the next good part, as shown in Fig.1, is known as change over time. In scope of this project major problem had to be solved in the framework of lean manufacturing. Since lean manufacturing involves small batch sizes and high product variability, a new method for reducing setup time had to be created.

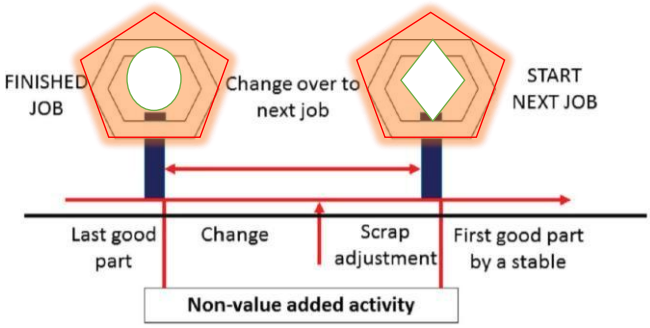

Fig 1: Change over activity

SMED is a scientific method for reducing setup time which could be applied in all type of industry and on any machine (Shingo, 1985) SMED's ultimate aim is to complete system setup and changeover operations in under 10 minutes. Due to the shorter setup time, manufacturing flexibility increased, allowing for more regular product mix changes. Moreover, with the reduced setup, machine utilisation and equipment efficiency will increase.

SMEDLITERATUREREVIEW

A. Improving Changeover Time: A Tailored SMED Approach For Welding Cells- Pablo Guzmánferradásetl..

The study introduced a customised approach that was created specifically for an automotive supplier. The main enablers for success were an effective strategy concept and preparatory activities, in addition to the SMED tailored methodology, where the waste was identified and eliminated.

B. Applying SMED Methodology In Cork Stoppers Production.- Sousa E, Etl..

The lean approach used in this project was to research the process and use lean theory to define and remove non-valueadding activities.
The assembly machine's working conditions were also examined in order to identify areas for change. As a result, the Value Stream Mapping (VSM) technique was used to identify the processes that really add value after eliminating non value added activities by using SMED technique.

C. Comparative Analysis Of The Implementation Of The Smed Method On Selected Production Stands- Katarzyna Antosz

Machine changeover time is reduced when the SMED system is used, which has various waste. This approach allows for the implementation of a continuous product flow without

long wait times or performance degradation. The demand for more variety in less quantity and Justin-time has risen, thus SMED can help to achieve this flexible demand.

D. Productivity Improvement Through Single Minute Exchange Of Die (SMED) Technique- Shivakumar S, Etl...

The Single Minute Exchange of Die (SMED) Technique decreased the setup time of the Gear Hobbing Machine by 20–25 percent, increasing productivity. used, which has various waste. This approach allows for SMED (Single Minute Exchange of Die) focuses on reducing setup time. The term "single minute" does not refer to a one minute, but rather to a period of less than ten minutes.

PROBLEM DEFINITION PROBLEM STATEMENT:

The problem identified with gear box manufacturing industry is that it currently produces a number of 260 gearbox per month, having the average customer demand order numbered 300 gearbox per month. The industry is unable to process the entire customer order due to the presence to high takt time redundant work and higher setup time. There is 20% production loss due to the existing non- value added activities during changeover's.

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2. METHODOLOGY

1) Study and Identify the bottle-neck process.
2) Perform literature review related to problem identified.
3) Data collection before implementation of SMED.(Actual process)
4) Data analysis (Distinguish between Internal &
External activities, Root causes)
5) Converting Internal activities to external activities.
6) Streamlining all aspects of setup activities(Kaizen).
7) Validating and Documenting new setup.

