Improving Productivity of a Manufacturing Plant using Single Minute Exchange of Die

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ABSTRACT

This paper is a proposal for the improvement of effectiveness of the manufacturing plant involved in any kind of production process. The concept of the productivity arises from the production system. When the system is at growing stage, the emphasis is not on the efficiency of the system. Neither employers nor employees have the idea about the effectiveness and output is not in accordance with inputs that's why wastages are more and profits are less, but after the scientific management concepts people seemto be productivity conscious.

The Single Minute Exchange of Die (SMED) is one important lean tool to reduce waste andimprove flexibility in manufacturing processes allowing lot size reduction and manufacturing flow improvements. SMED reduces the non-productive time by streamlining and standardizingthe operations for exchange tools, using simpletechniques and easy applications. However theprocess doesn't give the specific actions toimplement which can result in overlooking improvements. To overcome this, common statistical and industrial engineering tools can be integrated in the SMED approach to improve SMED implementation results. The applicability of the proposed SMED approach was tested for assembly machines changeovers in the automotive industry. The implementation has enabled reduction in setup time,through company's internal resources reorganizations without the need for significant investment.

The main factor of setting downtime was found in calculation, which was responsible for the increase downtime. After defining problem we used Single minute exchange of die (SMED) to reduce setting downtime. After implementation of SMED tools in assembly line we reduce setting downtime in Leak testing station. And this method implemented all three cells with the help of SMED downtime was reduced and productivity was increased. Finally some suggestions were made to case company for improvement of OEE, productivity and lean manufacturing tools.

Keywords: Single minute of exchange die (SMED), changeover, improvement, Performance calculation, productivity, Overall equipment effectiveness.

INTRODUCTION

Due to the intricacy of market order and competitiveness, many manufacturing organizations are under Pressure to produce and dispatch products in shorter delivery times. In the past a lot of effort has been put to reducing the cycle time and speeding up the output rate whilst totally ignoring the change overtime from one product to another. This has lead to the Economic batch quantity Concept and has resulted in small batches appearing to be uneconomical to run.(Antonio Carrizo et. al, 2011) Reducing Setup times (which we rarely concentrate on) can give the Equivalent of huge increase in process speed (which we almost and always concentrate on).This is all achieved without detriment to the quality of the Product. The idea of a setup time reduction plan is move towards SMED (Single Minute Exchange Die) or OTED (One Touch Exchange of Dies). (Antonio Carrizoet. al, 2011).

As proposed (UlutasBerna, 2011),the three main reasons for setup reduction are:-

a) Flexibility: - To be able to respond very quickly to changing market demands,you need to be able to produce small lot sizes in andan economical way.

b) Bottleneck Capacities: - Reducing setup times increases the available capacity,which can be interesting as an alternative to buying new equipment or installing an extra shift in situations where the market demand increases.

c) Cost Reduction: - Since, especially on bottlenecks,the direct production cost is related to machine performance, an OEE(Overall Equipment Effectiveness) can easily shown theimpact of setup reduction.

LITERATURE REVIEW

Working in any kind of manufacturing environment one of the unfortunate characteristics 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 numbers of methods and strategies that companies can use depending on the desired results. One of the most popular methods is Single Minute Exchange of Die or SMED. (Goubergen Dirk V., 2001)

SMED was developed by Shigeo Shingo in 1950s Japan in response to the emerging needs of increasingly smaller production lot sizes required to meet the required flexibility for customer demand. The SMED technique is used as an element of Total Productivity Maintenance (TPM) and “continuous improvement process” (Goubergen Dirk V., 2001).It is one of the methods of a reducing wastage in a manufacturing Process. The phrase "single minute" does not mean that all changeovers and start-ups should take only one minute, but that they should take less than 10 minutes (in other words, "single-digit minute").

