Single Minute Exchange of Dies: Overview

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ABSTRACT
Single Minute Exchange of Dies (SMED) is one of the lean production methods for reducing waste in a manufacturing process. In the current competitive scenario, controlling cost of manufacturing is a key to generating profits in any manufacturing concern. The key area to optimize manufacturing cost is utilization of machines most economically! Any machine down-time causes loss of productive time. The SMED technique works on rearranging and/or eliminating some of the elements in the changeover process. This would reduce total down-time and will increase available machine time for production. In an era where time is considered as money, SMED is a systematic way of ensuring that the shortest possible time is consumed for changeover activities. One must clearly understand that, "higher the cost of the machine, higher is its down-time cost". Stopping costly machines from production without any valid reason should be treated as an Organizational Crime. This is particularly the case for key machines like Ring Frame, Automatic-Winding machines, Looms, Stenter, etc. which are considered as the profit centres of a textile unit. The key aspect of Single Digit Minute Exchange of Dies (SMED) is internal and external activities of the methods. It deals with transferring internal activities into external ones.
Keywords: Die exchange, internal-external set-up, lean manufacturing, quick changeover

I. INTRODUCTION

SMED is a Japanese technique of management invented by Mr. Shingo. SMED means single digit minute exchange of dies. The die should be changed or exchanged in less than 10 minutes since it moves to double digit from 10 onwards. In real practice, any changeover activity should be covered in the least possible time. The technique used should make machine availability time more and minimize idle time for any scheduled changeover and other processes. This is suitable for any machine type, changeover activities and activity related to prolonged stoppage of machine. Implementation of SMED has become increasingly relevant in current times. Automatic modern machines used in present times are costly. A large amount is blocked in purchase of capital equipment and machines. Secondly, as compared to conventional machines, modern machines are nearly twice or thrice more productive. As such, compared to the old set up, fewer machines in sequence may create a troublesome situation in balancing the process line. More stoppages of such advanced machines will produce bottlenecks and thereby, lower the overall production of the organization. Therefore, any machine stoppage/ down-time is costly and critical. For an organization to maintain its competitive edge, costlier machines should be utilized to the maximum by controlling down-time; SMED helps in doing this.

II. SMED AS A LEAN MANUFACTURING TECHNIQUE

Production time per unit is lower with an increase in the lot size. The main objective of SMED is to separate external and internal activities from the process and to convert external operations to internal ones for productivity enhancement. [1] By using this technique, Yves De Groote Freelance reduced changeover activity time in the packaging line by 20%. The extra time available can be used for flexible production and other activities without high investment. [2] The necessity of SMED and fast changeover programs are more popular than ever due to higher demand for product variability, lower product life cycle and the need to reduce inventory. It has numerous benefits like reducing work in progress attitude i.e. delay in delivery of goods to customer, to increase the return on investment from the machine with better utilization. Identify the proper SMED technique and separate the changeover activity into external setup consisting of operations carried out while the machine is running and before changeover starts; internal setup consists of activities when the machine is stopped. Additionally, this may result in non-essential activities/operations. [3] SMED can remove non-essential activities, carry external setup and simplify internal setup. This method was invented and applied by Mr. Shigeo Shingo in the auto industry in Japan. At the time of implementation, it was found that once in time setup/ changeover, there was a huge problem of manufacturing of pressed car parts like doors, boot covers etc. The machine had to be stopped for 24 hours for changeover of the press for production of another part. By applying SMED, reduction in changeover time to a few minutes was possible. Currently, this method is widely used world over to reduce setup time and has been applied with success in various industries. [4] The validity of the method and procedure are verified where setup time changes are critical. Time saving is achieved with lower investment. Further, issues related to employer safety and ergonomics during changeover can be noted and necessary improvement can be done. This technique is used as a part of Total Productivity Maintenance (TPM) and continuous process improvement program. With the aid of SMED, improvements are substantial with data

