

## **CII NATIONAL “SMED” ABSTRACT**

**Kirloskar Oil Engines Limited, Kagal Plant Kolhapur**  
**Project line - R1040 Crankcase (OP190 B M/c)**

# PLANT PROFILE

KIRLOSKAR OIL ENGINES LTD., KAGAL, KOLHAPUR-416216

Kagal Plant is spread across **163** acres of Land

### OUR VALUES

**EXCELLENCE**  
In everything we do quality without compromise

**INTEGRITY**  
Say what we do, and do what we say

**COLLABORATION**  
We grow with people and partners

**EMPATHY**  
We always listen, and learn

**VALUE CREATION**  
We're building for a shared prosperous future

**INNOVATIVE THINKING**  
Be bold and brave, & stay relevant

### VISION

By 2025, Kirloskar Oil Engines touches the world

#### VIVID DESCRIPTIONS

We will constantly innovate, create products and service offerings which simplify lives

We will create iconic and valued global brands

We will establish leadership in emerging markets & create significant business in the developed ones

We will build simple systems and processes that enable exponential growth

We will be a leadership factory

We will deliver on Promise 2025

### PROMISE 2021

#### VIVID DESCRIPTIONS

Achieve 20% of yearly revenues from new products and services

Develop and nurture a basket of brands to deliver Kirloskar Oil Engines vision

Set double digit market share in 10 countries in defined product categories

Have customer centric new product development and order fulfillment process as a way of life

Develop a leadership fountain to succeed all senior roles

Achieve ₹ 5500 Cr revenue



Genset Plant



Engine Plant - I



Engine Plant - II

Product	Product Name	Capacities ( 2 Shifts Basis )	Range	Application
	Generating Sets with air cooled and liquid cooled engines	1750 / month	5 KVA to 1010 KVA	Power Generation
	DV Engine with 8, 10,12 and 16 Cylinders	200 / Month	400 HP to 1210HP	
	Liquid Cooled with 1,2,3,4 and 6 Cylinder Engines	4000 / month	14 HP to 330 HP	
	Air Cooled with 1,2,3,4,5 and 6 Cylinder Engines	5800 / month	10 HP to 120 HP	

Per Annum:

Engines : 1,32,000

Gensets : 21,000

Total Employees As on date  
**1092**

Managers (TL, GL & UL)  
**194**

Operators (Team Associates)  
**898**

## Plant Initiatives

Std. Work   Lean MFG.   5S   Kaizen   JH   VSM   QC

SMER   Mr. Customer   QEHS   ENCON   Six Sigma

Kaizen Coordinator : Mr. Shailesh Tupe

Total No. of Kaizen (till date) = **76, 035**

# PROJECT TEAM

Mr. Ramesh Chavan



Mr. Shailesh Tupe



Mr. Shankar Govindkoppa



Mr. Amol Yadav



Mr. Ajit Patil



Vilas Patil



Sachin Patil



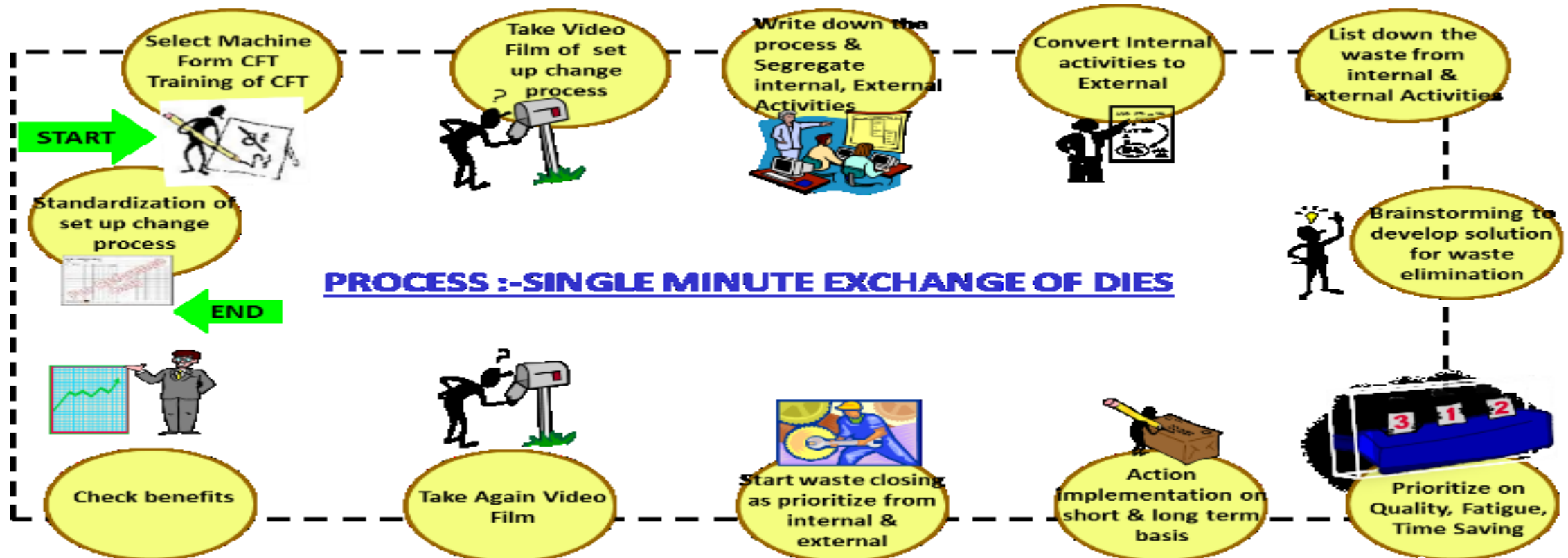
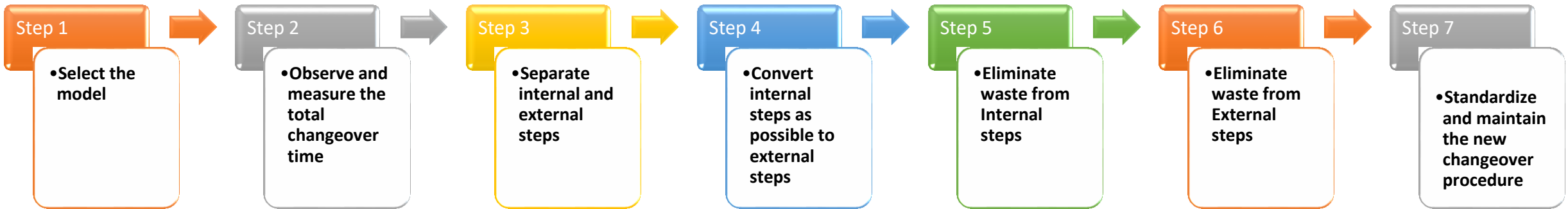
Mr. Satish Patil



**SMED  
CFT  
TEAM**

Project Theme	To reduce the set up change time on OP-190B m/c Top face finish milling ,finish & rough boring, rough and finish seat face, and chamfer finish operation of R1040 crankcase thus reducing Inventory Cost & Improving productivity
Location	Kagal – Kolhapur Plant
Department	R1040 crankcase M/c Line
Project Mentor	Mr. Ramesh Chavan
Project Team ( CFT)	<p>Mr. Shailesh Tupe ( Department- Process Engg.-TPS)</p> <p>Mr. Vilas Patil ( Department- Gurukul)</p> <p>Mr. Shankar Govindkoppa ( Department- Production)</p> <p>Mr. Mustafa Patel ( Department - Production)</p> <p>Mr. Mangesh Jagdale (ME)</p> <p>Mr. Amol Yadav ( Department - Production)</p> <p>Mr. Satish Patil (ME)</p> <p>Mr. Sachin Patil (ME)</p> <p>Mr. Ajit Patil ( Department - Maintenance)</p>
Supporting Members	Satish Patil , Prashant pawar
Start Date	05/09/2022
End Date	28/12/2022

# METHODOLOGY FOLLOWED




# PROJECT PLANNING

Implementation plan for set up change time reduction R1040 crankcase OP-190 B M/c.) Activity Chart																				
Sr.No.	Activity	Resp	Support	Plan / Actual	Sep-22				Oct-22				Nov-22				Dec-22			
					Wk-1	Wk-2	Wk-3	Wk-4	Wk-1	Wk-2	Wk-3	Wk-4	Wk-1	Wk-2	Wk-3	Wk-4	Wk-1	Wk-2	Wk-3	Wk-4
1	Concept Making.	STT / VMP	RRC	Plan																
				Actual																
2	Discussion with seniors on concept.	STT / VMP	RRC	Plan																
				Actual																
3	Suggestions adaptation & Finalize the concept.	STT / VMP	RRC	Plan																
				Actual																
4	Identify Project Area for for Time Reduction	STT / VMP	RRC	Plan																
				Actual																
5	Identify the trainers and preparation template for the same.	STT / VMP	RRC	Plan																
				Actual																
6	Training given to trainers ( How to take video Film , Identify 7 wastages, Unsafe Condition & 3D )	STT / VMP	RRC	Plan																
				Actual																
7	Take all video film of OP190B m/c of Set up & Categorization change .	STT / VMP	RRC	Plan																
				Actual																
8	Observe Video Shooting , Study & write Process sheet for Waste Identification & Conversion of internal to external activity	STT / VMP	RRC	Plan																
				Actual																
9	Take CFT Meeting For waste Identification, list down all waste	STT / VMP	RRC	Plan																
				Actual																
10	Waste closing	STT / VMP	RRC	Plan																
				Actual																
11	Monitoring results & check Benefits after Waste Closing by Taking Video.	STT / VMP	RRC	Plan																
				Actual																

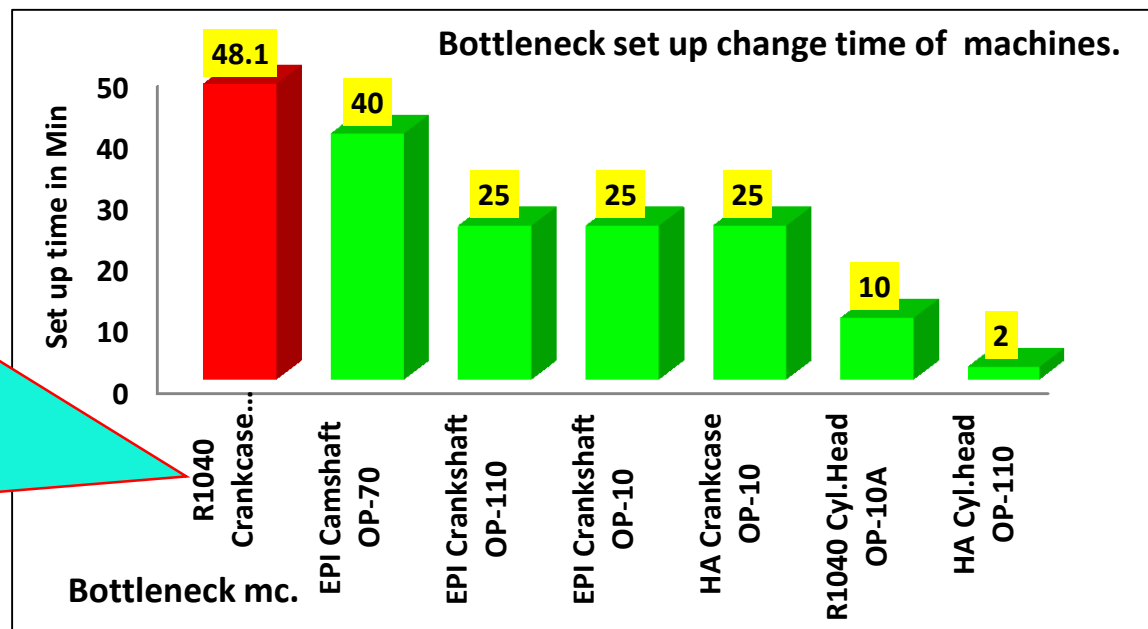
P D C A

# SELECTION OF BOTTLENECK MACHINING LINE FOR SET UP CHANGE

In-house machining line of critical 5C components of Engine:-

Crankcase	Cylinder Head	Crankshaft	Camshaft	Connecting Rod
				

Machine line select for project from 5C machine line.



