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Setup Changeover Time Reduction in 4 Wheel Drive Front Axle Differential Case Cone Bearing Pressing Process – SMED Method

Ebenezer G, Gopalakrishnan S, Adam khan M

Abstract**:** ***Single minute Exchange of Die is one of the LEAN approach to reduce the set up change over time and seven kind of losses due to the weakness in the initial process customization. Manufacturing organizations faces problem in reduction of cost and increasing the efficiency or productivity which is real challenge in the manufacturing operations. In the highly competitive or globalized society the manufacturer need to find a method to reduce the cost and production time to reduce the operating cost and Quality of product and Reliability. This paper deals with the basic over view of a reduction in set up time in a sub assembly stage of an auto sector by Setup Changeover Time Reduction (SMED). It is definitely possible to reduce the set up times and cost of sub assembly production considerably by simple modifications or improvements. The reduction of set up time can be done with the help of SMED methodology. Various types of industries can apply the SMED Methodology to reduce their set up times.***

Keywords: SMED – Single minute exchange of Die; 4WD – Four wheel drive.

I. INTRODUCTION

SMED is a method for reducing the time of the changeovers in the equipment. The crush of the SMED process is to convert as many changeover in steps as possible as much, and to simplify the steps.

SMED considerations: - Basically it reveals eight techniques that should be considered in implementing SMED. It is separating internal and external operations from the process and Convert internal to external setup to focus to reduce the time consumption. It is helps mainly to reduce non-productive time. This we can do by standardize functional clamps or eliminate fasteners altogether. Can use intermediate fixtures and adopt parallel operations in adjustments & manual dependency.

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* Correspondence Author (s)
Ebenezer G *, department of Mechanical Engineering, Kalasalingam Academy of Research & Education, Virudhunagar Dist., Tamilnadu, India. Email: g.ebnezer@klu.ac.in
Gopalakrishnan S, department of Quality Assurance, Tractor and Farm Equipment (TAFE) Ltd., Kalladipatti – 624201, Dindigul Dist, Tamilnadu, India. Email: sivasubu_gops@rediffmail.com
Adam khan M, department of Mechanical Engineering, Kalasalingam Academy of Research & Education, Virudhunagar Dist., Tamilnadu, India. Email: adamkhan.m@klu.ac.in

The Work aim to

a) Through reduction of resource losses using SMED in 4WD Diff. Case line
   i) By reducing the manufacturing variable cost
   ii) By reducing the manufacturing fixed cost
b) Through reduction of time losses using SMED in 4WD Diff. Case line
   i) By reducing the loss due to set up change over
   ii) Reduce setup changeover time, thereby reducing loss.

From the previous experimentation the following data were identified

1. The total line stoppage in all the cells are 498 minutes per month.
2. The vital line stoppage contribution is 74 minutes in 4WD front axle line.
3. It is about 15 % of total line stoppage / month.

II. MATERIAL AND METHODS

The suggested SMED process is based on changeover improvements requirements with respect to the process conditions. It consists of five steps

Step 1: Classify External and internal activities are to be listed.

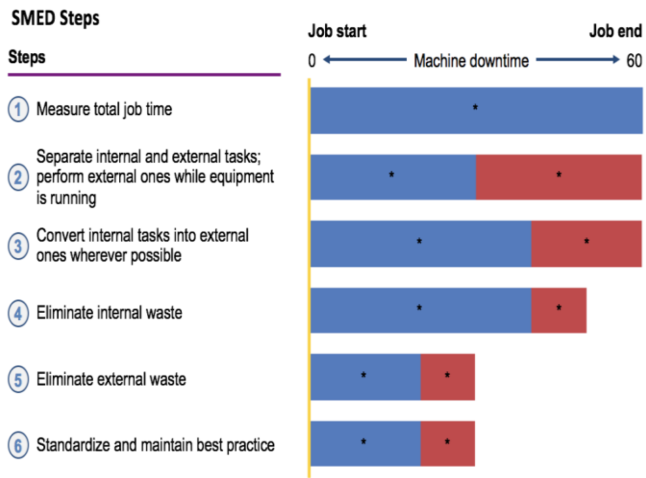

Fig. 1. **SMED process steps for improvement**

Step 2: External and Internal Work to be separated and then remove activities which are not required.