Single-Minute Exchange of Die (SMED) refers to the theory and techniques used for the reduction of equipment setup times. SMED has as its objective to accomplish setup times in less than ten minutes, i.e. a number of minutes expressed by a single digit. Although not all setups can be literally reduced to this time, between one and nine minutes, this is the goal of the SMED methodology (Shingo, 1985).SMED, also known as Quick Change Over of Tools, was developed by Shingo (1985), who characterized it as a scientific approach for the reduction of setup times, and which can be applied in any industrial unit and for any machine. 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 vis-à-vis the first piece produced by the subsequent lot (Shingo, 1985).

Before the development of the SMED methodology, the best way to minimize the cost of idle machines during setup operations was to produce large lots, in order to obtain the lowest possible percentage of idle time per unit produced. According to Min and Pheng (2007), the ideal amount of each production lot was obtained when the inventory costs equalled the costs of idle equipment during the changeover of tools. Toyota came across this problem because inventory costs for their vehicles were extremely high. Before this problem, the best way to reduce the amount of production loss was to reduce setup times (Shingo, 1985).

RESEARCH METHODOLOGY

Statistical data collection methods were used for measuring machine setup time in assembly line A of a manufacturing unit. Production process flow and standard operation procedure were reviewed briefly before setting up the data collection table was done. The next step was to create a data collection table prior to collecting data and the time taken was measured using a stopwatch. Based on the actual production, data was collected and recorded on a daily basis. Subsequently, a statistical bar chart was drawn to monitor and analyse the problems. These methods helped to identify the main contributor to high time loss and helped to visualize and better understand the root causes and finding possible solutions to the problems. (Maynards 2004)

MTBF (Mean time to between failures) can be minimized by applying SMED (Single mode of exchange die) tool, which include the arrangement activities during the maintenance and setup time. In SMED first of all we analyse the available system by distinguish the system as internal and external one, then after that try to maximum conversion of the internal system into external system , the main motive of this conversion is the provide better service or tool during the time of maintenance.

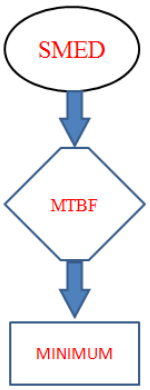


Fig 1 MTBF process

RESULTS AND DISCUSSIONS

We found after OEE recording and analysis that equipmentlosses where setting downtime time were too more as compare to other downtime so we worked on reduction in Set up Change time in B, NB and E manufacturing Cell. We used Single Minute of Exchange Die (SMED) tool.

In all the stations, we studied micro operations, workers movement and methods of operation. Micro operation was done by using stop watch, we calculated time required for each activity and after we recorded and analyzed the workers movement to performed methods of

operation to change the setup of machine. Methods of operation were categorized into the following four types:

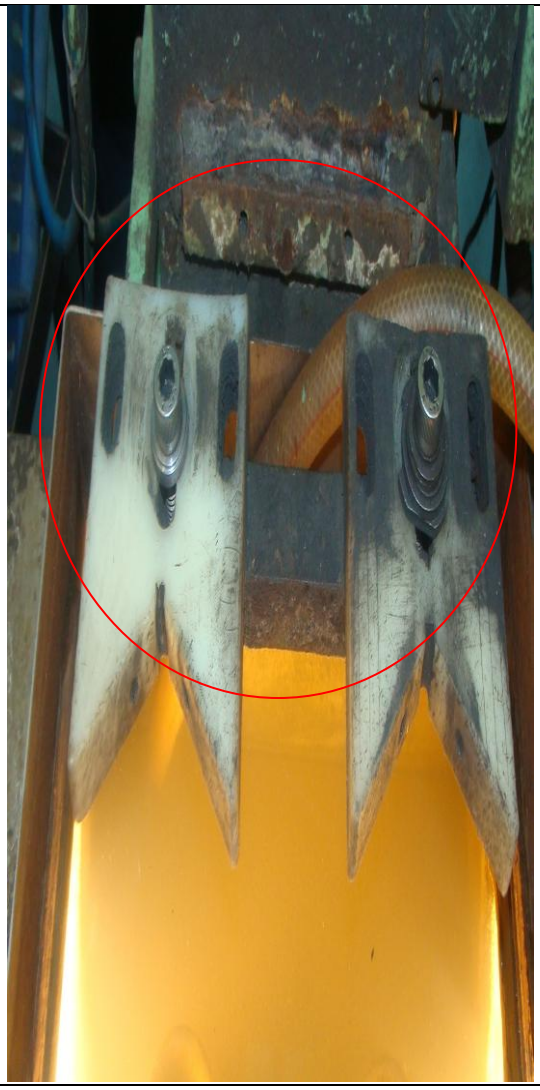
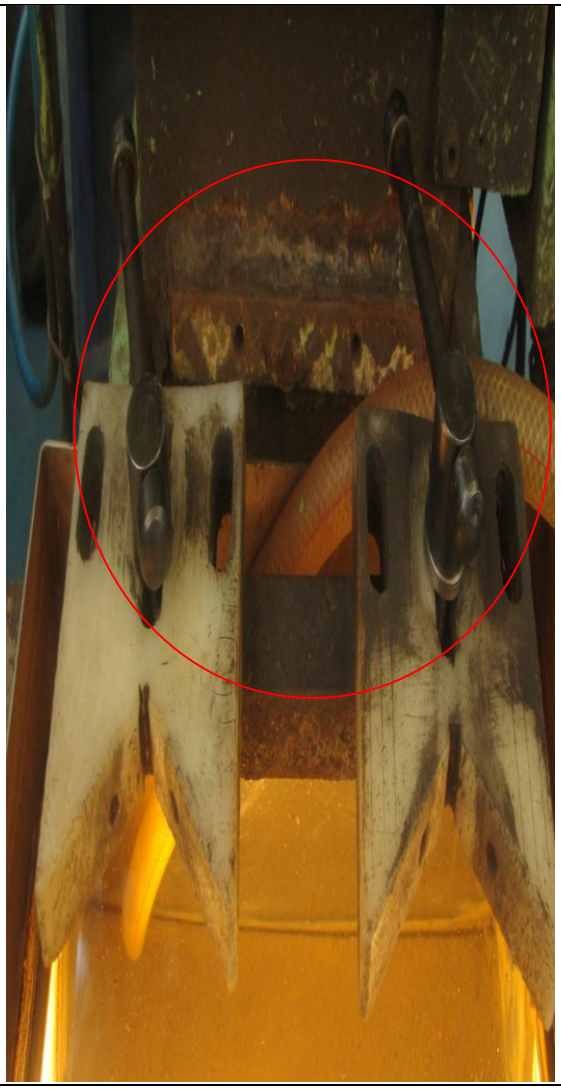
- Elimination
- Combination
- Relocation
- Simplification

Leak Testing Machine station was selected because in both the Leak Testing Machine station and Oil Filling Machine station only one worker was changing the settings. And we implemented SMED tools for reduction of setup time. Table 1 shows below the setting operation performed during tool changeover process.

Table 1 Activity and operation performed during setting changeover process.

Leak Testing Machine					
Before				After	
Sr. No	Activity	Time in sec	Method of operation	Action Plan	Time in sec
Dismounting of Tool					
1	See the plan	10	Nil		10
2	Search the bottom Locator for next PRO.	15	Simplification	One Stand to be provided for the tooling.	10
3	Remove the bottom Locator of Previous PRO.	15	Nil		15
Change of Tool					
4	Keep the Removed locator on the specified position.	20	Nil		20
5	Fit the bottom locator.	15	Nil		15
Adjustment Of Tool					
6	Search the Allen Key.	20	Elimination	T Bolt in place of Allen bolt.	0
7	Loosen the V Block	30	Simplification	T Bolt in place of Allen bolt.	10
8	Put the lower mountings on the bottom locators.	15	Nil		15
9	Set the V - Block as per diameter of the tube.	80	Nil		80
10	Tight the Bolt	95	Simplification	T Bolt in place of Allen bolt.	20
Total Time before		315 secs	Total Time after		195 secs

Figure 1 Before and after implementation of Allen bolt.