KIRLOSKAR OIL ENGINES LTD., KAGAL

HOURLY PRODUCTION REPORT

Line Name: <u>R1040CCL</u>	Shift: <u>II</u>	Dept: <u>Machine Shop</u>	Date: <u>13/09/22</u>	Task Time: <u>6.5 min</u>
Team Leader: <u>Mustafa Fikri</u>	TA Name (Online): <u>Swapnil Amte (1)</u>	Part Name: <u>421C</u>		
TA Name (Offline): <u>Julie H.</u>				

Time from - to	Available time in Min.	Total Output OK - Total Qty. Per time	Rejection Qty. Per time	Reason for rejection	Machine Break-down (Min)	Inspection in Time (Min)	Model Change time (Min)	Tool change time (Min)	Process Problem (Min)	Cutting / forging shortage	Others (Min)	Line stop (Min)	Reason for Loss of Output
3.30 - 4.30	60	06	00								20	20	0793 019 - Seat checks problem - 20min
4.30 - 5.30	60	06	00		20							20	0794 - Radial feed adv/ret failure - 20min
5.30 - 6.30	60	08	00		25							25	0795 - Comp unloading problem - 25min
6.30 - 8.00	90	08	00										
8.00 - 8.30 (Dinner)	20	00	00										
8.30 - 10.00	90	10	00				48.10					48	0790B - Setup change - 48.10 min
10.10 - 11.00	50	06	00					15				15	0720 - To excess tool load - 15min
11.00 - 11.25	25	06	00					15				15	0720 - T13 milling cutter change - 15min
TOTAL OK QTY (A - B) =		50		TOTAL LINE STOP TIME (C+D+E+F+G+H+I) = L =								143	
		Model	Plan	TOTAL AVAILABLE TIME (in min)								435	
		Model 1	485	18									
		Model 2	6514 STD	20									
		Model 3	485	12									
		Model 4											
		Model 5											
		NET TIME (435 - L) = M =											292

Special Communication if any:

Prepared by: <u>Swapnil Amte</u>	Approved by:
KGL-F-MSKP-G-01	Page 1 of 1

BREAK DETAILS (2nd shift):

1) 3.15 to 3.25 Autonomouse Maintenance

2) 3.25 to 3.30 communication meeting

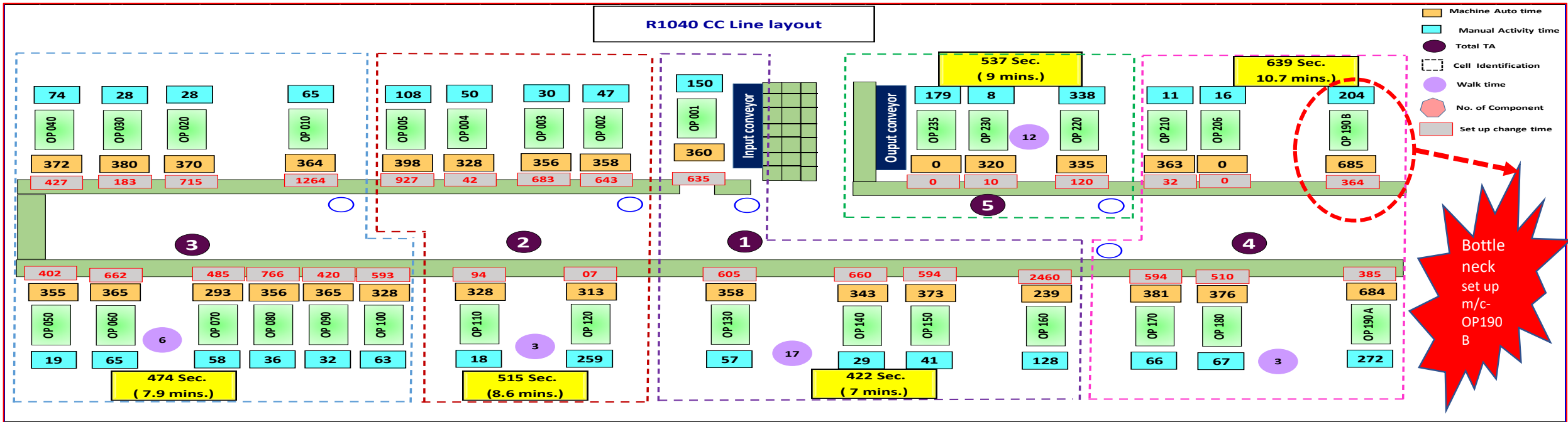
3) 8.00 to 8.30 - Dinner

4) 10.00 to 10.10 - Tea Break

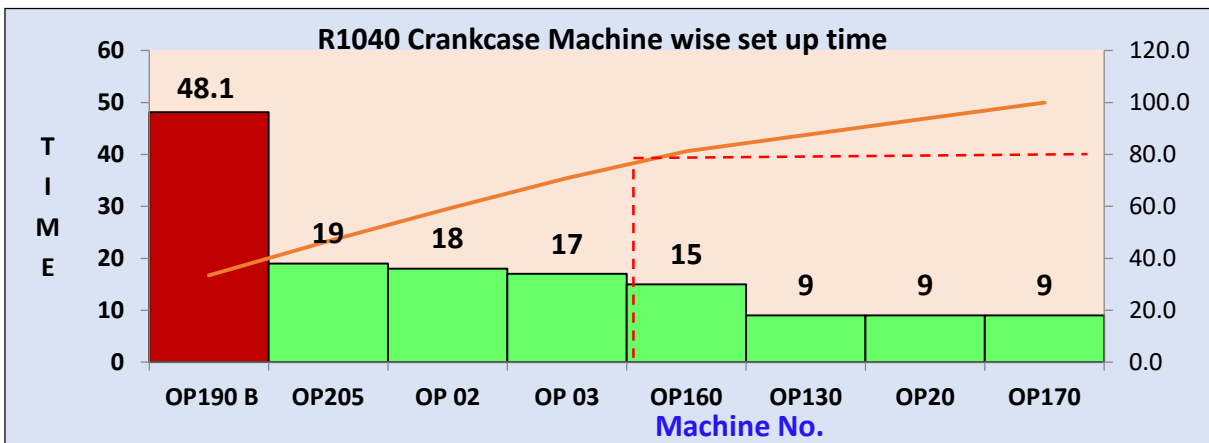
5) 11.25 to 11.35 - Machine cleaning

6) 11.35 to 11.40 - Report writing

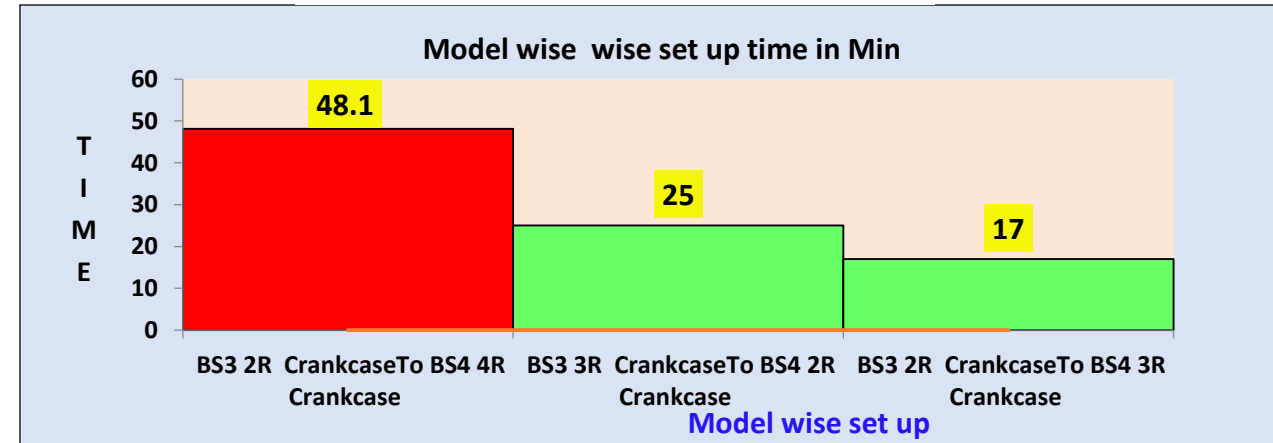
# SELECT THE APPROPRIATE MODEL FOR SET UP CHANGE



**Machine wise Set up Change time**



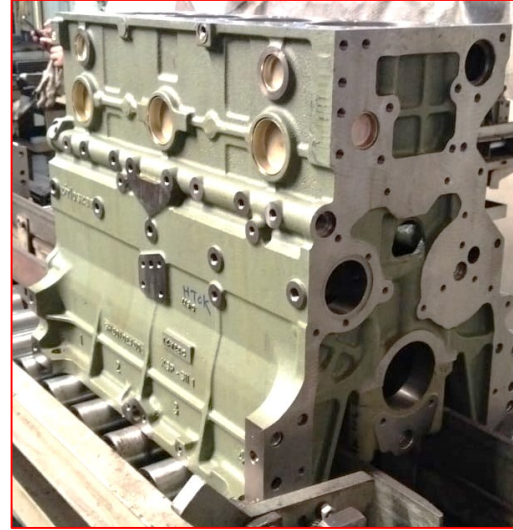
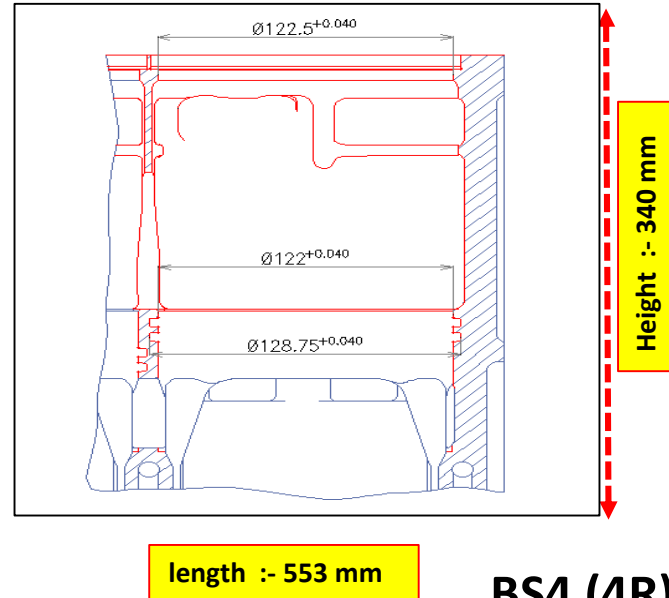
**Model wise Set up Change time**