showing reduction of setup time from 25% to 85%. This helps to bring in greater production flexibility for more frequent product mix at an affordable cost. [5] The key focus was on reducing the down-time or stoppage time during the warp knotting operation. Some trials were undertaken related to parameters which affect the warp knotting process and which lead to increase in the downtime. In one of the trials, the time required for knotting of pile beam and ground beam was observed. Based on the required equipment available for knotting, some trials were carried out in knotting of pile beam and ground beam. By implementing all results from the trials, there was a reduction in time of about 15 minutes in pile warp knotting operation and about 14 minutes in ground warp knotting operation. Improvement in the quality of warp knotting process and minimum end breaks is seen. [6] A change in the mindset towards routine operations is recommended in the SMED technique. A significant increase in machine availability could be obtained by observing routine activities from a different perspective. Many of these gains were without additional expenses or with marginal additions. Changing the existing methods to a better-suited method is recommended for reducing the time required for "internal elements". The principle of change in the workload is found to be useful. In every study, scope for reducing machine down-time was noticed through application of the SMED technique. The percentage of reduction in machine down-time varied from 17% to 28%. [7] The term SMED really represents an attitude of mind rather than merely physical exchange of dies on the shop floor. For higher productivity, machine availability must be ensured. Machines become non-productive when certain changes are required to be made or scheduled cleaning and preventive maintenance activities are to be carried out, due to the nature of the process. When time is money, SMED is a systematic way of ensuring that the shortest possible time is used for changeover activity. With SMED, completion of a given operation within the minimum time can be achieved without last minute unscheduled changes. SMED is mainly used in situations such as change from one type of item to another in the manufacturing line and routine machine cleaning, setting, preventive maintenance to complete given tasks in a few minutes without mistakes, with less investment. [8]

In a conventional set up operation, internal and external set ups are confusing. The operation, which could be done externally, is done as an internal set up. Therefore, machines remain idle for a long period. While using the SMED technique, one must study the actual shop floor condition in great detail. The initial steps to reduce set up time are as follows: [9]

- Select the machine for which set up is to be reduced.
- Interview the workers about set up operation difficulties they are facing.
- In case of a complicated operation, the set up process is captured in a video recording.

Fujimoto, Takahiro and Shimokawa Kouichi [10] state that the SMED process is fairly common-sense. In the history of the automobile industry, Nissan and Toyota started setup reduction work at the same time. The activity was carried without consultations with Mr. Shigeo Shingo or anyone else. In recent years, a few industrial engineers and equipment designers have given thought to this technique. Lean manufacturing has shown good results in continuous linked process industry like textiles. In textiles, there is a need to react quickly to respond to changes in fashion trends or the market. The mindset of employees is that they can work effectively without lean and there is no need to change the existing technique of changeover/ setup time to change the die. There is also a fear in the mind of the manager of adverse effects on production and cost if the new technique fails. [11] Lean is used for discrete items with large volume and low variety. The availability of the machine, improvement in efficiency and low cost of production results in effectiveness of the machine. Hence, TPM is an effective tool in manufacturing industries. While implementing this, we find barriers like lack of exposure of the management, and difficulty in understanding the process and methodology by the middle management. Since this process takes time to implement, the management shows strong resistance to it. However, it is the key aspect between failure and success of companies as far as maintenance is concerned. [12]

III. DATA COLLECTION AND ACTIVITIES UNDER SMED OPERATION

The work allocation among the work force and their activities are observed. Time required for specific elements in the activities should be noted in the prescribed format using a stopwatch. After critical evaluation, the activities are classified into (a) internal set up and (b) external set up. Again, each internal set up task is observed to check whether it can be performed as external set up. The findings about the possible changes in activity should be discussed with the concerned authorities. The suggested changes are then applied in practice. After implementing the changes, all the activities should be observed repeatedly for effective time saving. The same activity is observed in various organizations. These observations help to assess the different methods for carrying out the same activity.