Before	After
Search / required Allen key for V-block setting.	Provide modified Allen bolt (T-bolt)
	

We found problem to Search/required Allen key for V-block setting. For this operation more time is required. This problem is shown all three cells and this problem was eliminated by providing modified Allen bolt (T-bolt) by replacement of the normal Allen key. This idea is generated in SMED tools catalogue designed and developed by Shingo (1985).

After analysis table 1 shows that before total setting time is 315 sec/setup change and after implementation of modified Allen bolt (T-bolt), setting time is achieved as 195 sec/setup change, we implemented it in all the cells i.e. NB, B and E cells.

After implementation we calculated reduction in downtime. We used Table 1 for calculation and results are shown in Table 2.

Table 2 Calculation reduction in downtime after implementation modified Allen bolt (T-bolt)

Months	Jan-12	Feb-12	Mar-12	Average of three month
No of set up	193	227	241	220
Time/Setup change in min	24.68	21.93	20	22
Setting Downtime in min	4765	4980	4720	4822
After implementation of modified Allen bolt (T-bolt) average Time/ setup reduce 2 min				Time/setup=20 min
Average monthly setting downtime reduced in one cell				422
Average monthly setting downtime reduced all three cells				1266
Average monthly setting downtime reduced in one cell in percentage				8.75
Average monthly setting downtime reduced all three cells in percentage				26.25

Benefits after implementation:-

Leak testing station saves 120 sec per setting after implementation of SMED tool.
Form table 5.40 shows the average one setting time is 22 minute. After implementation we reduce 2 minute in time/setup change, 422 minute reduced in average monthly setting downtime in one cell and 8.75 percentages reduced Average monthly setting downtime reduced in one cell in percentage it's too beneficial to case company.

- Increase Productivity.
- Elimination of setting loss.
- Ease of Operation.
- Set up Time reduced.
- Low cost to implement
- Less reluctance to perform setup changes
- No special skills required
- Eliminates bottlenecks
- Machine work rates improve
- Setup errors disappear and "set up pieces" are reduced
- Reduced inventory levels
- Safer operations
- Product quality improves
- Deskilling of the Activity.

SUGGESIONS

- Ensuring the right people is present and ready.
- Preparation of tools, parts & equipment.
- Transport of tools, parts & equipment to the required location.
- **Improved transport:** -reducing movement of parts, jigs, tools etc during the internal phase.
    - To ensure that the tools needed are close and ready for setup.
    - To facilitate start up can occur before old tools are returned to storage.

CONCLUSIONS

SMED methodology applied to prepare an optimal standard procedure for changeover operations on defined machine.However, for small batch manufacturers the issues that led to the change in focus for long run producers have not been present to the same degree.A comparison of results and achievements before and after SMED implementation were doneto measure the effectiveness of SMED to reduce cycle time. Hence, not only it is imperative to focus on reducing the amount of productive time that is lost when a machine is being set, but also to eliminate errors, with the application of poka yoke principles to the setting equipment and procedures.

At this present scenario of competitive world only that player are able to stand in this storm of competition who know their abilities and weakness, and very well aware about the global market strategies, and are able to recover from big losses and able to make decision correct with the safety of organizational base. In that case OEE is helping a lot for making organization strong with real details of equipment and production capabilities. Overall Equipment Effectiveness is process to measure the performance rate of plant with three different measuring factors i.e. Availability, Performance and Quality, By applying different tools of industrial management like, Autonomous maintenance, Quality Maintenance, Planned maintenance, Cost of Production, SMED (Single Mode of Exchange Die), 5S (Seiri, Seiton, Seiso, Shiketsu, Shitsuke), Training, Safety and Environment. And, we utilized SMED as a tool in our case study research.

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