These progressive steps initiating training to the operatives where it has implement and execute the process products functions of the implementation.

This reveals the necessary fixtures and quick changeover arrangements should be in order by arranging with proper 5S and check the adequacy of these tools by check list.

S. No	Description	Internal	External	Start Time	End Time	Time in Sec
Setup Change over time From G4 to 50 HP & Vice Versa						
1	Remove the RH Locator & kept in Tool Stand RH Side(G4)	✓		0	4	4
2	Pick & place the Guide Tool in Tool Stand RH Side(G4)	✓		4	8	4
3	Pick & place the Base Locator(G4)	✓		8	12	4
4	Pick & place the base locator(50HP)	✓		12	16	4
5	Pick & place the Guide Tool(50HP)	✓		16	20	4
6	Pick & place the RH Locator(50HP)	✓		20	24	4
	Time in Secs.(A)					24
Setup Change over time From RH to LH Locator & Vice versa						
1	Remove the RH Locator & kept in Tool Stand RH Side(G4 / 50HP)	✓		0	4	4
2	Pick & place the LH Locator	✓		4	8	4
	Time in Secs.(B)					8
	Total Set up change over Time (A) + (B) = (C)					32

Fig. 2. **Computerized image generation on seperation of internal and external work**

Step 3: Convert internal work into External work.

Converting internal to external activities

S. No	Description	Internal	External	Start Time	End Time	Time in Sec
Setup Change over time From G4 to 50 HP & Vice Versa						
1	Remove the RH Locator & kept in Tool Stand RH Side(G4)	✓		0	4	4
2	Pick & place the Guide Tool in Tool Stand RH Side(G4)	✓		4	8	4
3	Pick & place the Base Locator(G4)	✓		8	12	4
4	Pick & place the base locator(50HP)	✓		12	16	4
5	Pick & place the Guide Tool(50HP)	✓		16	20	4
6	Pick & place the RH Locator(50HP)	✓		20	24	4
	Time in Secs.(A)					24
Setup Change over time From RH to LH Locator & Vice versa						
1	Remove the RH Locator & kept in Tool Stand RH Side(G4 / 50HP)	✓		0	4	4
2	Pick & place the LH Locator	✓		4	8	4
	Time in Secs.(B)					8

Fig. 3. **Conversion of internal and external work**

This step involves two significant activities to be performed by the improvement idea which captured. The detailed analysis of the internal identifications and detect wrong prediction. This type of analyzing two different ways to convert these activities into external work. By completing this, tools and fixtures to be standardized and involve in regular calibrations.

Step 4: Stabilize and reduce internal work.

This steps involves optimizing the process through regular or standard tools and fixtures by implementation.

This mainly reveals the stabilization of process by sustaining the results through standard fixtures and work holders.

List of tools are used before SMED and after SMED is listed for the various groups' 50HP range and G4 / G5 ranges. The number of tools is reduced by communizing the tool base plate on the subjective pressing machine on the 4WD front axle sub assembly.