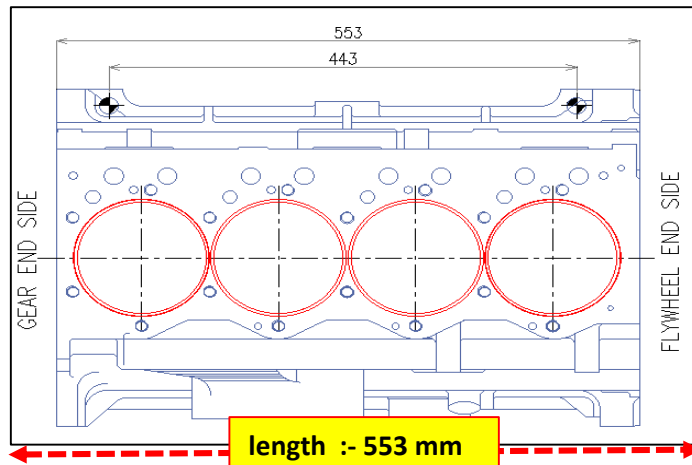
# NEEDS FOR SET UP CHANGE

## BS4 (4R) Cartridge change view

## BS4-4R CRANKCASE

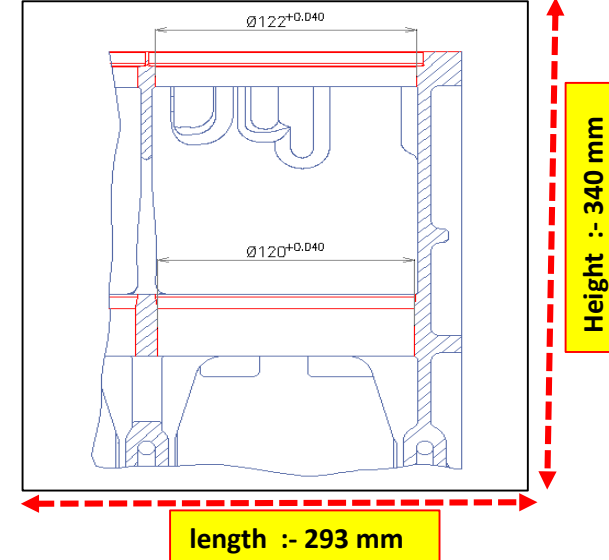


## BS4 (4R) Fixture change view

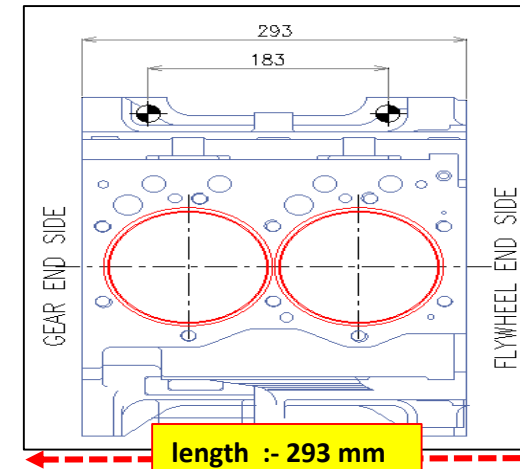


## BS3 (2R) Cartridge change view

## BS3-2R CRANKCASE



## BS3 (2R) Fixture change view



Model wise dimensions are different, so need for set up change in the existing Fixture

# DEFINING THE CURRENT ISSUE & UNDERSTAND THE PROBLEM

## R1040 Line Current Issue :-

Current R1040 Crankcase requirement of

Internal Customer( Assly Lines) :-

- 1 BS4 (4R) Crankcase - 500 No's
- 2) BS3 (4R) Crankcase - 1,500 No's
2. 2R Crankcase ) - 600 No's
3. 3R Crankcase- 1500 No's

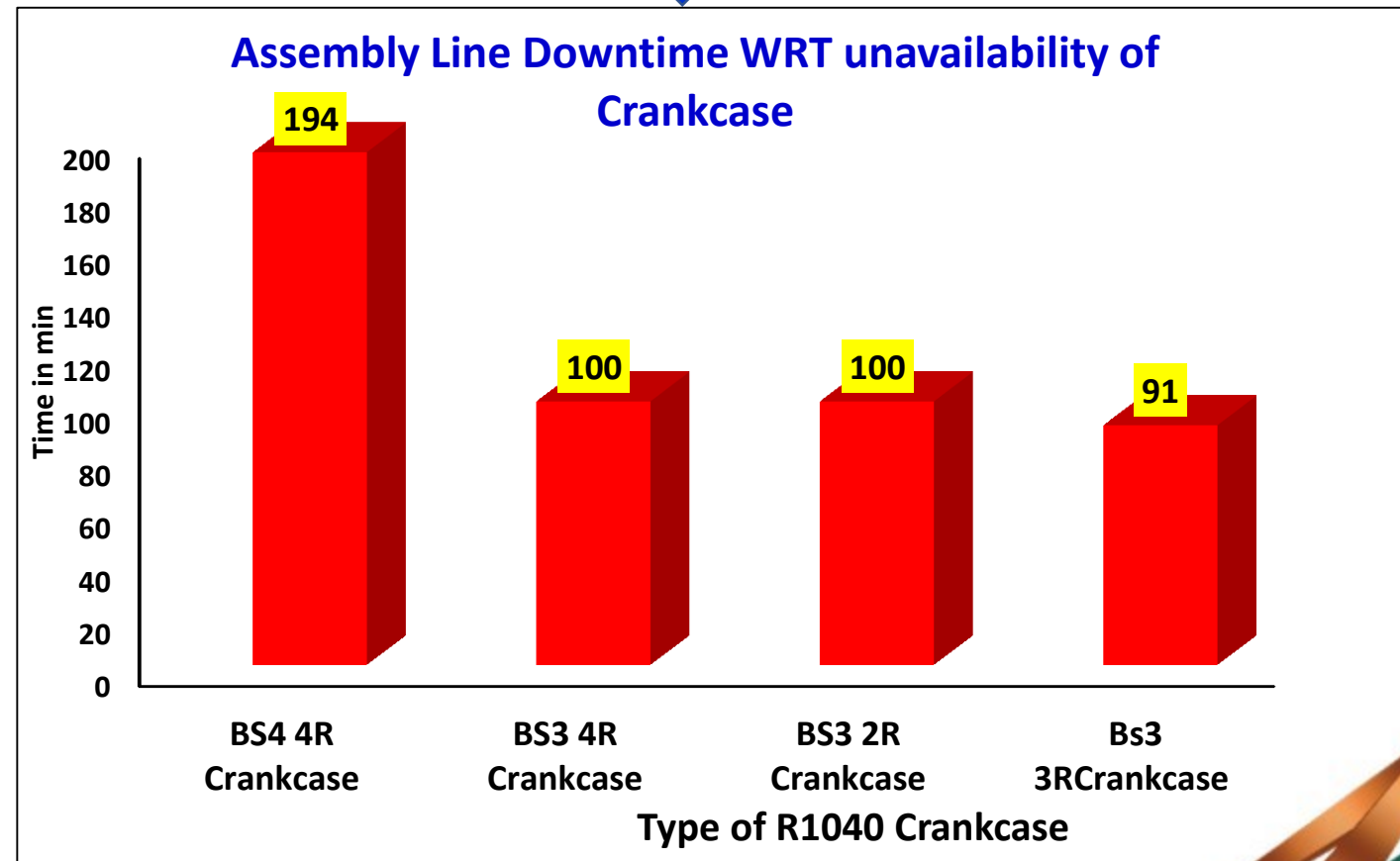
Monthly average production - 4100 / Month  
Cycle Time - 6 Minutes

Average monthly Set up change down time –  
 $48.5 \times 10 \text{ times} = 485 \text{ min}$

Monthly loss - 80 No's Crankcase due to set up  
change down time.

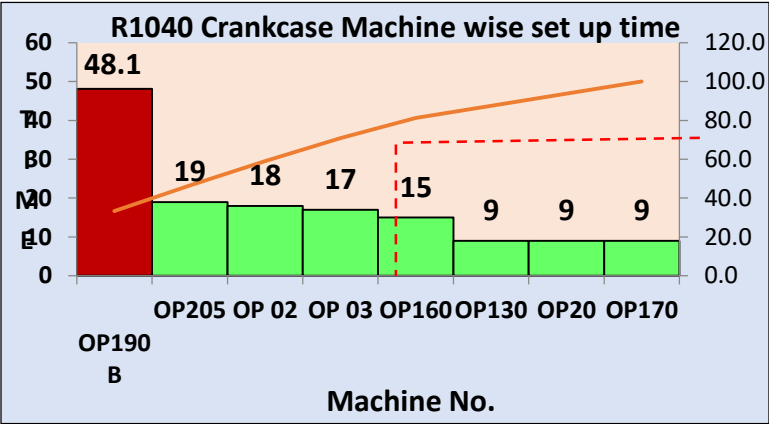
Monthly Engine Losses in 80 No's

## Assembly Line wise Downtime at Internal Customer End



# Analysis ,Observe & measure the current set up Cycles

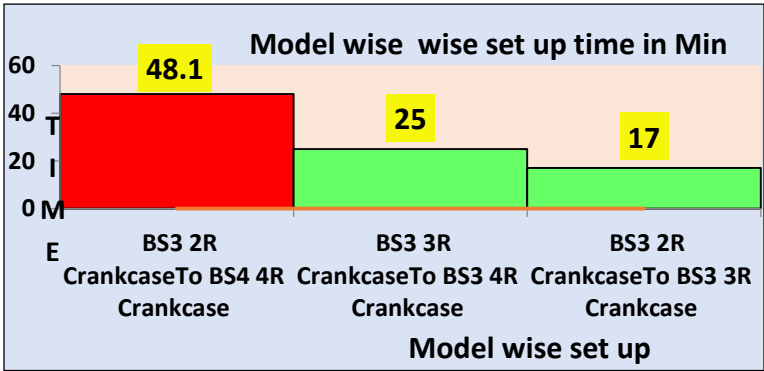
- ☐ Training given to concern line Team members with CFT. ( 12 nos.)
- ☐ Video Shooting taken of Selected model
- ☐ Machine wise set up change time



