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Reduction of setup time in CNC machine using SMED technique

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Abstract- Nowadays more manufacturing company facing the problem of loss of more time spend for the setup process. SMED is created by shigeo shingo. SMED is the one of the lean tool to reduce setup time in any machine less than the 10 minutes that's why it is called as single minute exchange of die. And then this paper evaluate the organization and execution of SMED for reduce setup time in CNC machine when we reduce setup time in CNC machine Company profit and productivity also gradually increased.

Keywords — Single Minute Exchange of Die (SMED), Changeover Time, Setup time, CNC Machine.

1.INTRODUCTION

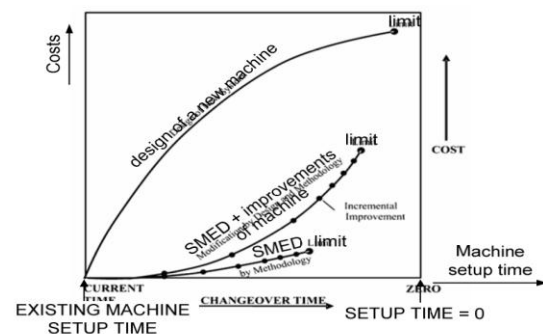
Due to the complexity of competitiveness many manufactures are under pressure to produce and deliver the products within shorter delivery times.

Applying lean principles of SMED and other tools represents a systematic method for identifying all activities which contribute in the value stream of decision making process and eliminating non value added activities which are losses of available time. The goal of any business to make profit. SMED is scientific approach to reduce setup in any manufacturing industries.

For example is F1 (formula one) race they stop the cars in pits for fuel, filling and changing tires, water all requirements are completed within 10 to 15 seconds which is the best example of the application of SMED and successfully achieving. They are already prepared for all parts materials before the pit stop begins.

SMED system is a set of techniques that perform changeover operation in less than 10 minutes or single digit minutes. SMED also known as quick changeover of tool it was developed by shigeo shingo. In single minutes exchange of dies there are four stages. Preliminary stages, separate internal and external setup, convert internal to external setup and finally streamlining all aspect of setup.

Setup time is defined as time taken by between last good piece of previous run and first good piece of next run. The objective of this project is to reduce the setup time and to increase the productivity by using SMED and other lean tools. Setup time of CNC machine is about from that reduce to 41 minutes only. The below given figure shows the relation between the machine setup time and costs. Figure 1: Relation between machine setup time and costs.



SETUP

Setup time is time taken between last good piece of previous run (finished piece) and first good piece of next run (commencement of next job). Setup times are non value added activities

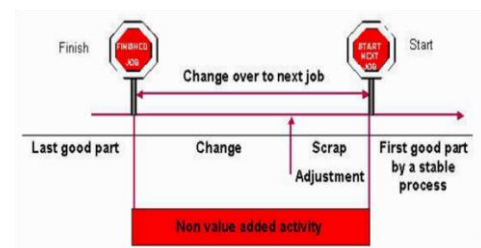


Fig 2 : setup time

SMED

Single Minute Exchange of Die (SMED) is a concept originated by shigeo shingo, Japanese thought leader who helped evolve the Toyota

production system. This method chosen for setup time reduction of a CNC machine for this project.

SMED is defined as the minimum amount of time necessary to change the type of production activity taking into consideration the moment in which the last piece of a previous lot was produced or the first piece produced by the subsequent lot.

II. LITERATURE REVIEW

McIntosh, Culley, Gest, Mileham, Owen (1995) illustrated about importance of activity categorisation before implementing the SMED. This process provides information's about product, machine, tools, fixtures, fasteners, housekeeping and etc., to prioritise activities and take up implementation in a rigorous fashion, with full commitment at all levels without any hurdles [4].

Patel, Shaw, Dale (2001) illustrated that how smaller organisations are approaching the set-up time reduction and mistake proofing. The paper mainly talks about the barriers of implementing these techniques such as lack of financial support, resistance to change, lack of strategic planning and lack of knowledge and training. In smaller company always management hesitates to change .

Claire and Richard (2001) have talked about the fundamental requirements before implementing the SMED phase introduced by Shingo. The case study of textile industry in this paper reveals that the foundations for SMED can be built with following prerequisites,

- Teamwork approach to communication;
- Visual factory control;
- Performance measurement; and
- Kaizen to simplify both assessment & measurement.

Imen (2005) illustrated in one of his collection that how techniques like 5S' and visual controls helps in successfully implementing SMED, showed that how to reduce trial runs and control and also expressed that SMED is not only suitable to industries it can also be used from bakery to the office works.

Das, Baki, Li (2009) have illustrated changeover optimization. It addresses the issues of machine loading, tool allocation, and part type grouping with the intent of developing an operation sequencing technique capable of optimizing operation time, non-productive tool change times, and orientation change times. They have basically approached with computational method to solve these problems.

Bikram Jit Singh, Dinesh Khanduja (2010) have talked about the manufacturing excellence. They have illustrated SMED as one of the technique for organisations to achieve manufacturing excellence. In the paper they have explained how the Indian SME's are approaching these concepts. The paper basically talks about the implementation steps of SMED like how to separate internal & external set-ups, how to optimize, also talked about the cost analysis of set-up change.

- The literature survey reveals that the implementation of SMED will improve the productivity and reduces the running cost of the machines.
- The data gathering and analyzing the data with appropriate tools will certainly helps to identify the problems.
- The prerequisites are to be categorized before approaching the SMED for better results. Significance of operators' training in order to make the system work, stabilize and to continuously improve the same. The importance organization involvement to make the successful implementation of the system.