Fig. 4. **Optimization of internal work by using proper fixture**

Streamline all aspects of Internal activities - Before

E C R S

S.No	Description	When	Who	Steps Followed ECRS	How
Setup Change over time From G4 to 50 HP & Vice Versa					
1	Remove the RH Locator & kept in Tool Stand RH Side(G4)	15.02.2019	SGK	ECRS	• Tool redesigned & optimized to suit both the models (LH & RH) in single piece. • LH & RH side process made flexible for both models.
2	Pick & place the Guide Tool in Tool Stand RH Side(G4)	15.02.2019	SGK	ECRS	
3	Pick & place the Base Locator(G4)	15.02.2019	SGK	ECRS	
4	Pick & place the base locator(50HP)	02.03.2019	SGK	ECRS	
5	Pick & place the Guide Tool(50HP)	02.03.2019	SGK	ECRS	
6	Pick & place the RH Locator(50HP)	02.03.2019	SGK	ECRS	
Setup Change over time From RH to LH Locator & Vice versa					
1	Remove the RH Locator & kept in Tool Stand RH Side(G4 / 50HP)	02.03.2019	SGK	ECRS	• LH & RH can be swapped by inverting the tool. Tool redesigned.
2	Pick & place the LH Locator	02.03.2019	SGK	ECRS	

Fig. 5. **Description of the work and the people responsible**

Step 5: Standardize and reduce external work.

This steps mainly focusing time based involvement in the process derived basically in internal and external progress identified. This involves all pick and place and base holder arrangements.

Streamline all aspects of changeover time- After

SL NO	ACTIVITY	START TIME	END TIME	ACTUAL TIME (Sec.)	Steps followed ECRS	S. No	Steps after SMED	START TIME	END TIME	ACTUAL TIME (Sec.)
Streamline Internal activities										
Setup Change over time From G4 to 50 HP & Vice Versa										
1	Remove the RH Locator & kept in Tool Stand RH Side(G4)	0	4	4	Y			0	0	0
2	Pick & place the Guide Tool in Tool Stand RH Side(G4)	4	8	4	Y			0	0	0
3	Pick & place the Base Locator(G4)	8	12	4	Y			0	0	0
4	Pick & place the base locator(50HP)	12	16	4	Y			0	0	0
5	Pick & place the Guide Tool(50HP)	16	20	4	Y			0	0	0
6	Pick & place the RH Locator(50HP)	20	24	4	Y			0	0	0
Setup Change over time From RH to LH Locator & Vice versa										
1	Remove the RH Locator & kept in Tool Stand RH Side(G4 / 50HP)	0	4	4	Y	1	Invert the tool upside down for change over from LH/RH & vice versa. Tool redesigned.	0	3	3
2	Pick & place the LH Locator	4	8	4	Y					
Total Time Before SMED Implementation				32			Total Time After SMED Implementation			3

Fig. 6. **Photographic image of the process time**

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III. RESULTS & DISCUSSIONS

The suggested SMED approach was tested and implemented in a tractor company. Within this company the number of changeovers had reduced from 6 to 1 and utilization rate of the line was reduced.

By this, the overall equipment efficiency of the line has improved. The organization has some experience in implementing SMED approach from previous observations, but without the expected results. Lean solutions were applied within process, people and progress by engineer from the continuous improvement function.

Based on the SMED streamlining activity, the change over time is reduced considerably from 32 sec. to 3 sec. In the internal issues and the changeover steps are reduced from 8 to 1.

The standardization is the evidence from establishment or implementation, here the standardization is completed by updating the SOP and training sign off with the work men.

Considering the variants and the time saved from the change over time reduction by means of tool design improvements the following are the types of savings obtained. They are

More production time available in Hand. Line stoppage due to set up changeover is reduced from 74 to 32 minutes in the front axle (4WD) sub assembly. In addition to that tooling related cost is reduced considerably.

A. Time saving

More production time available in Hand. Line stoppage due to set up changeover is reduced from 74 to 32 minutes in the front axle (4WD) sub assembly. In addition to that tooling related cost is reduced considerably.