- ☐ With the help of CFT, Activities are listed down accordingly.
- ☐ Activity & Time of Each activity had recorded.
- ☐ Model wise set up time in time



Process Study Sheet							
Line Name :- R1040 Crankcase				Responsibility :- Vilas Patil & Shallesh tupe			
Machine Name :- OP-190 B				Total Video Time:- 2.3 minute			
Process Name :- Top face finish milling ,finish & rough boring, rough and finish seat face, and chamfer finish operation				Operator name :- Amol Yadav			
Sr.No.	Main set up work elements	Start	End	Total	Internal Activity	External Activity	Conversion of internal to external
1	Operator has come near the mc.& Press the Emergency stop	0	7	7	√	X	X
2	After Emergency stop confirm thr mc with respect to set up change	7	23	16	√	X	X
3	Operator loose & remove the antiback stoppers	23	28	5	√	X	X
4	Operator has loose & remove allen bolt for 2R antiback stopper	28	55	27	√	X	√
5	Operator fit the antiback stopper for 2R model & tight the allen bolt	55	73	18	√	X	X
6	Operator has tight the 3R antiback stopper with allen bolt	73	82	9	√	X	X
7	Operator has walk to taken air gun for set up change.	82	138	56	√	X	√
Total Time in Min.		138		0	7		



# Analysis ,Observe & measure the current set up Cycles

## Process wise Set up change Before time

### OP-190B m/c set up change wise activity & time

Sr.no.	Process name	Before set up change time in minutes	Before set up change time in second
1	Cartridge change from BS3 to BS4 component	11:12	672
2	Master setting with dial gauge	11:00	660
3	Dowel pin , anti back stopper & stopper changes as per model	10:58	658
4	First piece inspection of BS4 component	15:00	900
Before improvement set up change time		48.10	2890

## Process wise set up change activity



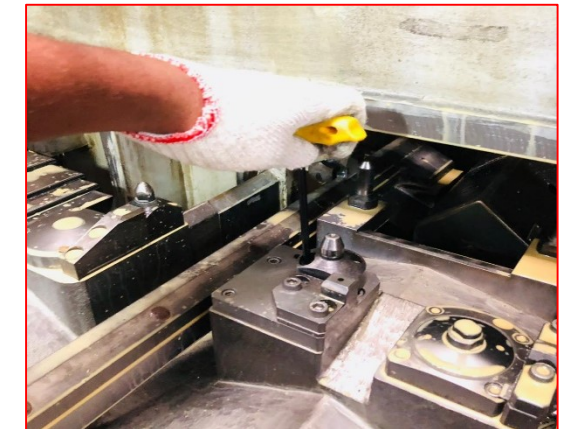
Cartridge change from BS3 to BS4 component



Master setting with dial gauge



First piece inspection of BS4 component



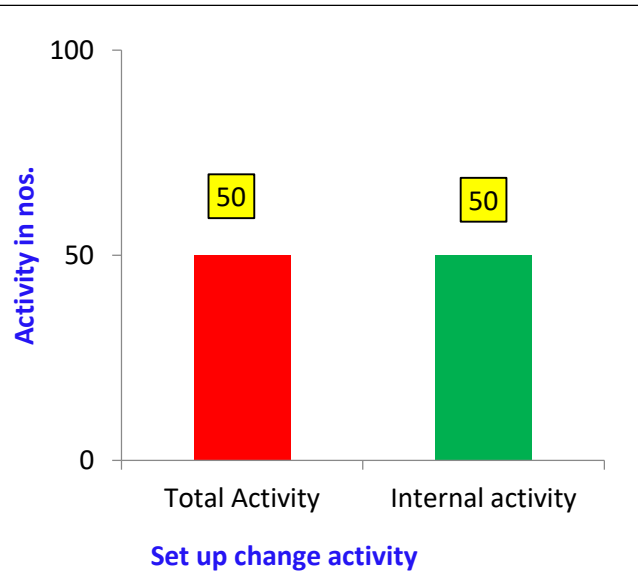
Dowel pin , anti back stopper & stopper changes as per model

# Internal & External set up classification

- ❑ All Activities are listed down with the help of CFT.
- ❑ Total Activities – **50 nos.** for required to do the model change.
- ❑ All these divided into the Internal & External activities.

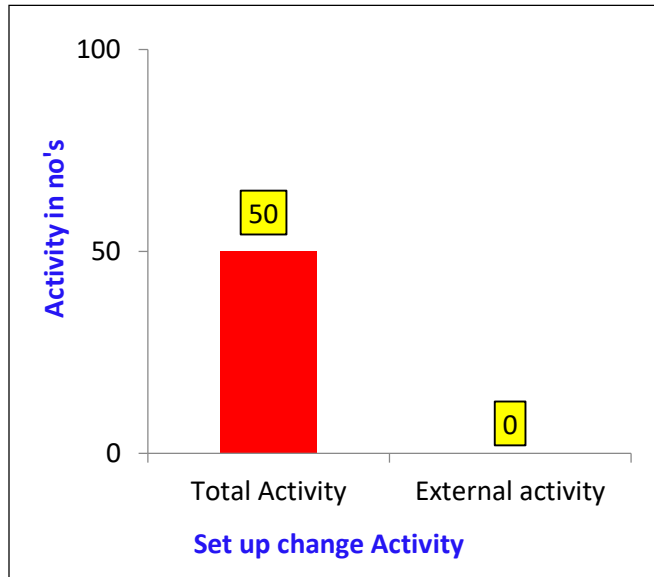
## Internal Activities

Activities occurring during the changeover that *can only be performed when production is shut down*



## External Activities

Activities that *could be performed during a production run*



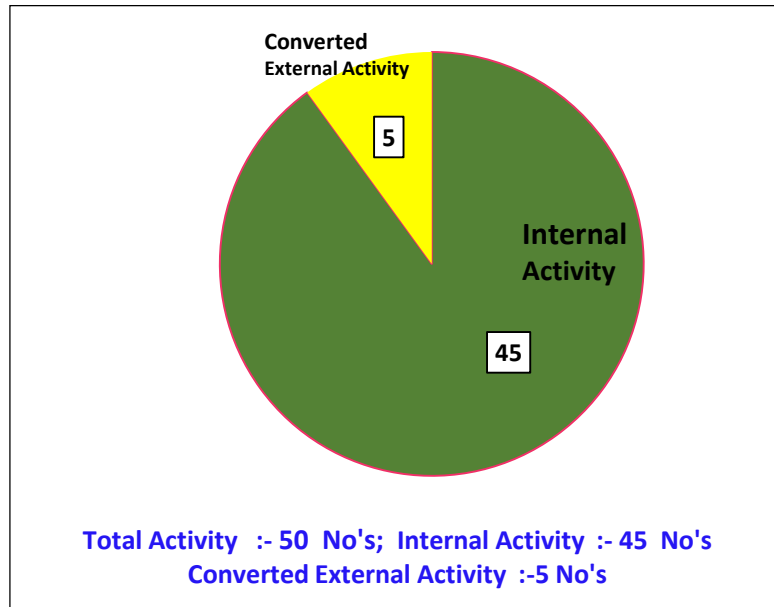
Process Study Sheet							
Line Name :- R1040 Crankcase				Responsibility :- Vilas Patil & Tupe Sir			
Machine Name :- OP-190 B				Total Video Time:- 2.01 Min.			
Process Name :- Set up change of OP-190 B Machine.						Catagory	
Sr.No.	Main Set Up work Elements	Start	End	Total	Internal	External	
1	Operator has come near the mc.& Press the Emergency stop	0	8	8	√	—	
2	After Emergency stop confirm thr mc with respect to set up change	8	14	6	√	—	
3	Operator loose & remove the antiback stoppers	14	28	14	√	—	
4	Operator has loose & remove allen bolt for 2R antiback stopper	28	56	28	√	—	
5	Operator fit the antiback stopper for 2R model & tight the allen bolt	56	73	17	√	—	
6	Operator has tight the 3R antiback stopper allen bolt	73	86	13	√	—	
7	Operator has walk to taken air gun for set up change.	86	121	35	—	—	
Total Time in Min.		121		7	0		

# Shifting internal set up activities to External set up activities

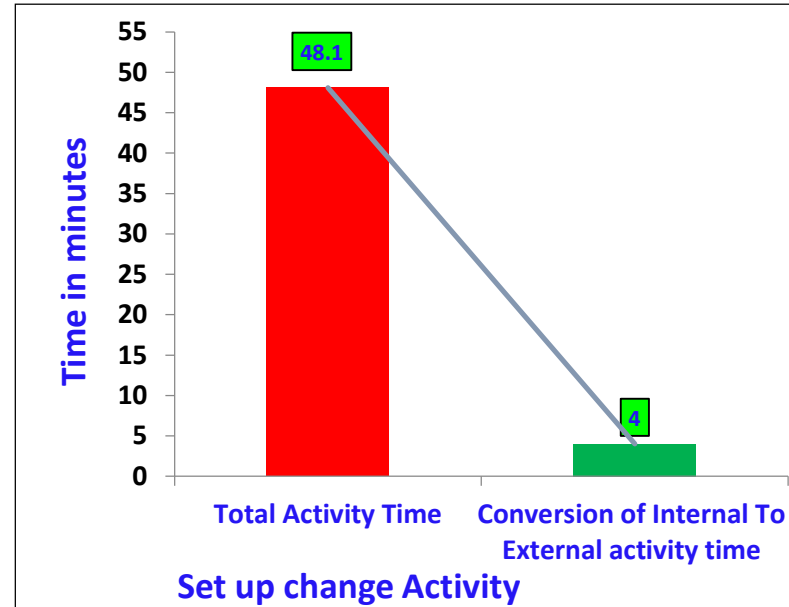
- ❑ Out of **50 activities** , **05 no's** of the activities are converted from Internal activities to External activities
- ❑ **Total Time saving** from Internal activities to external activity is **4 minutes/** set up change