III. SMED TECHNIQUES

- Separate internal and external setup operation.
- Convert internal into external setup.
- Streamlining all aspects of setup.
- Use functional clamps or eliminate fasteners altogether.
- Eliminate adjustment.
- Mechanization.
- Use intermediate jigs and fixtures.

IV. ORGANIZATION AND EXECUTION OF

SMED

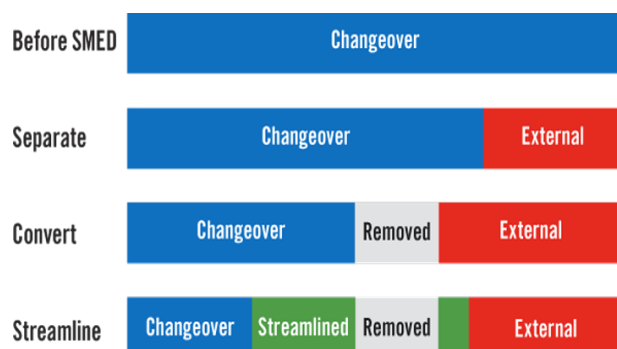


Fig 3 : SMED Stages

STAGES OF SMED

- Analysis of current setup activities
- Separate internal setup and external setup
- Convert internal setup into external setup
- Streamlining all aspects of setup

1. Analysis of current setup activities

Observe the current setup operation activities to carried out by manual. Otherwise videotape is the best for time observation & visualize by the videotapes. And then what are operation performed. How much time it will take to each and every operation.

2. Separate internal and external setup

This step is to separate internal and external elements. Internal elements are carried out when machine is stopped (i.e. Not making parts).

External elements are that can be completed while the machine is running.

3. Convert internal elements into external

In order to convert internal into external setup. Main focus was on related with tool searching, drawing clarification, program changing, tool not available for the next operation. Where we can reduce or eliminated delay, unwanted motion. Pallet change and tool cabinet, check list are gives better result.

4. Streamlining All Aspects of Setup

All setup operation internal and external are finally improved by some ideas and technique. Internal setup streamlining can be achieved by parallel operation.

TASK	TIME (mins)	INTERNAL	EXTERNAL	IMPROVEMENT IDEAS	AFTER SMED TIME (mins)
Job unloading from the M/C	8	✓	–	Use pneumatic spanner, reduce no.of bolts and nuts.	4
Programme feeding in M/C	2	✓	–	–	2
Next job is loading on M/C	10	✓	–	Functional clamps and pallet change.	6
Tool searching	5		✓	Prepare check list and preset tools.	0
Tool setting	20	✓	–	Provision for setting block and modular tool holder.	12
Machining	70		✓	–	70
Tool is not available	5	✓	–	Preplanned set of tools and drawer tools cabinet.	0
Dial gauge is holded and unholded	4	✓	–	Additionally use holding device in machine.	3
Testing and inspection by dial gauge	7	✓	–	–	7
Diagram doubt and clarification	9	✓	–	Before the commencement of work discuss with designer and supervisor.	5
Calculation for program changing	8	✓	–	Preplanned and discuss with program designer.	6
MDI Program changing	15	✓	–	Stimulate and check the program before the work start.	10
Blow air for Chip removal	3	✓	–	Pallet change.	0
Total time	166				125

Table 1: Analysis of current setup activities and implementing SMED.

Before using the SMED techniques current setup time is 166 minutes then after using SMED setup time is reduced to 125 minutes, so we can save 41 minutes by some improving techniques.

In this table what are the internal setup and external setup activities are carried out in the CNC VMC machine and then how we can reduce this setup time by some ideas are also given in the table.

V. PARETO CHART ANALYSIS

Pareto analysis is a formal technique useful where many possible courses of action are competing for attention. The purpose of this exercise is to track the causes of lost time and determining which are the worst offenders. This can be done with the within an individual production workstation across multiple work station. Its drawn by using excel sheet. Pareto chart analysis for detailed current setup activities are given below in Fig .4

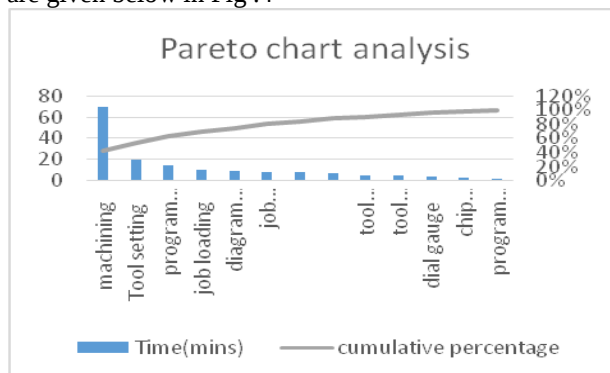


Fig.4 : Pareto chart for detailed current setup activities.

The Pareto chart provides a graphic depiction of the Pareto principle, a theory maintaining that 80% of the output in a given situation or system is produced by 20% of the input.

VI. CONCLUSION

This work mainly focused on the application of Single Minute Exchange of Die with the intention of reducing setup time in CNC VMC machine. Setup time reduced in CNC machine from 166 minutes to 125 minutes so that 25% setup times are successfully reduced and 41 minutes are reduced from previous setup time by using SMED. This objective of this project have been achieved and this project was successfully done.

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