DATA COLLECTION, DATA ANALYSIS AND KAIZEN

Activity

This paper is a description of a case study project completed at a gear box manufacturing organisation. By studying, the whole process of machining and time study the boring operation for finishing operation on VMC is identified as the bottleneck process. At this point, all relevant information about the output, processes, cycle time, wastes, and so on must be gathered, and the actual problem at the machining preparation area, particularly at the VMC machine, must be identified. The issue was the VMC (boring) machine's long initialization time of 80 minutes. To solve the problem of a long setup time on a VMC (boring) machine, the SMED technique was used.

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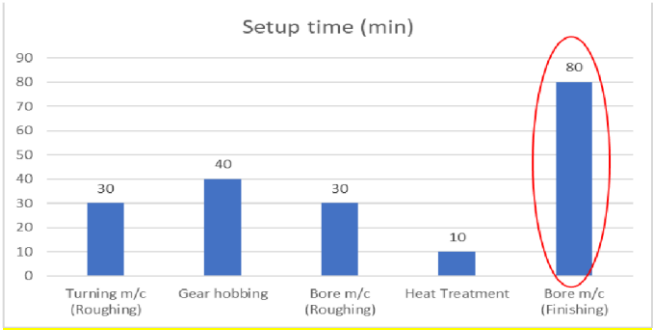

Fig 2: Bottleneck identification

We used a video camera, a stop watch, and a time study form to collect data on the events that took place during setup time. The data was analysed, and the root cause of the problem was discovered. Following the identification of the problem, the next move was to take steps to change the system. To solve the issue of the boring machine's long setup time, we chose to use the SMED technique. To minimise the boring machine changeover period, all of the data was analysed and improvement activities were carried out. Table 1 shows the actual data that was collected.

The findings illustrate that the machine took 80 minutes to complete the changeover from one commodity to the other, based on the actual data collected. The weekly changeover frequency was ten times a week, or 800 minutes a week. As a result, the company loses 65 minutes per day in boring machine setup time. In terms of money and productivity, this was a significant loss. The machine generated 34 pieces per day, with the setup activity accounting for the majority of the 20% time loss. To minimise system setup time, we used the SMED steps below. The part chosen for this study was observed as Item No: d90290122A, Description: Discset.

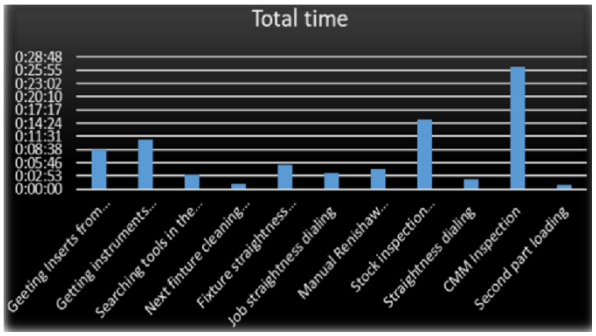

Fig 3: Total time for each activity

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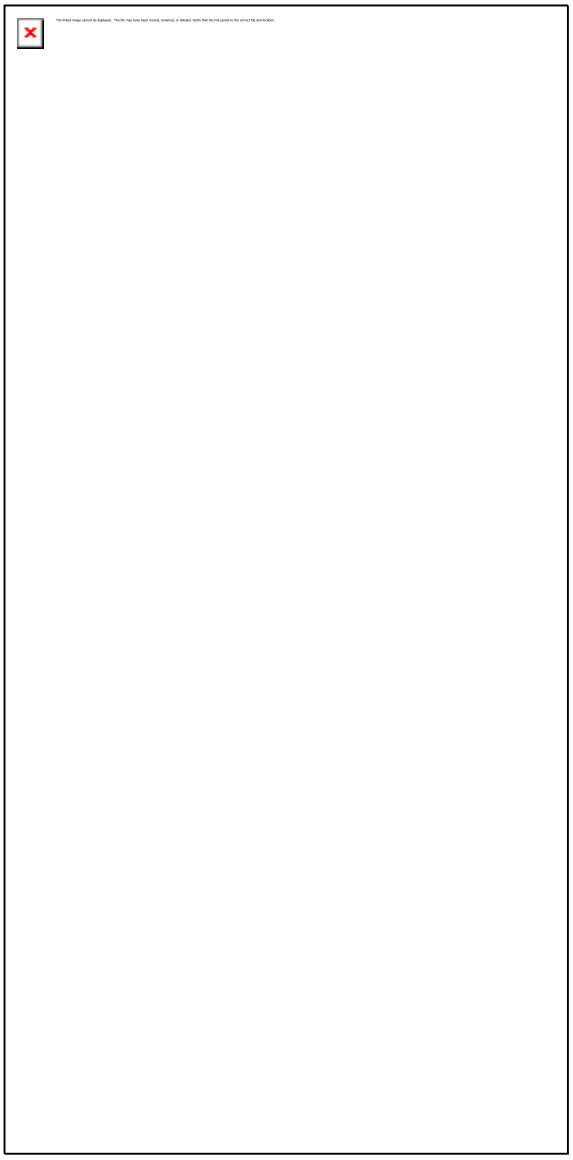