## Activity conversion sheet

### Conversion of Internal/External activities



### Time saving due to Conversion of Internal/External activities

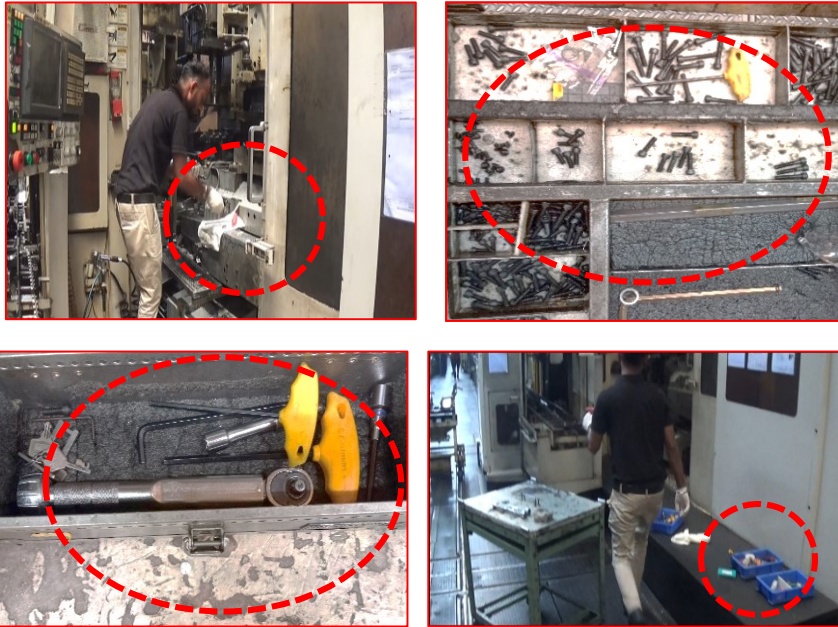


Internal Activity Converted into External Activity									
Line Name :- R1040 Crankcase							Responsibility :- Vilas Patil & Tupe Sir.		
Machine Name :- OP-190 B							Total Video Time:- 613 Sec.		
Process Name :- Set up change of OP-190 B Machine.							Catagory		
Sr.No.	Main Set Up work Elements	Start	End	Total	Internal Activity	External Activity	Converted Activity		
1	Operator has go to backside of mc. For set up change.	0	8	8	Internal	**	External		
2	Operator has open the mc. Set up door manually.	8	11	3	Internal	**	**		
3	Operator has kept the all tools on cooler.	11	19	8	Internal	**	**		
4	Operator has connect the air gun.	19	30	11	Internal	**	External		
5	Operator has take the allen key	30	37	7	Internal	**	**		
6	Operator has flush the air on fixture parts for cleaning perpose	37	59	22	Internal	**	**		
7	Opeartor has loose & remove the rest pad ( Datum seat cap 2R)	331	351	20	Internal	**	**		
8	Opeartor has flush the air on rest pad ( Datum seat kocating area )	351	382	31	Internal	**	**		
9	Opeartor has walk for taking the magnetic stic.	382	430	48	Internal	**	External		
10	Operator has pick the allen bolt by Magnetic stic.	430	440	10	Internal	**	External		
11	Opeartor flush the air on rest pad and allen bolt	440	463	23	Internal	**	**		
12	Operator has fitted the rest pad ( datum seat ) by allenkey on 2R location	550	595	45	Internal	**	**		
13	Operator has change the washer	595	613	18	Internal	**	**		

**Objective :- To convert maximum internal activities into external activities & time saved by 4 minutes**

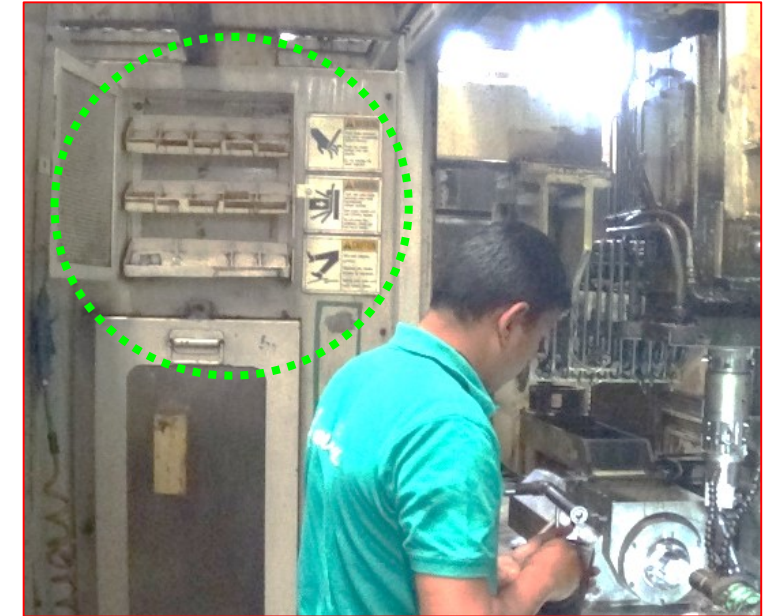
# Shifting internal set up activities to External set up activities

## BEFORE IMPROVEMENT

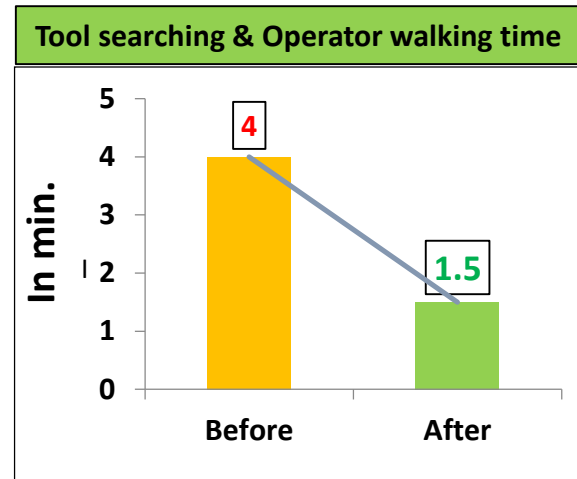


Operator required more time to carry all set up parts from offline storage area to the machine set up position

## AFTER IMPROVEMENT



Special set up part and tooling's storage designed and developed near to machine side



**Benefits :-** Over processing (Walking ) time is Reduced by **2.5 Mins per set up change**

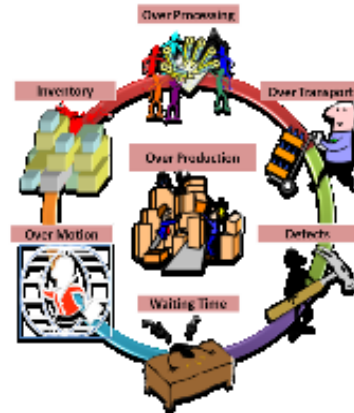
# Eliminate Waste from Internal steps

**Waste** is anything that **increase the cost of production ( Non Value Added )**.

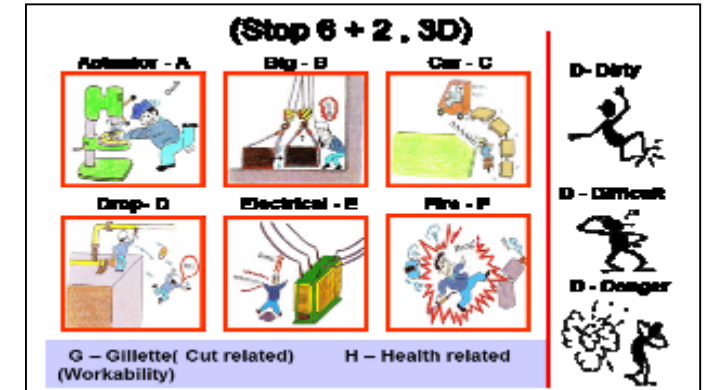


## Categorization Of Wastes

**Muda**  
**Mura**  
**Muri**



7 Types of Waste

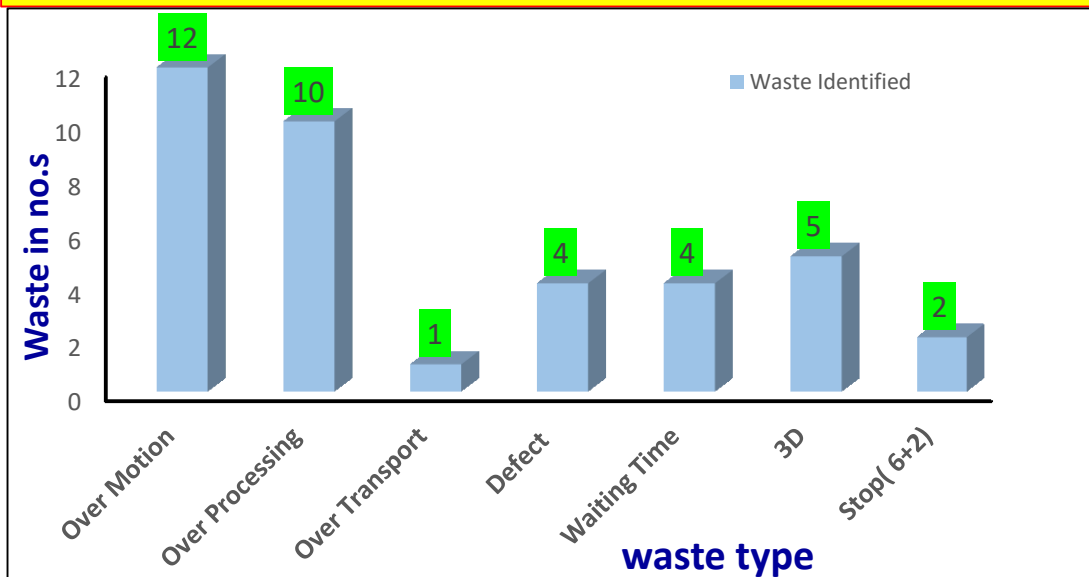


Unsafe Conditions

## Waste Identification list

Video No.	Waste No.	Before Photo	Problem Point/Waste	Type of Waste	Countermeasure / Action	After Improvement Photo	Department	Status
Video no.1	1		Operator has more walk to take the allenkey	Over Motion	Seprate box is made at left side of machine so that operator cannot have to go to take allen key from another machine.		Production	closed
	2		Cartridge loosening sequence is not defined	Defect	Cartridge loosening sequence is defined for first semifinish, second time finish and last time group operations.		ME	closed
	3		Operator has more time to remove the cartridge	Over Motion	T Shaped Allen key is used instead of L shaped allen key.		Production	closed
	4		Operator has more time require to cleaning the cartridge	Over Processing	Cleaning sequence to be defined		Production	closed
	5		Semifinish Finish and grooving cartridge have no identification for keeping	over processing	Seprate compartment and identification inside the cartridge keeping box. I.e. For semifinish, #1.1, #1.2, #2.1, #2.2. For finish, #3 and #4, For groove #6 identification is there.		ME	closed
	6		Removed cartridge have not separate keeping location to near the machine	Over Motion	Two seprate boxes are kept for B53 and B54 cartridge.		Gunukul	closed

## Categorization of internal step waste



Total Internal step identified waste 38 no's

Total Internal activity 45 no's


# Eliminate Waste from Internal steps

## Cause:-


More time required for setting the dial gauge on master from BS4 model to BS3 Model for cartridge setting