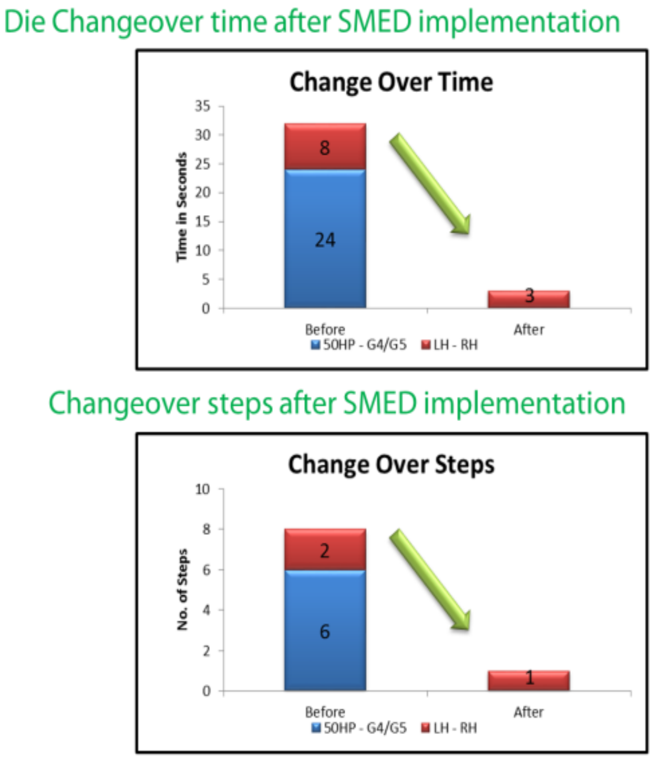


Fig. 7. **Comparission between before and after implementation in die change over time.**

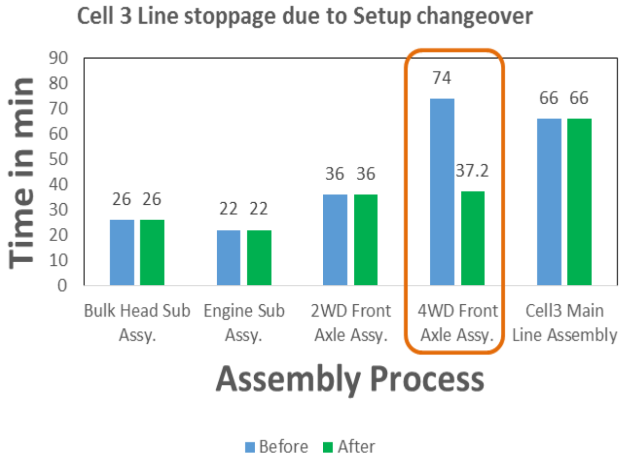
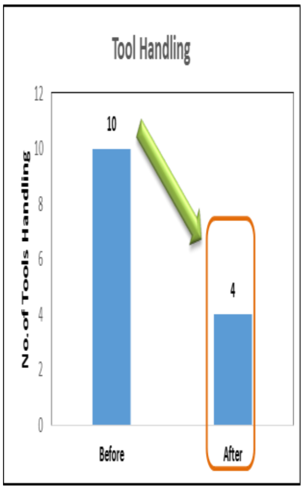


Fig. 8. Comparission between before and after implementation in setup time



Diff. Case LH & RH Cone Bearing Pressing			
	BEFORE SMED		AFTER SMED
S.No	G4/G5 Tools	50HP Tools	G4/G5&50HP Tools
1	MOAT0434-D1	WH 15418 -D1	MOAT0434-D1&D2
2	MOAT0434-D2	WH 15418 -D2	MOAT0434-D6
3	MOAT0434-D3	WH 15418 -D3	MOAT0434-D5
4	MOAT0434-D4	WH 15418 -D4	WH15418-D5
5	MOAT0434-D5	WH 15418 -D5	
		Total Tools Used before SMED	10
		Total Tools Used after SMED	4
		No. of Tools Eliminated	6

Fig. 9. **Comparission between before and after implementation in tool handling time.**

IV. CONCLUSION

SMED methodology is used to design for multiple workers with multiple machines in appropriate activities depend on tasks performed earlier by several people. Within the present study, the suggested method worked well for two variety of sub assembly in a single machine by a single operator.

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