There is no distinction between internal and external setups: The activities of the previous setup were filmed with a video camera and analysed. It covers the entire change from one part to another. The total time needed for setup is 80 minutes.

Separating Internal and External Setups: Internal activities can only be completed when the system is shut down, while external activities can be completed when the previous batch is being generated or after the next batch has begun.

Internal to external setup conversion: We defined internal activities that could be translated to external ones. The tool scan, instrument arrangement, and inserts arrangement were all turned into external searches. We were able to save 15 minutes of setup time by doing such. Employer self-inspection helped to reduce inspection time as parallel operations is performed simultaneously as shown in table 2

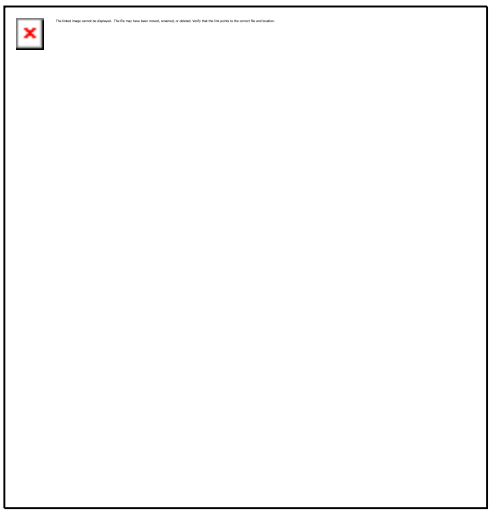

Table 3: Improved setup activity after SMED

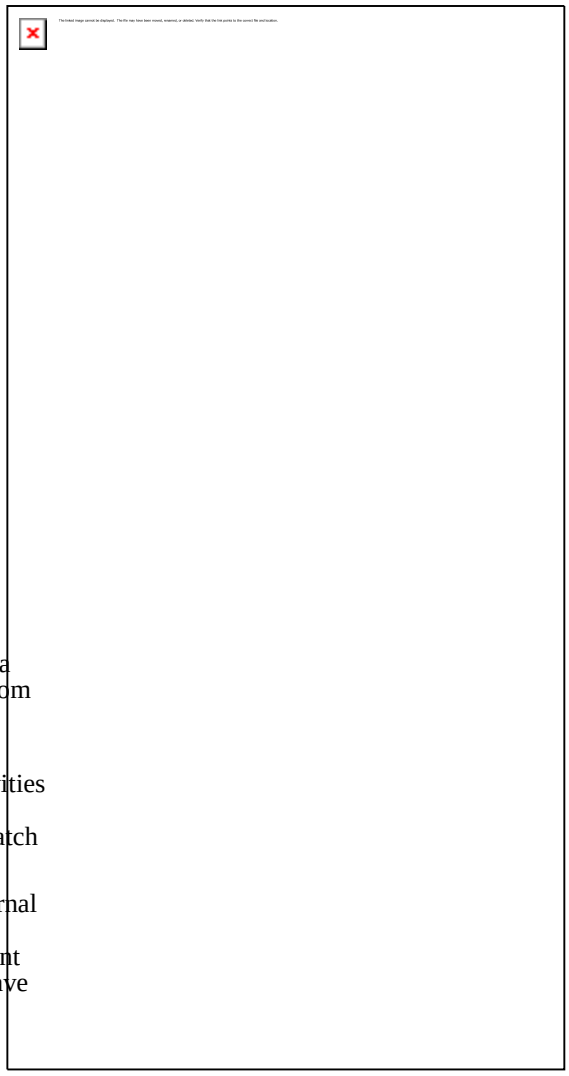

Table 1: Actual setup activity before SMED

Table 2: Conversion of activities to external

After analysing the whole setup activities, fixture and lang is standardize on the machine bed which further reduced setup time upto 8 minutes.
Streamlining all aspects of the setup operation: Various solutions were used to boost each internal to external activity. We check the best solution for activities using various experiments and iteration. In the machine setup process, we removed the straightness dialing with dowel pin indicating Poke-Yoke. We saved 19 minutes with experimentation and 11 minutes with enhancement ideas. Prior to implementation, we choose the best solution for each operation.
To maximize setup time, we incorporated the best solution. We reduced machine startup time from 80 minutes to 24 minutes by using the SMED technique and kaizen. With the introduction of the improvement task, we saved a total of 56 minutes. New approaches are used to verify the new setup. Table 3 depicts the setup operations after the changes have been implemented.