**Why?** More time required for setting and adjusting the dial gauge on BS3 master for cartridge setting



**Why?** Both BS3 & BS4 model dial gauge setting and adjusting on BS3 master for cartridge setting



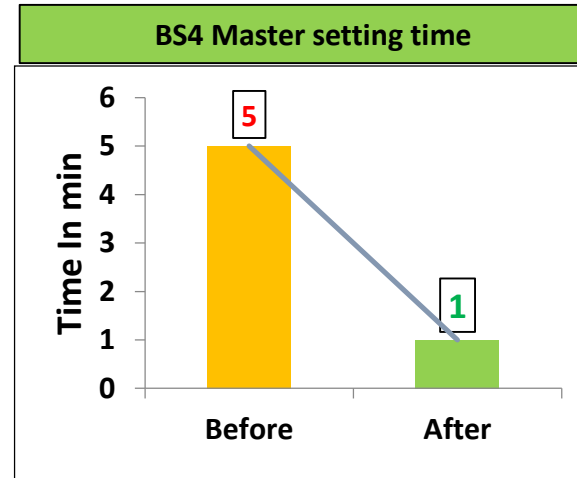
**Why?** BS4 Model master not available for Cartridge setting

**Root cause :- BS4** Model master not available for Cartridge setting

# Eliminate waste from Internal steps

## MUDA - OVER PROCESSING

### BEFORE IMPROVEMENT



Operator required more time for existing BS3 master used for adjusting dial gauge for BS4 model for cartridge setting

### AFTER IMPROVEMENT



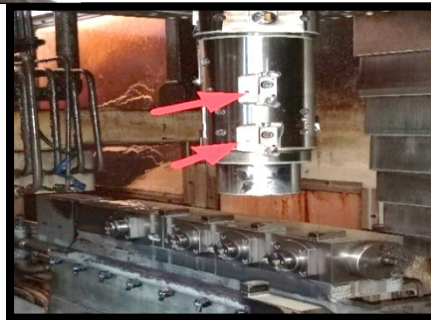
BS4 master provided with setting gauge for BS4 model cartridge setting

**Benefits :-** Over processing (adjusting ) time is Reduced by 4 Mins per set up change

# Eliminate Waste from Internal steps

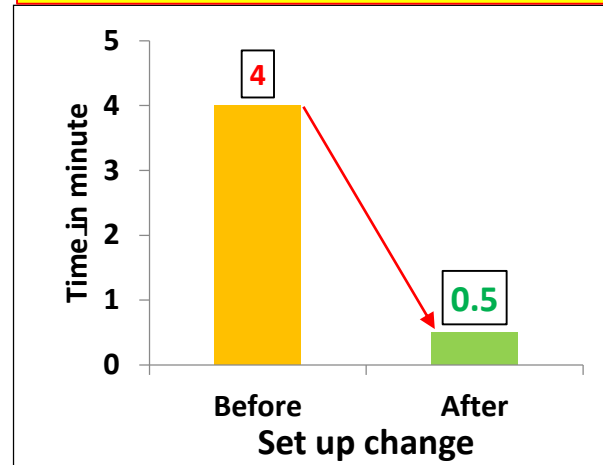
## MUDA - OVER PROCESSING

### BEFORE IMPROVEMENT

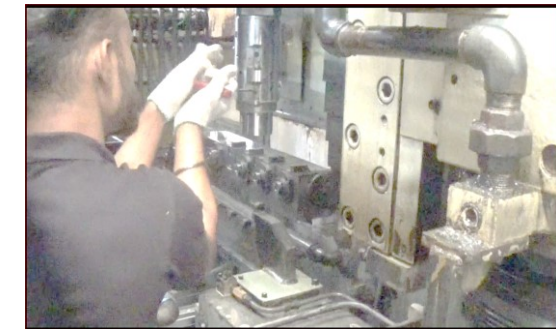
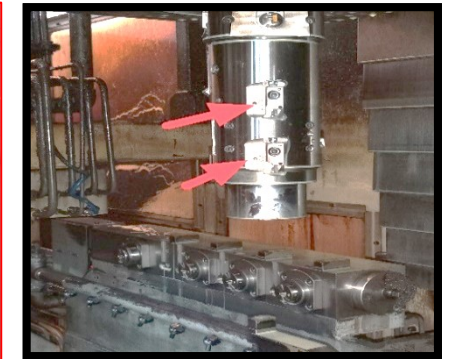
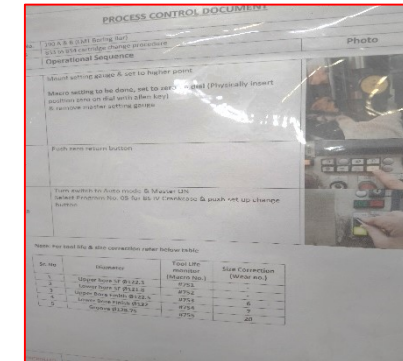


Operator required more time for fitment of cartridge because no sequence of cartridge fitment. Cartridge fitment procedure not defined.

Loosening and tightening sequence defined.



### AFTER IMPROVEMENT



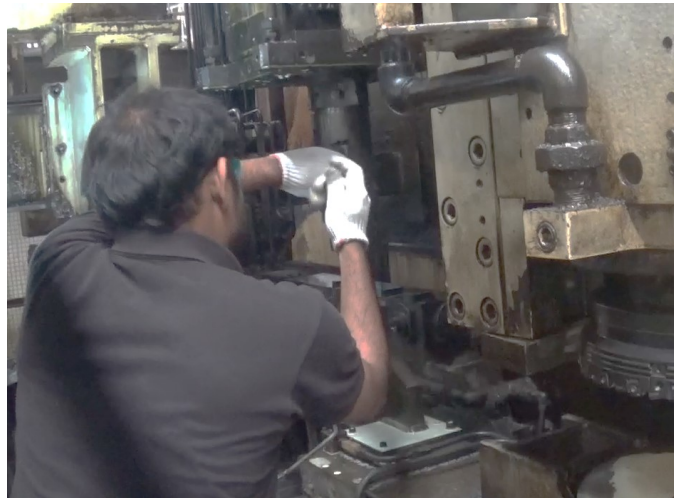
Cartridge fitment and loosening sequence defined and identification done procedure defined. Cartridge loosening sequence is defined for first semi finish, second time finish and last time groove operations.

**Benefits :-** Over processing (Walking ) time is Reduced by **3.5 Mins per set up change**

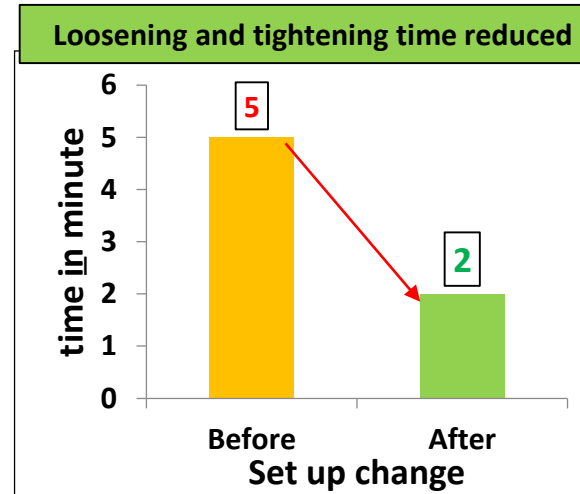
# Eliminate Waste from Internal steps

## MUDA - OVER PROCESSING

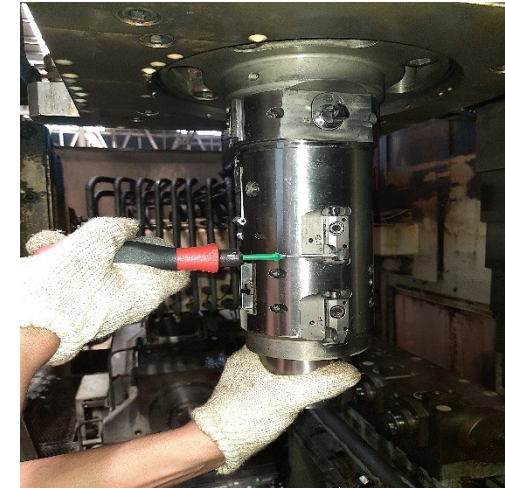
### BEFORE IMPROVEMENT



Operator required more time for fitment of insert clamping by Standard thorx key



### AFTER IMPROVEMENT



Special Thorx key with Torque provided for insert clamping

**Benefits :-** loosening & tightening time is Reduced by 3 Mins per set up change

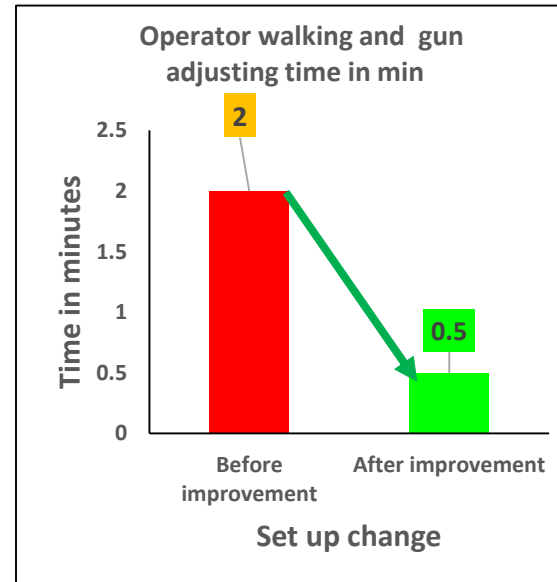
# Eliminate Waste from Internal steps

## MUDA – Over Motion

### BEFORE IMPROVEMENT



Operator has more walk to take the air gun , connect with air pipe and use for chip removing, boring bar and cartridge cleaning during set up



### AFTER IMPROVEMENT



Air gun provided for near the machine for set up insert, cartridge, boring bar cleaning and chips removed with air

**Benefits :-** Walking distance eliminated by 1.5 minutes and distance reduced by 5 meters

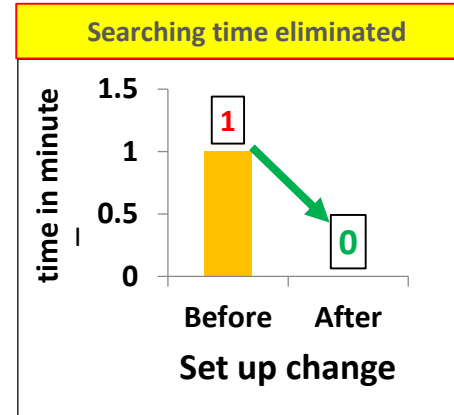
# Eliminate Waste from Internal steps

## MUDA - OVER PROCESSING

### BEFORE IMPROVEMENT



Operator has more time required for searching the cartridge of BS4 and BS3 model.