Methodology

Step 1: Observe the current method; follow to changeover. Team work will be used to observe the changeover by means of Recorder, Timers and Fact collectors. Recorder - Overall duration, breaks the changeover activity

in detail, record the equipment used. Timers - Time each step. Fact collectors - Breakdown the steps into actions in as much detail as possible.
Step 2: Separate the Internal and External activities. Internal activities are those that can only be performed when the process is stopped. External activities can be done while the last batch is being produced, or once the next batch has started.
Step 3: Convert (where possible) Internal activities into External ones.
Step 4: Streamline the remaining Internal activities and changes, by simplifying them. Analyze the elements (facts) and discuss all possible ways of improving the steps.
Step 5: Streamline the External activities and changes. Analyze the elements (facts) and discuss all possible ways of improving the steps.
Step 6: Document the new procedure and the actions that are yet to be completed. Write down the new internal and external procedures. Fill in the action sheet to ensure that the new procedures can be achieved. Review the whole activity to determine the changes that the team should make before the next SMED activity.
Step 7: Carry out the process repetitively to reduce changeover time.

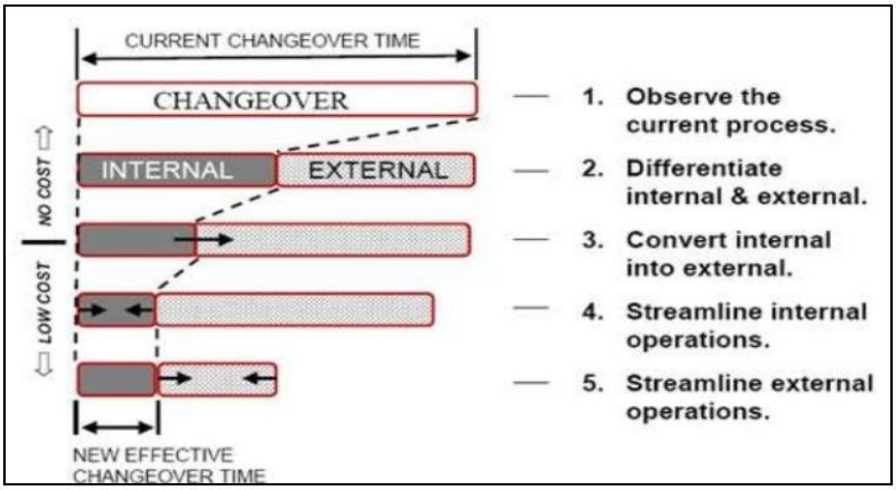

Figure 1: Quick changeover activities

IV. BOTTLENECKS IN SMED PROJECTS

Van Goubergen sums up a few bottlenecks in implementing SMED [2]:

a. Many companies believe that changeover is a necessary evil that has to be accepted. Therefore, changing over is avoided as much as possible, often resulting in batches that are too large.
b. People often think that reducing the changeover time is purely a production problem. But it is also a design problem. According to Van Goubergen, there is an enormous gap between the engineers designing the machine and workers using the machine.
c. It is also believed that changeover is no more than just exchanging a few parts and setting the machine, after which production can continue. This is not the case; changeover starts the moment the last item of product A is produced and ends as soon as product B is produced at nominal speed of machine. Sometimes, the changeover takes only half an hour, but readjusting the production process takes half a day.
d. Many people believe that changeover is a technical issue and always has a cost. That is definitely not true. Changeover is a combination of organization, method and technology.

V. CONCLUSION

Initially, the SMED technique was utilized in mechanical industries; after its benefits were observed, it was applied in many manufacturing as well as IT industries to increase production time. The SMED technique works only on one formula - that the 'Internal' activities must, as far as possible, be converted into 'External' activities. The technique requires recognition from the top management team and workers. It makes maximum machine availability for production and improves quality of the product. It reduces the workload of workers, which helps in improving their efficiency with respect to efficiency of the machine. Significant time savings are achievable using the SMED technique with minimum investment.

VI. REFERENCES

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