

# Implementation of SMED Technique to Reduce Setup Time of Bandsaw Cutting Machine

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**Abstract**—In the manufacturing sector, there is a great competition, and to stay in the market, one needs to reduce the losses during manufacturing. One of the major losses during production is setup time of machine, which affects the delivery time, inventory, productivity & cost of product. We have selected a Bandsaw cutting machine for the setup time reduction with basic objective to reduced setup time by 50%. With implementation of SMED technique we could able to reduce setup time from 40 min to 10 min. SMED is one of the Lean manufacturing tools which used to reduce the setup time of machine.

**Keywords**— SMED, Lean Manufacturing, Setup time reduction, Internal & external setup

## I. INTRODUCTION

In today's manufacturing sector, customer demands small quantity and high variety of product. Customer wants a product Just-in-Time, which demands smaller production quantities. If someone wants to produce small quantities, it will require more number of setups. More number of setup means more time spends on loss, which is not good for the company. Production with big batch size is also not economical, as it increases the inventory carrying cost; it requires more space to store material, etc. The optimum solution can be finding only with the implementation of Lean manufacturing. SMED is one of the Lean manufacturing tools used for the setup time reduction. If machine setup time is less, we can produce the batch with very small quantities and deliver product in short time. Just in time can be achieved only if we implement SMED concept i.e. quick change over. Thus Quick change over or SMED is a critical element in lean manufacturing [5].

Lean manufacturing is a concept of continuous improvement which emphasizes on the elimination of waste in the production system. To have an economical production, efforts have taken in the cycle time reduction to speed up the production rate, instead of focusing on the setup time reduction. This leads to the uneconomical small batch production [6].

Setup time or changeover time is the time between ends of last piece of one product and starting of 1st good piece of other product. Total changeover time is a loss; during this change over time, production is stopped. Setup time is non value added activity which does not add any value in the product. Also customer does not pay for the losses; customer only pays for the value added activities. During setup time machine needs to be kept switch OFF. The changeover time includes the activities performed by keeping machine off.

These include preparation, tool change, die change, fixture change, adjustment, etc. Changeover time is one of the 16 losses in TPM. Changeover time must be as minimum as possible [5].

Single minute Exchange of die (SMED) focuses on the setup time reduction. The single minute does not mean a one minute, but it means a single digit minutes i.e. less than 10 minute [1]. SMED is a step by step methodology to reduce the setup time of machine. SMED can be applied to any machine in any industry. The need of SMED arises due to increase in demand of more variety in less quantity and Just-in-time. It helps to reduce batch size & minimum inventory in the company. There are two major terms in SMED, External setup & internal setup [1].

The case study was implemented at Endress + Hauser Flowtec, Aurangabad at Bandsaw cutting machine which is used for cutting long pies into small pieces in pipe preparation area.

## II. PROBLEM DEFINITION & METHODOLOGY

Problem definition:

Bandsaw cutting is one of the most important & critical machine in the production area. It is used to cut long pipes into small ones as per required lengths. It is the only machine which was having long setup time in complete area; it was 40 mins setup time of this machine. This 40 min is a non-productive time and is non value added activity as per Lean Principles. We decided to reduce setup time by at least 50%. To reduce we decided to implement SMED tool which is appropriate for these types of problems. The setup time at different machines is as follows

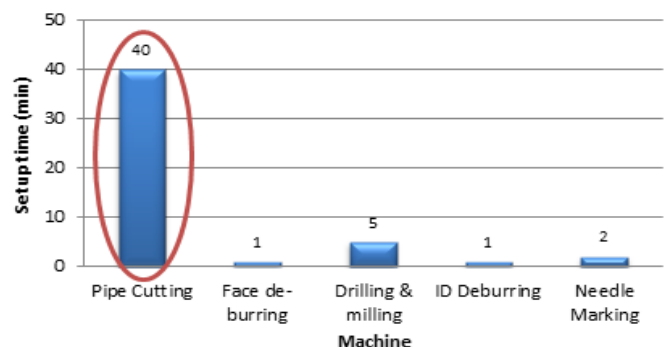


Figure 1: Setup time of different machine

Methodology:

- Literature review for SMED & Lean manufacturing in books, Journal, manual, etc.
- Analysis of existing setup time by taking video and listing down the activities
- Identification of internal activity & external activities
- Conversion of internal activity to external activity, wherever possible
- Designing of proposal to Reduce internal activity & external activities
- Implementation of proposed solution
- Validation of new setup system.