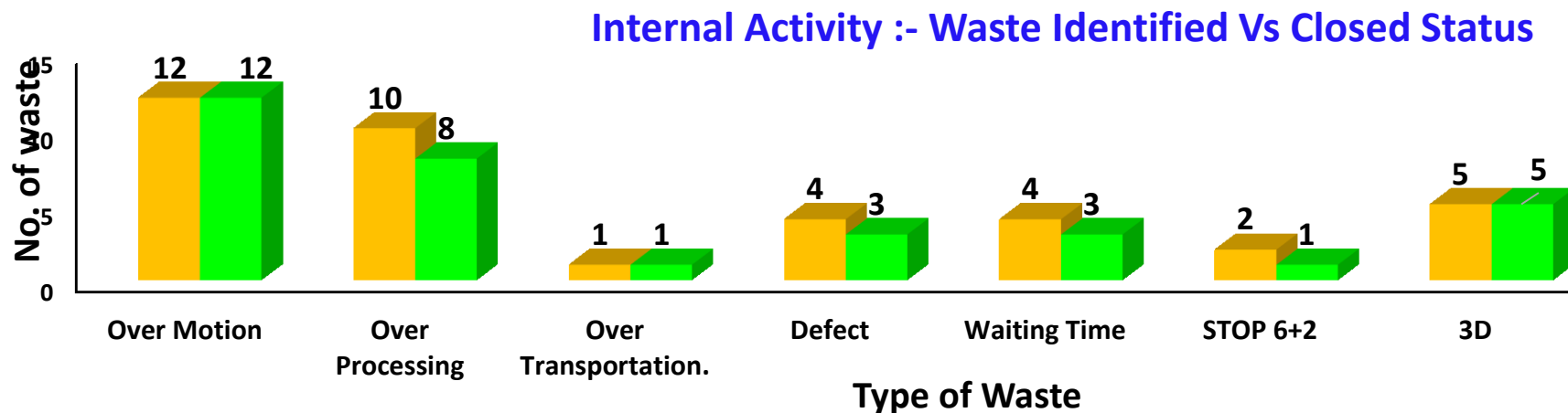


### AFTER IMPROVEMENT



operator searching time eliminated due to Engraving done on boring bar ,BS4 & BS3 model Cartridge

**Benefits :-** Searching time eliminated by 1 Mins per set up change

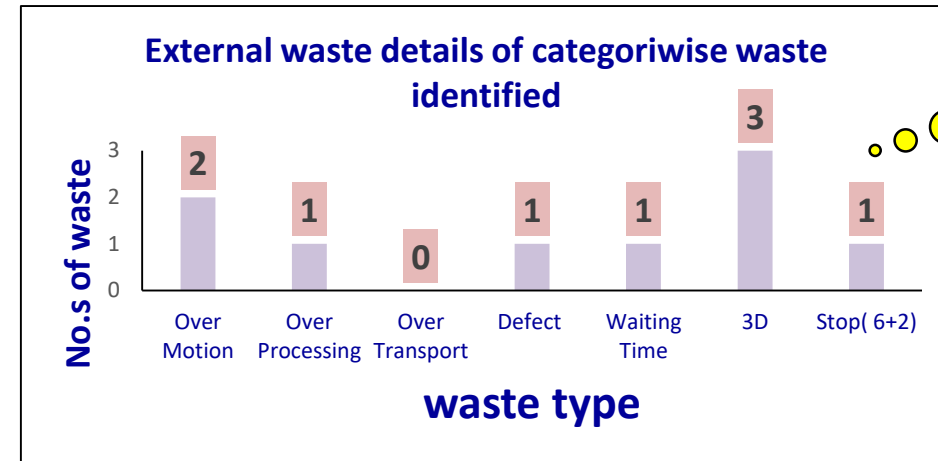


Internal Waste Identified 38 No's

Waste closed 34 No's

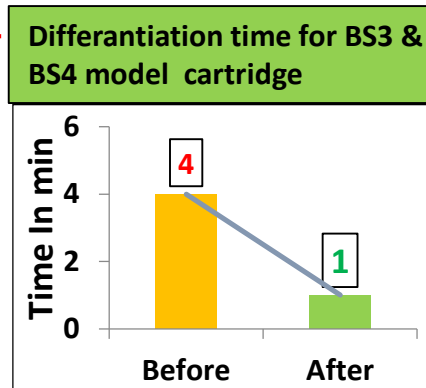
# Eliminate Waste from External steps

WASTE IDENTIFICATION LIST		
Problem Point/Waste	Type of Waste	Countermeasure / Action
Operator has walk more to take the setup change box.	Over motion	Set up change box provided near to the mc.
Operator has crowdy platform for walking to setup change box keeping area to machine.	Waiting time	Once tool box provided operator has not required to walk and take the tool box.
Operator has keep Tool box in componen keeping location.	Dirt	Allen key keeping arrangement provided in Set up change box.
Allenkey kept on conveyor	Dirt	Set up change Tool Box provision required



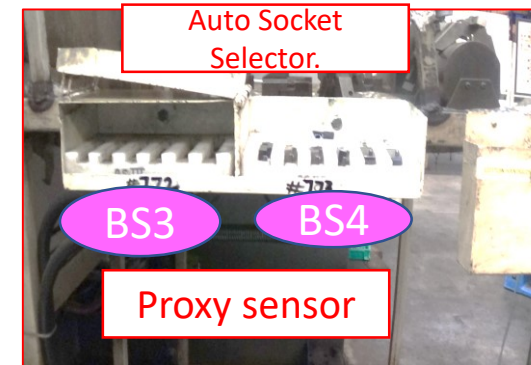
Total 9 Waste identified

## BEFORE IMPROVEMENT



Cartridge kept in bin in mixed condition ,Chances of wrong fitment of BS4 cartridge against BS3 Cartridge

## AFTER IMPROVEMENT



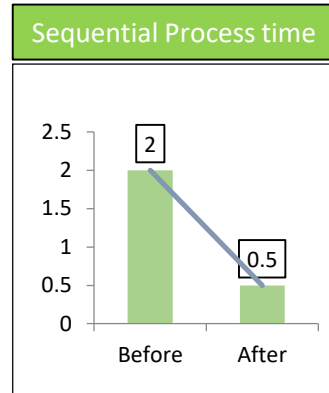
Poka-yoke provided to differentiate BS4 Cartridge and BS3 Cartridge.  
Proxy switch provided and eliminate wrong cycle start and boring bar dash.

**Benefits :- Defect - elimination of wrong cycle start, boring bar dashing to component**

# Eliminate Waste from External steps

## BEFORE IMPROVEMENT

Set up change  
Procedure  
sheet  
not  
defined



## AFTER IMPROVEMENT

OP 1908 Set up change checklist

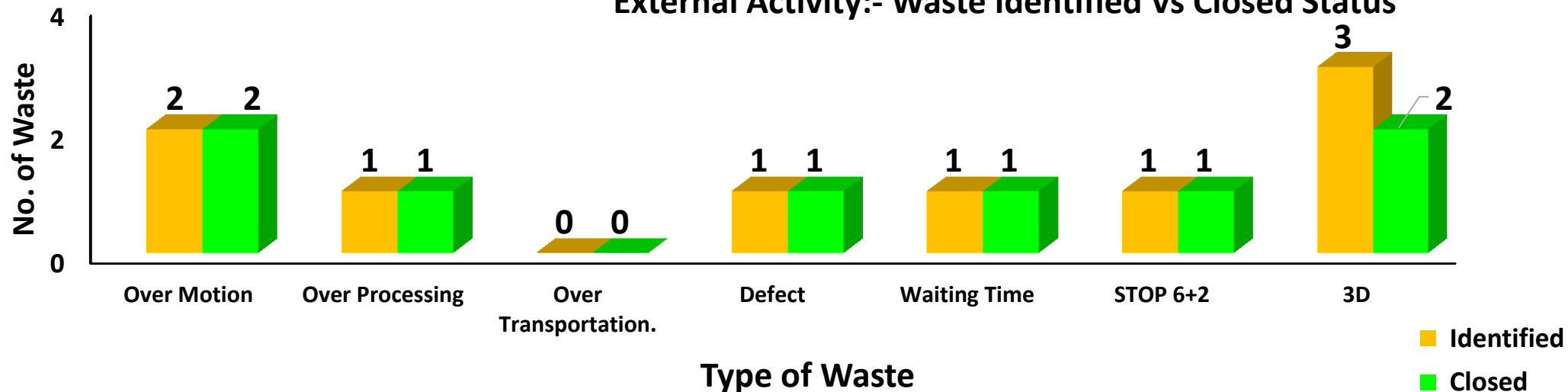
Sr. No.	Set up change activity	Activity Checked	Model Name	48 B54 to 28	28 to 48 B54	48 B54 to 28	28 to 48 B54
1	Press Emergency & Clean Boring bar						
2	Remove B54 cartridge #1, cartridge #1.2, cartridge #2.1 & cartridge #2.2 all cartridge from boring bar with special 5 mm allen key						
3	Clean cartridge mounting area						
4	Take 2R Cartridge as per below nomenclature						
5	Mount 2R Cartridge on boring bar & tight bolt with special 5 mm allen key as per below nomenclature						
6	Take Ø122.5 setting gauge & set Ø122.5 setting gauge dial to zero on master						
7	Take Ø122.5 setting gauge & set Ø122.5 setting gauge dial to zero on master						
8	Mount setting gauge on boring bar & set to higher point on insert						
9	Ensure #1.1 & #1.2 (Ø121.8) reading should be -0.10 to -0.15 on dial						
10	Ensure #2.1 & #2.2 (Ø122.3) reading should be -0.10 to -0.15 on dial						
11	After setting remove master						
12	Remove B53 #3 B&B Cartridge from boring bar by following below steps First loose Cartridge nutting pad with T18 hex key Remove Cartridge nut (20x6) with 4 mm allen key Remove cartridge from boring bar						
13	Clean cartridge mounting area with cotton						
14	Take 2R cartridge as per below nomenclature						

15	Mount B53 #3 B&B Cartridge to boring bar by following below steps and insert cartridge into cartridge mounting pad (While mounting cartridge ensure ball made boring with ball flat on cartridge mounting area with tightening of cartridge nutting pad with T18 hex key & tight Cartridge bolt (20x6) with 4 mm allen key				
16	Remove 2R #9 Special Cartridge from boring bar with 4 mm allen key				
17	Clean cartridge mounting area				
18	Take & mount B54 groove machining cartridge				
19	Ensure cartridge dial to lower side				
20	Tight bolt with 4 mm allen key				
21	Release Emergency button				
22	Turn switch to Manual mode & master ON				
23	Push (FIN, BO, TOOL SETTING) soft key on counter operation screen for finish insert setting Ø122.5 & Ø122.5				
24	Ensure No. 5 wear to be 0.000 for Ø122.5 finish diameter				
25	Take Ø122.5 setting gauge & set Ø122.5 setting gauge dial to zero on master				
26	Take Ø122.5 setting gauge & set Ø122.5 setting gauge dial to zero on master				
27	Mount setting gauge & set to higher point				
28	Macro setting to be done, set to zero on dial (Physically insert position zero on dial with allen key) & remove master setting gauge				
29	Push (FIN, BO, FINISH RETURN) soft key on counter operation screen to return finish tool (Ø122.5 & Ø122.5)				
30	Push (CHARACTER TOOL SET, POS) soft key on counter operation screen for groove insert setting				
31	Take Ø128.75 setting gauge & set Ø128.75 setting gauge dial to zero on master				
32	Ensure No. 20 wear to be 0.000 for Groove finish diameter				
33	Mount setting gauge & set to higher point				
34	Macro setting to be done, set to zero on dial (Physically insert position zero on dial with allen key) & remove master setting gauge				
35	Push zero return button				
36	Turn switch to Auto mode & Master ON				
37	Select Program No. 05 for B5 IV Checklake & push set-up change button				
	Team Associate Signature				
	Team Leader Signature				

