Reduction in Setup Time by SMED Methodology: A Case Study

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Abstract - In the present world scenario, the flexibility and responsiveness to customer demands are the imperative task. Perfection is not attainable. But if we chase perfection, we can catch Excellence. To stand up in today's Globalization world, Manufacturers need to find ways to reduce production time and cost in order to improve operating performance and Product quality. It is normally possible to greatly reduce the setup times. Fantastic results are possible through better teamwork, proper Planning and simple modifications. The main objective of this paper is to reduce cycle time of the operation by using Single Minute Exchange of Dies (SMED). This Study is carried out in one of the automotive industry. This document demonstrates the need to overcome most of bottleneck of equipment's unavailability for resources utilization and to run the process more effectively. The project objectives have been achieved where the changeover time was reduced to 24.5% and hence increases the productivity. Single Minute Exchange of Dies (SMED) is the approach to increase output and reduce quality losses in any manufacturing

Keywords- SMED, Cycle Time, Internal and External Activity, bottleneck

I. INTRODUCTION

Business objectives are mainly, long term growth and profitability that can happen only by increasing in the productivity. Due to the increasing demand from the market order and Competitiveness, many Manufacturing Organizations are under pressure to produce good quality products 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.[1] 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). [1]

There are three main reasons for setup time reduction they 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 a economical way.

b) Bottleneck Capacities: - Reducing setup times increases the available capacity, which can be interesting as an alternatives 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 the impact of setup reduction.

II. SMED LITERATURE REVIEW

Setup time is defined as a the elapsed time from when the last part of the current run is Completed until the work centre starts running the first good piece of the next run [2] or Setup time can be defined as from the stop of Production of Product A until the start of Production of non defective units of Product B.

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"[3] It is one of the method of a reducing wastage in a manufacturing Process. The phrase "single minute" does not mean that all changeovers and startups should take only one minute, but that they should take less than 10 minutes (in other words, "single-digit minute"). The production of large lots also has inherent capital costs with the amount invested in inventory. If we add to this inventory cost the capital opportunity cost, it is no longer profitable to produce large lots. In the Single Minutes exchange Of Die there are four stages involved to make a setup reductions which are Preliminary stages, Separate internal and external setup, Convert internal to external setup and Streamlining all aspect of setup. In Single Minutes exchange Of Die (SMED), two important operations are involved. They are the internal and external setups:

• Internal time: can be only carried out when the machine or process has stopped

• External time: could be while the machine or process is still in operating

The SMED concepts was applied accordingly to certain pre-determined conventional process, Plan-Do-Check-Act (PDCA) cycle is a checklist of four stages which must be gone through, to get from 'problem-faced' to 'problem-solved'.

III. DATA COLLECTION AND IMPROVEMENT ACTIVITY

XYZ is the Local vendor for most of the nearby companies who manufacturer automotive components. The company manufactures a range of critical components for commercial vehicles and diesel engines.

Scenario: There are 2 Milling machine and 2 VMC's in machining production line which handles three variants of the component. Each machine has an operator assigned to it. The cycle time for the bottle-neck operation is 5 minutes and 39 seconds. There seems to be enough scope for reducing this cycle time. The output of production line is about 66-70 pieces/shift and 198 pieces/day i.e.198 * 25=4950 pieces/month.

The SMED technique was applied to solve the problem of the high changeover time or conversion time. Analysis of the problem has been conducted and the root cause was identified. Three important tools that were used in collecting data are stop watch, cam recorder and camera. Once the problem has been identified, the next steps are proposing the counter measure of the appeared problem and improve the actual process. To improve the actual process, the SMED technique was applied to reduce the machine changeover. All the data were analyzed and the improvement activity was carried out to improve the current machine changeover time. Verification was done using mathematical equations to check and shows the impact of productivity and capacity based on the improvement activity. The actual data have been collected and shows in Table 1.

Table 1: Time required for various operation.