3. RESULTS AND CONCLUSION

Our initial goal for this project was to decrease setup time by 50%, from 80 minutes to 40 minutes, but with the introduction of improvement ideas, we were able to cut setup time from 80 minutes to 24 minutes. The setup time is decreased by 70% as a result of SMED implementation.
Figure 4 depicts the setup time before and after SMED implementation.

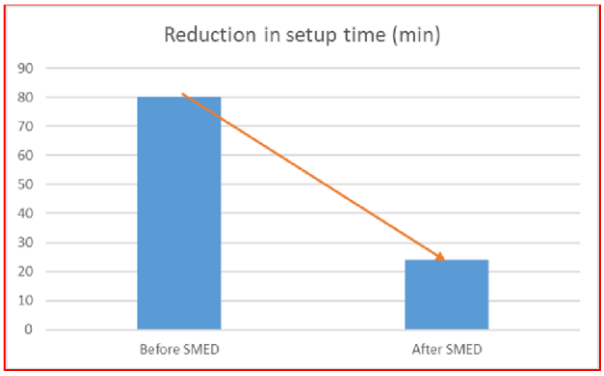

Fig 4:Setup time comparison

Machine availability improved by 60 minutes a day due to a reduction in setup time. Before the improvement in setup, the operator could produce 34 pieces per day; after the improvement in setup, the operator can produce 42 pieces per day. It yields a 20% rise in productivity. Delivery time reduction, capability increases, improved operator morale, lower overall cost of goods and inventory, benefits were determined with the help of setup time reduction. Table 4 shows a list of the benefits.

Table 4: Improvement achieved

Parameter	Before SMED	After SMED	Improvement
Setup time	80 min	24 min	70% down
Productivity	34 piece/day	42 piece/day	20% up
Gearbox	260/month	310/month	50/month up

This study focuses on using the Single Minute Exchange of Die (SMED) technique to reduce the time it takes to set up a VMC Machine. According to the findings, a significant reduction in setup time was achievable. The results show that by implementing a good improvement concept, the setup time can be reduced from 80 minutes to 24 minutes. This research has shown that removing NVA from the process can have a significant impact on the manufacturing system. The basic goal of Lean concepts is to achieve this. The elimination of NVA, or waste, in the entire process contributes to increased efficiency, cost savings, and quicker product delivery to customers.

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