Study of SMED Methodology and Its Systematic Procedure of Implementation

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Abstract:**To stand in today's globalizing world, the manufacturer's need to find new ways to reduce the production time. Many manufacturersstruggle to improve productivity, producing the right products or services at right place and meeting timely delivery. Short changeover times are now a critical part of manufacturing business because of small batch size. This process of changeover needs to be streamlined with the removal of waste and non-value added process. The changeover time reductionmethodology has predefined procedure and steps. Starting with the data collection, changeover time reduction project proceed towards removal of unnecessary steps or implementing different method for same procedure. New techniques or tools are used to shorten the time taken for any process. Various additional processes are added to it to make sure that effectiveness of the project increases. All these newly added process and steps are the outcome of various studies and work that were carried over time in the field of manufacturing and process engineering. The present paper suggests process steps of Single Minute Exchange of Die for change over time reduction.Future scope of improvement is also suggested wherever possible to further decrease the cost and time.**

Keywords: Productivity, SMED, Changeover time, Set-up time

I. INTRODUCTION

Due to intricacy of market and competitiveness many manufacturing are under pressure to produce and dispatch products in small batch.[1]High variety and low quantity parts is major scenario of the present production system, this has led to wave off economic batch quantity concept.[2]As a result batch sizes have reduced and continue to shrink.[4] However this type of production leads to significant increase on setup frequency. Thus ability to perform quick setup process is widely acknowledged as an essential requisite to flexibility and small batch manufacturing. The importance of short changeover time has always been critical for manufacturing companies.[12]Now a day's customer demand a wide range of products delivered with high quality and quicker response.The idea behind setup time reduction plan is to remove waste. Companies are these days focusing on to reduce the setup time and to remain in the competition.[9]Many of the firms are going for the Single Minute Exchange of Die (SMED) method, which is quite simple and results obtained are well satisfying. Flexibility of production and Responsiveness to market are the two main pillars of manufacturing, which is operated by the demand of the products variety and quality.[10]

II. LITERATURE REVIEW

When working in any kind of manufacturing, one of the unfortunate things is waste. Waste can extend from unused raw material to damaged products, and it can carry quite of a financial loss for the company if not treated in an efficient manner.In order to reduce waste, there are several number of methods and strategies that companies can use depending on the desired results.[6]The techniques used in the Lean philosophy are based on five fundamental principles: create value for the customer, identify the value stream, create flow,produce only what is pulled by the customer, and pursue the perfection by continuous identification and elimination of waste. Due to the increasing demand of the smaller lot sizes and to meet the required flexibility of the customer, Shiego Shingo in 1985 in Japan proposed a method called SMED, which states that the changeover should take one minute or more precisely less than ten minutes. Single Minute Exchange of Die is related to setup reduction and is main objective is to reduce the time to a single digit value.[2]

III. SINGLE MINUTE EXCHANGE OF DIE

It is a system for reducing the time it takes to complete equipment changeovers. The essence of the system is to convert as many changeover steps as possible to "external" and to simplify the remaining steps. "Changeover" is defined as the period between the last good product from previous production order leaving the machine and the first good product coming out from the following production order.[14, 15]Quick changeover is a key to reducing production lot sizes and thereby improving flow.[18]

Landeghem classified the different reasons for reducing setup times into three main groups [3]:-

A. *Flexibility:* Due to the large amount and variety of products and due to the reduction of the quantities requested by customers, a company must be prepared to quickly react to customers' needs.

B. *Bottlenecks capacity*:Especially in these cases, every minute is crucial. Changeover time should be minimized to make sure maximize the available capacity for production.

C. *Costs minimization*: Production costs are directly linked to the performance of equipment. With setup time reduction, machines stop for less time, thus production cost decreases.

Shingo considered elimination of waste from process.
The waste is known as 'MUDA' in Japanese which is further sub-categorized into seven parts

A. *Overproduction:* Are you producing more than consumer demand?
B. *Waiting:* How much lag time is there between production steps?
C. *Inventory (work in progress):* Are your supply levels and work in progress inventories too high?
D. *Transportation:* Do you move materials efficiently?
E. *Over-processing:* Do you work on the product too many times, or otherwise work inefficiently?
F. *Motion:* Do people and equipment move between tasks efficiently?
G. *Defects:* How much time do you spend finding and fixing production mistakes?

There are two types of activities that are involved in the setup or changeover.

A. *Internal Activities:*Setup activities that are conducted while equipment or machinery is not in operation. This time affects the production and is needed to reduce as much as possible by using different methods.

B. *External Activities:*Setup activities that are being conducted while equipment or machinery is performing operation.[10] This time is utilized to save the internal time and do processes like tool collection arranging attachments or parts on places which are easily accessible during the changeover.[17]

There are the following terms which define SMED:

A. *Batch:* A quantity of items that are processed together.

B. *Changeover:* The process of switching from the manufacturing of one product or part to another on a machine or a series of machines by changing parts, dies, molds or fixtures, also called a set-up. Changeover time is the time elapsed between the last pieces before changeover to the first good piece from after the changeover.[16]Figure 1 shows the changeover activities from last product of batch A to first product of batch B.

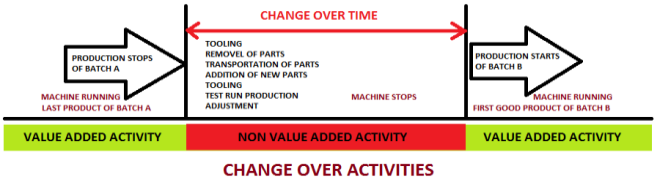

Figure 1: Changeover Activities

C. *Die Set:* This is the tooling that is either removed or replaced during a changeover.

D. *Downtime:* Production time lost due to planned or unplanned stoppages.[13]

E. *Lot:* A quantity of itemthat are processed together.

F. *Value Added Activities:*The activities that add value to an item from the customer's perspective.

G. *Non-Value Added Activities:* The activities that add costs but no value to an item from the customer's perspective. These are activities that the customer is generally not willing to pay for.[8]

IV. METHODOLOGY

The SMED methodology is a part Lean tool that supports organizations in the reduction of setup times and in the elimination of wastes identified in the changeover operations.[3]Figure 2 shows suggested methodology for implementing SMED.