Operation No.	Description	Tools required	Time (sec)	Operator Condition
1	Mount the component on Machine bed	Manual	11	Working
2	Clamp the component	Spanner	26	Working
3	Tool Setting	Manual	40	Working
4	Close the cover of Machine	Manual	5	Working
5	Machining	-	188	Ideal
6	Open cover of machine	Manual	5	Working
7	Unclamp the component	Spanner	24	Working
8	Unloading the component from Machine	Manual	10	Working
9	Blow air for chip	Pneumatic Blower	10	Working
10	Select the next component for loading	Manual	20	Working

Authors view: According to the above collected data we can make out that the Machine is ideal for 151 seconds (i.e 2 minutes 31 seconds) and worker is ideal for 188 seconds (i.e 3 minutes 8 seconds) and he is busy for only 151 seconds (i.e 2 minutes 31 seconds) and Hence there is enough scope for reducing the setup time.

IV. APPLICATION OF SMED METHODOLOGY

SMED helps to reduce the cycle time by eliminating wastes and unwanted processes and also helps to improve current setup process and manufacturing flexibility. The following activities are carried out during application:- [3]

a) Distinguish Between Internal Activities and External Activities:-

- Internal Activity Means:- Those carried out when the machine has Stopped.
- External Activity Means:- Those carried out when the machine is running.

Table 2: Identifying Internal and External Activities

Operation No.	Description	Activity	Time (sec)
1	Mount the component on Machine bed	Internal	11
2	Clamp the component	Internal	26
3	Tool Setting	Internal	40
4	Close the cover of Machine	Internal	5
5	Machining	External	188
6	Open cover of machine	Internal	5
7	Unclamp the component	Internal	24
8	Unloading the component from Machine	Internal	10
9	Blow air for chip	Internal	10
10	Select the next component for loading	Internal	20

Total Internal Activity Time:- 151 Sec
Total External Activity Time:- 188 Sec
b) Converting Internal Activities to External Activities:-
In order to achieve the single digit setup time, we have to covert internal setup activities to external activities, So that we can use the machine more effectively. In Order to convert internal activity to External activity, main focus is on the tasks related with material handling, information gathering, adjustment and control. In the Current scenario, we can see that the 188 sec are External Activities and 151 sec Internal Activities. Though External Activities are greater than internal, our aim is to convert more internal activities to External.

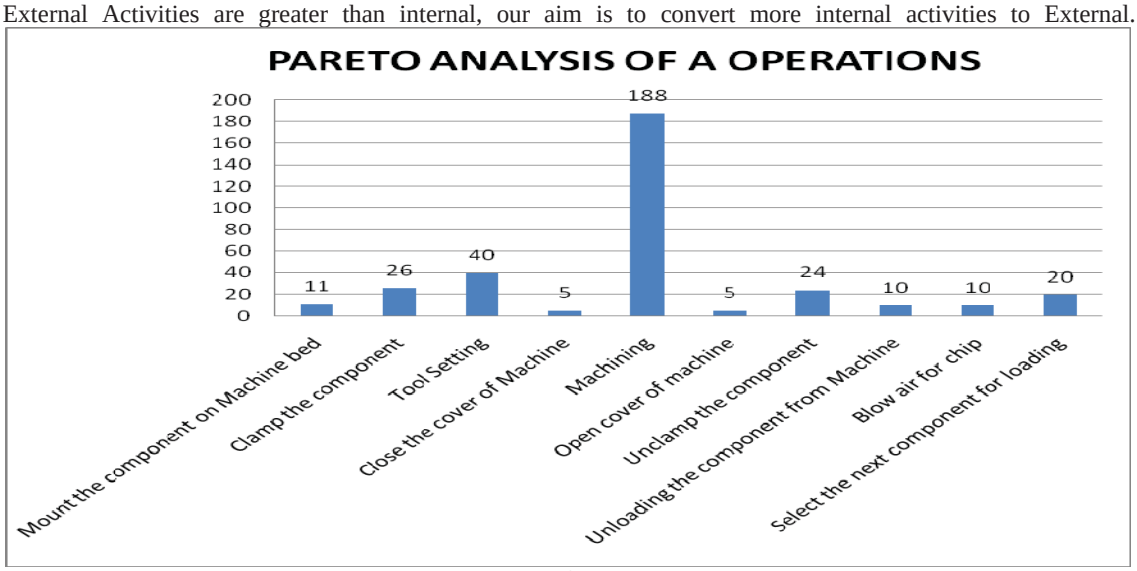

Figure: Analysis of various operation.