III. DATA COLLECCTION, DATA ANALYSIS AND IMPROVEMENT ACTIVITY

This paper is a summary result of project done on case study at defined company. At this stage, it is necessary to collect all the information related to the production, processes, cycle time, wastes, etc. and identify the actual problem at the pipe preparation area, especially at Bandsaw cutting machine. The problem was the long setup time of 40 min at Bandsaw machine. The SMED technique was applied to solve the problem of long setup time at Bandsaw machine. To collect data we used video camera, stop watch & the time study form to understand the activities done during setup time. Analysis of the data has been done and root cause of the problem was identified. Once the problem was identified, next step was to take action on the problem to improve the system. We decided to implement SMED technique to solve the problem of long setup time of Bandsaw machine. All the data was analyzed & improvement activities were carried out to reduce the changeover time of Bandsaw machine. The actual data obtained was as shown in the table 1.

Table 1: Setup activities before improvement

SN	Activity	Internal time (Min)	External time (Min)
1	Clean machine after last batch is over	1.96	
2	Change coupler of Shuttle vise		
a)	Remove studs (02 nos.) of Shuttle vise from base plate	8.83	
b)	Remove support bar		
c)	Replace coupler with new		
d)	Assemble Support bar		
e)	Assemble studs (02 nos.)		
3	Change coupler of Front vise		
a)	Repeat step 2 (a-e) for Front vise	8.35	
b)	Take forward the shuttle vise		
4	Set Stroke length		
a)	Set the stroke length (Cut Pipe length) and lock slide stopper	3.77	

b)	Take backward the shuttle vise		
5	Keep pipes & write heat number	7.23	
a)	Keep pipe on roller conveyor (03 nos. Pipes)		
b)	Write Heat number by marker on each pipe		
6	Base plate changing	2.53	
a)	Remove old base plates of front vise & shuttle vise		
b)	Add new base plates at front & shuttle vise		
7	Adjustment	7.38	
a)	Front vise adjustment		
b)	Shuttle vise adjustment		
8	Set (Adjust) the front vise & shuttle vise nuts & base plate		
9	Set the position of coolant pipe		
Total Time in Minutes		40.05	0.00

Based on the actual data obtained, the results shows that the machine needed 40 min to complete changeover from one product to other. The changeover frequency was 2 in a day, equivalent to 80 minutes per day. That means company losses 80 minute per day in setup time of Bandsaw cutting machine. This was a big loss in terms of money. Machine OEE was 79% and out of 21% losses, maximum time loss was in setup activity. We used following steps of SMED to reduce setup time of machine.

Preliminary stage - Internal & External setups are not distinguished: Old setup activities were recorded with video camera and analyzed them. It covers the complete changeover from one product to another product. Total time required for complete setup is 40 mins.

Stage 1- Separating Internal and External Setups: Internal activities are those that can only be performed when the machine operation needs to be stopped, while external activities can be done while the last batch is being produced, or once the next batch has been started.

Stage 2 - Converting Internal to external Setup: We identified those internal activities which can be converted into external activity. Long pipe loading & heat number writing activity converted into external. With this we saved 5.2 min of setup time.

Stage 3 - Streamlining all aspects of the setup operation: Each internal/external activity was improved with different solutions. With different experiments & iteration we check the optimum solution for activities. We replaced hydraulic cylinder and eliminated the threading in the machine setup operation. With experimentation we saved 19 min and with the improvement ideas we saved the 11 min. We select the best solution for each activity before implementation.

With experiment & regression analysis it shows that the minimum time will required with the 85 mm coupler length and slotted bar. We implemented this in new setup.

We implemented the optimum solution to reduce the setup time. With implementation of SMED technique we reduced machine setup time from 40 min to 10 min. We saved total 30 min with the implementation of improvement activity. New setup is validated with different methods. The Table 2 shows the setup activities after implementation of improvements.



Figure 2: Machine setup before improvement



Figure 3: Machine setup after improvement

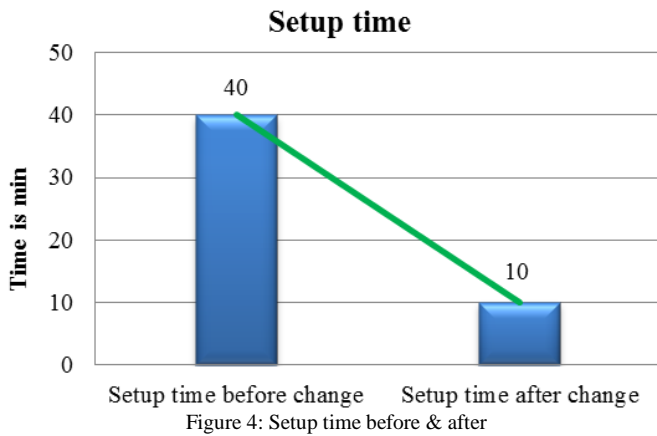
Table 2: Setup activities after improvement

SN	Activity	Internal time (Min)	External time (Min)
1	Clean machine after last batch is over	1.03	
2	Change coupler of Shuttle vise	0.00	
a)	Remove studs (02 nos.) of Shuttle vise from base plate		
b)	Remove support bar		