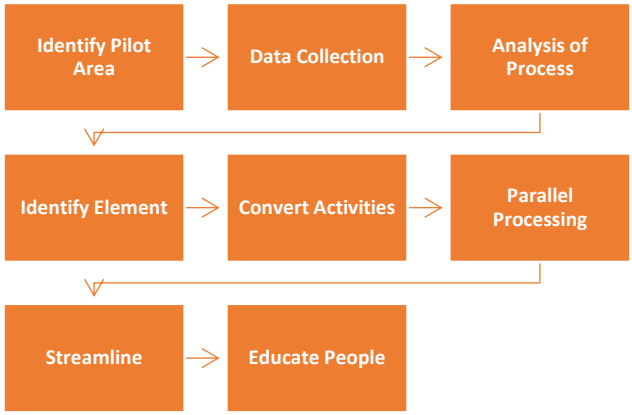

Figure 2: SMED Implementation Steps

A. *Identify Pilot Area:* In this step, the target area for the pilot SMED program is selected. This starts with the selection of production line and then narrows down to the machine which have the maximum changeover time on the line. This machine should worth implementing changeover.

B. *Data Collection:* Based on the actual production, data has to be collected of current situation.[11] Then number of video recording is done and stop watch

observations are carried out.Eliminating the time that may be wasted during searching required equipment is important. Therefore, a list of materials and equipment's that is being used during setup is made. Also, forms are designed to enable that they are available and properly working when needed.

C. *Analysis of Process:* Videos are used to analyze how setup tasks are executed in the current case. Then, based on the stop watch observations, total time is analyzed. A chart is drawn where the time taken for each movement and process is mentioned with the time taken to perform the same.

D. *Identify Elements:*After analyzing the present situation in the previous step, internal and external activities are identified and now separated. In this step, groups of task are formed and their total time is identified.

E. *Convert Activities:*Identifying elements helps in converting internal to the external one. In order to convert internal activities to external activities, main focus is made on the tasks related with product and material handling, information gathering, cleaning, maintenance, adjustment and control. These activities can be easily converted into external.

F. *Parallel Processing:* Activities that performed in seriesin present scenario and can be made parallel by studying and finding methods of combining. This is done by adopting new sequence of performing activities.

G. *Streamline:* In this step, the improvement studies should be reported and checklist is made. The causes for recursive activities were determined as much as possible and act plans to eliminate them were provided. Finally, the setup tasks will no longer be unpredictable time delays by use of the precise time records. Therefore, better planning activities will lead to better customer satisfaction.

H. *Educate People:* The education and skill levels of the workers are also an important issue that needs to be considered during SMED. The educated and well informed people are able to perform activities smoothly. The new sequence of performing activities is introduced to them.

V. RESULT AND FUTURE SCOPE

The developed process is made a part of production line and this is also video recorded as well as time is noted using stopwatch. The changes observed are shown in Figure 3.

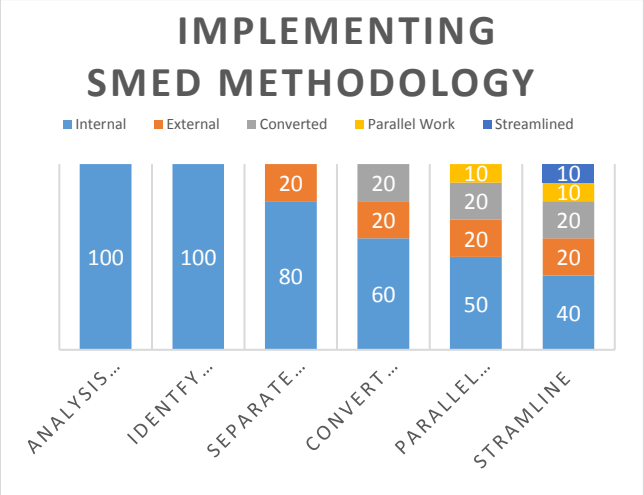

Figure 3: Result representation after Implementing SMED

The video is analyzed and new time is noted of execution for each activity. The result shows a reduction of 60% of setup time with 40% activities made external. 20% of time is saved by parallel processing and streamlining the activities.

As anything in this world is not perfect there is a scope of further improvement. Likewise in this implementation of SMED methodology there are some issues that are still in process and can be removed in future with innovaton and improved technology so they are suggested as future scope.

VI. CONCLUSION:

Implementation of the lean principles in any process will bring good results to any industry. Huge results can be achieved by elimination of non-value adding activities. If these principles are applied in all department of the organization they will bring considerably good results. SMED methodology is applied to prepare a standard operating procedure for the changeover operation on particular machines. A comparison of results achieved before and after SMED implementation is to be made. The elimination of the wastes improves the productivity which in turn delights the customer and helps the organization to move towards their vision and goals. I conclude that by educating the people about SMED technique and following proper procedure, Productivity can be achieved and wastes can be eliminated. It should be kept in mind that successful implementation of new production methods on line requires sustainability and permanent solutions and the key of sustainability is the standardization of that optimal solution. The SMED results in improvement of ergonomics and safety of the people working in addition of cost and time. The future scopes are also mentioned if any.

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