By the above shown diagram it is clear that more than 70 seconds are wasted for loading and unloading of the component. One better suggestion for conversion is that we can use the pallet change which gives the better result.

Table : Converting Internal to External Activity.

Operation No.	Description	Time (sec)	Activity
1	Mount the component on Machine bed	11	External
2	Clamp the component	26	External
3	Tool Setting	40	Internal
4	Close the cover of Machine	5	Internal
5	Machining	188	External
6	Open cover of machine	5	Internal
7	Unclamp the component	24	External
8	Unloading the component from Machine	10	External
9	Blow air for chip	10	Internal
10	Select the next component for loading	20	Internal

c) Improvement Ideas:

In the final Step the improvements studies were done and checklists were formed. The causes for recursive activities were searched as possible and ideas implemented to eliminate them were provided.

Table: Before and After SMED

Operation No.	Description	Befor SMED Time (sec)	Improvement Ideas	After SMED Time (sec)	Total time savings (sec)
1	Mount the component on Machine bed	11	Pallet change	0	11
2	Clamp the component	26	Pallet change	0	26
3	Tool Setting	40	POKA YOKE	30	10
4	Close the cover of Machine	5	No change	5	0
5	Machining	188	No change	188	0
6	Open cover of machine	5	No change	5	0
7	Unclamp the component	24	Pallet change	0	24
8	Unloading the component from Machine	10	Pallet change	0	10
9	Blow air for chip	10	No change	10	0
10	Select the next component for loading	20	POKA YOKE	18	2
	Total	339		256	83

Comparison between before SMED and after SMED: - After the SMED technique was applied to the bottle neck Operation, the total time taken to perform the operation was decreased by 24.5 percent from 339 sec to 256 sec. The Company Started producing the Number of Components increased from 198 to 258 per day and Number of Components per month increased from 4950 to 6450.

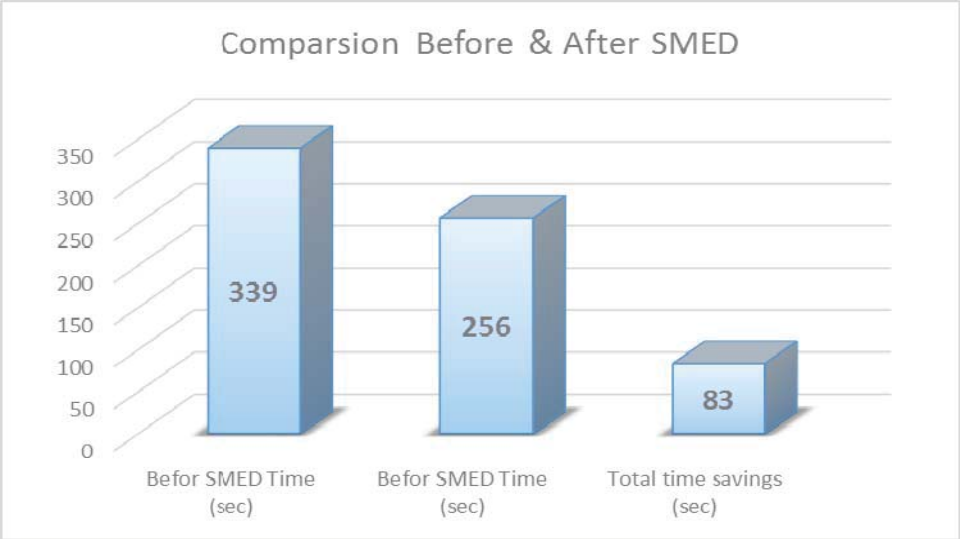

Figure: Comprasion Before & After SMED.

V. CONCLUSION

SMED methodology applied to prepare an optimal standard procedure for changeover operations on defined machine. This study described an effective industrial application of the SMED methodology, which led to significant improvements, reductions of setup time. A Comparison of results and achievements before and after SMED implementation were made to measure the effectiveness of SMED to reduce cycle time. Hence, not only is it 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.
The project objectives have been achieved where the changeover time was reduced to 24.5%.
The Elimination waste in the entire operation improves productivity, reduces the cost which in turn delights customer and helps organizations in moving towards their vision and goals. We conclude that modifying the existing practices has resulted in significant NVA elimination.

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