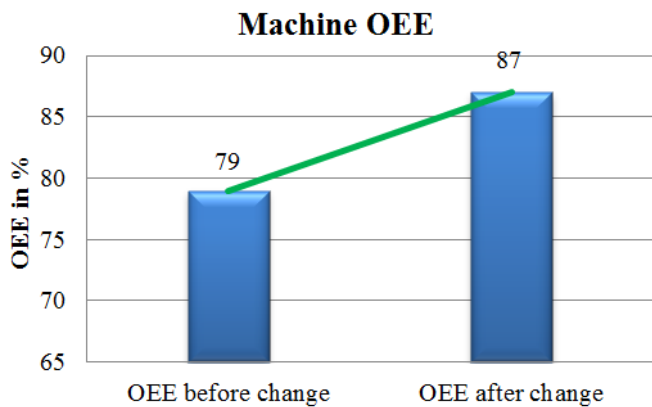
c)	Replace coupler with new		
d)	Assemble Support bar		
e)	Assemble studs (02 nos.)		
3	Change coupler of Front vise	0.00	
a)	Repeat step 2 (a-e) for Front vise		
b)	Take forward the shuttle vise		
4	Set Stroke length	3.88	
a)	Set the stroke length (Cut Pipe length) and lock slide stopper		
b)	Take backward the shuttle vise		
5	Keep pipes & write heat number	0.00	5.2
a)	Keep pipe on roller conveyor (03 nos. Pipes)		
b)	Write Heat number by marker on each pipe		
6	Base plate changing	1.65	
a)	Remove old base plates of front vise & shuttle vise		
b)	Add new base plates at front & shuttle vise		
7	Adjustment	3.25	
a)	Front vise adjustment		
b)	Shuttle vise adjustment		
8	Set (Adjust) the front vise & shuttle vise nuts & base plate		
9	Set the position of coolant pipe		
Total Time in Minutes		9.8	5.2

#### IV. RESULTS & DISCUSSION

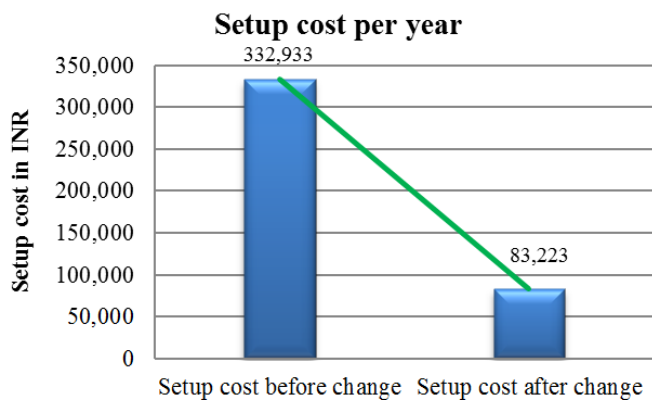
Before starting of this project, our objective was to reduce setup time at least by 50%, i.e. from 40 min to 20 min. but with implementation of improvement ideas, we could reduce setup time from 40 mins to 10 mins. As a result of implementation of SMED the setup time is reduced by 75%. Figure 4 shows comparison of setup time before & after implementation of SMED.



As setup time is reduced by 30 mins (75%) due to that loss on the machine gets reduced and machine availability for production is increased. Due to increase in availability, machine OEE increased from 79% to 87%, as shown in figure 5.



We have saved 30 minutes for each setup. For the machine there were average 2 setups in a day. Considering setup time saving of 60 min every day and machine running cost, cost saving due to setup time reduction is INR 249,700 per year. Setup cost per year before & after improvement is shown in figure 6.



Because of setup time reduction by 30 min, machine availability increased for 60 min extra every day. Before setup improvement operator was able to produced 33 pieces per day and after setup improvement operator produces 38 pieces per day. It increases the productivity by 15%.

Other benefits obtained from the setup time reduction were delivery time reduction, capacity increments, operator morale improvement, total cost of product reduction, etc. summary of benefits is shown below in table 3.

Table 3: Result Comparison Summary

Parameter	Before	After	Remark
Setup time	40 min	10 min	75% down
OEE %	79%	87%	8% up
Setup cost/year in INR	332,933	83,233	INR 249,700 down
Productivity	33 pc/day	38 pc/day	15% up

### V. CONCLUSION

This research work mainly focuses on the Implementation of Single minute Exchange of Die (SMED) technique to reduce setup time of Bandsaw Cutting Machine. The research result shows that substantial reduction in setup time was possible. The result shows that with the implementation of good improvement idea one can reduce the setup time from 40 minutes to 10 minutes. This study has proved that elimination of NVA in the process can bring the huge results in the manufacturing system. This is the basic objective of Lean principles. Elimination of NVA i.e. waste in the entire operation leads to improvement in productivity, reduction in cost, & faster delivery of product to customer. Simple improvement in activities reflects on the financial terms of the production.

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