New set up change sheet prepared and defined

**Benefits :-** Set Up change process time reduced from **2 minutes to 0.5 minutes**

### External Activity:- Waste Identified Vs Closed Status

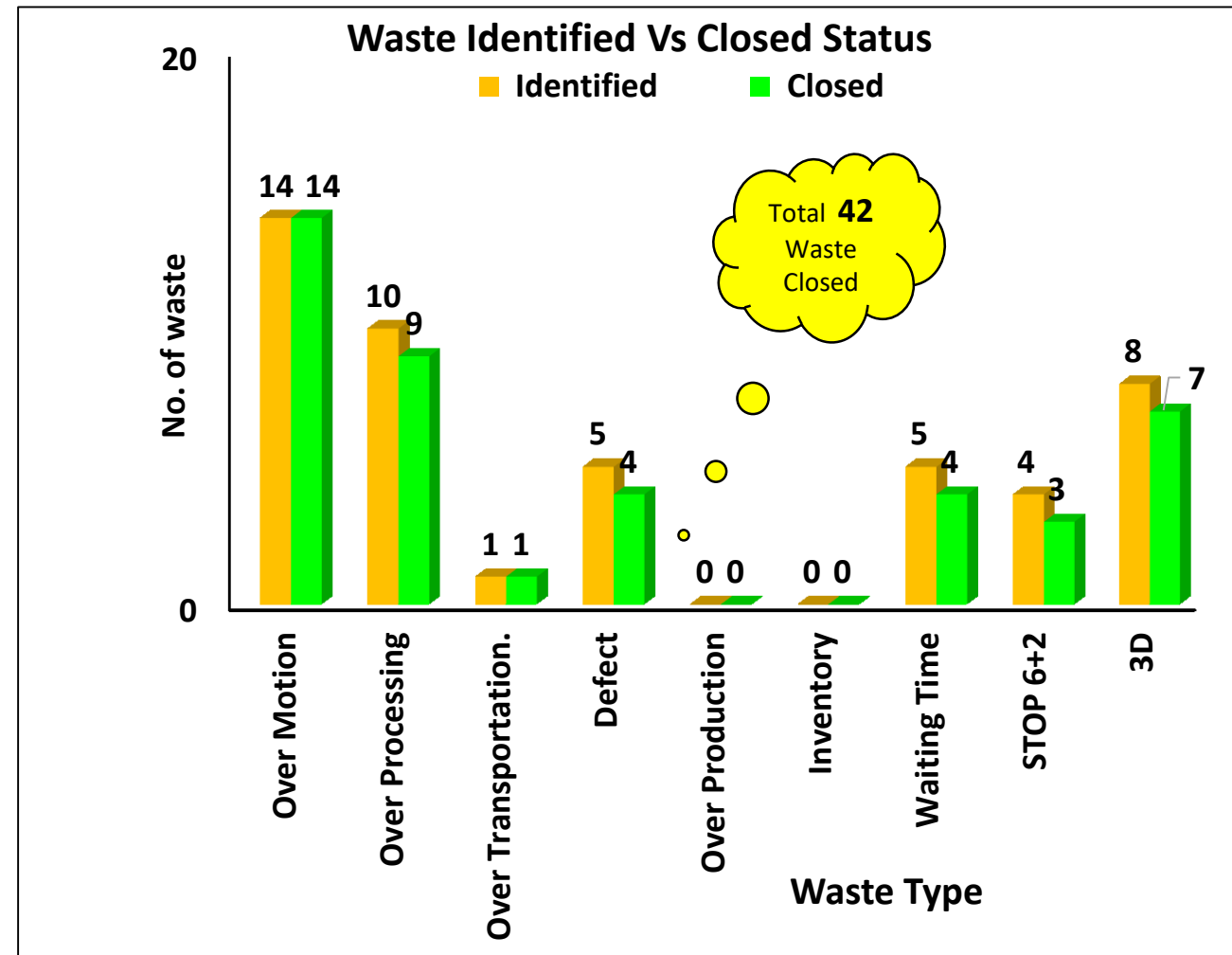


**External Waste Identified 9 No's**

**External Waste closed 8 No's**

# Responsibility Allocation & Waste closing Status

Sr. no.	Work Activities	RESPONSIBILITY	TIME
1	Activity Planning	Shailesh Tupe (PE-TPS)	Daily
2	Production related activities/Trials	Shankar Govindkoppa (Prod.)	Per shift
3	ME related activities	Sachin Patil (ME)	Daily
4	Training related activities	Vilas Patil ( PE-TPS )	As Req.
5	Maintenance related activities	Ajit Patil (Maint.)	Daily
6	Special tools/Fixtures	Mangesh jagdale( ME)	Daily
7	Fabrication/Pokayoke activities	Amol Yadav (Production)	Daily
8	Standard processes/procedures	Satish patil (ME)	Daily
9	Work Progress Review	Shailesh Tupe (PE-TPS)	Daily



- **Total Waste (Internal & external ) Identified :- 47 nos.**
- **Total Waste ( Internal & external) Closed :- 42 nos.**
- **In process Waste -Management related waste :- 5 nos.**

# Standardization -Set Up Change Check Sheet & Safety Calendar

OP 190B Set up change checksheet					
Model Name		4R BS4 to 2R	2R to 4R BS4	4R BS4 to 2R	2R to 4R BS4
Sr. No.	Set up change activity	Date Shift	Date Shift	Date Shift	Date Shift
1	Press Emergency & Clean Boring bar.	✓	✓	✓	✓
2	Remove BS4 cartridge #1.1, cartridge #1.2, cartridge #2.1 & cartridge #2.2 all cartridge from boring bar with special 5 mm allen key	✓	✓	✓	✓
3	Clean cartridge mounting area	✓	✓	✓	✓
4	Take 2R cartridge as per below nomenclature	✓	✓	✓	✓
5	Mount 2R Cartridge on boring bar & tight bolt with special 5 mm allen key as per below nomenclature	✓	✓	✓	✓
6	Take Ø122.5 setting gauge & set Ø122.5 setting gauge dial to zero on master	✓	✓	✓	✓
7	Take Ø122 setting gauge & set Ø122 setting gauge dial to zero on master	✓	✓	✓	✓
8	Mount setting gauge on boring bar & set to higher point on insert	✓	✓	✓	✓
9	Ensure #1.1 & #1.2 (Ø121.8) reading should be -0.10 to -0.15 on dial	✓	✓	✓	✓
10	Ensure #2.1 & #2.2 (Ø122.3) reading should be -0.10 to -0.15 on dial	✓	✓	✓	✓
11	After setting remove master	✓	✓	✓	✓
12	Remove BS3 #3 & #4 Cartridge from boring bar by following below steps First loose Cartridge butting pad with T18 torx key Remove Cartridge bolt (2no's) with 4 mm allen key Remove cartridge from boring bar	✓	✓	✓	✓
13	Clean cartridge mounting area with cotton	✓	✓	✓	✓
14	Take 2R cartridge as per below nomenclature	✓	✓	✓	✓
15	Mount BS3 #3 & #4 Cartridge to boring bar by following below steps and Insert cartridge into cartridge mounting slot (While mounting cartridge ensure ball inside boring with ball flat on cartridge mounting side) with tightening of cartridge butting pad with T18 torx key & tight Cartridge bolt (2no's) with 4 mm allen key	✓	✓	✓	✓
16	Remove 2R #9 Special Cartridge from boring bar with 4 mm allen key	✓	✓	✓	✓
17	Clean cartridge mounting area	✓	✓	✓	✓
18	Take & mount BS4 groove machining cartridge	✓	✓	✓	✓
19	Ensure cartridge butt to lower side	✓	✓	✓	✓
20	Tight bolt with 4 mm allen key	✓	✓	✓	✓
21	Release Emergency button	✓	✓	✓	✓
22	Turn switch to Manual mode & master ON	✓	✓	✓	✓
23	Push [FIN. BO. TOOL SETTING] soft key on counter operation screen for finish insert setting (Ø122.5 & Ø122) (a) Ensure No. 6 wear to be 0.000 for Ø122.5 finish diameter (b) Ensure No. 7 wear to 0.000 for Ø122 finish diameter (c) Take Ø122.5 setting gauge & set Ø122.5 setting gauge dial to zero on master (d) Take Ø122 setting gauge & set Ø122 setting gauge dial to zero on master	✓	✓	✓	✓
24	Mount setting gauge & set to higher point	✓	✓	✓	✓
25	Macro setting to be done, set to zero on dial (Physically insert position zero on dial with allen key) & remove master setting gauge	✓	✓	✓	✓
26	Push [FIN. BO. FACING RETURN] soft key on counter operation screen to return finish tool (Ø122.5 & Ø122)	✓	✓	✓	✓
27	Push [CHAMFER TOOL SET. POS.] soft key on counter operation screen for groove insert setting (a) Take Ø128.75 setting gauge & set Ø128.75 setting gauge dial to zero on master	✓	✓	✓	✓
28	Ensure No. 20 wear to 0.000 for Groove finish diameter	✓	✓	✓	✓
29	Mount setting gauge & set to higher point	✓	✓	✓	✓
30	Macro setting to be done, set to zero on dial (Physically insert position zero on dial with allen key) & remove master setting gauge	✓	✓	✓	✓
31	Push zero return button	✓	✓	✓	✓
32	Turn switch to Auto mode & Master ON	✓	✓	✓	✓
33	Select Program No. 05 for BS IV Crankcase & push set up change button	✓	✓	✓	✓
Team Associate Signature		Team Leader Signature			

ACCIDENT FREE DAY -  
DANGEROUS OCCURRENCE  
MINOR INJURY - INJURY RESULTING INTO SMALLER / MINOR LOSS TO HUMAN HEALTH & SYSTEM  
MAJOR INJURY - INJURY RESULTING INTO HEAVIER / MAJOR LOSS TO HUMAN HEALTH & SYSTEM

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Month-January 76

Month-February 76

Month-March 76

Month-April 76

Month-May 76

Month-June 76

Month-July 76

Month-August 76

Month-September 76

Month-October 76

Month-November 76

Month-December 76

Month-January 77

Month-February 77

Month-March 77

Month-April 77

Month-May 77

Month-June 77

Month-July 77

Month-August 77

Month-September 77

Month-October 77

Month-November 77

Month-December 77

Month-January 78

Month-February 78

Month-March 78

Month-April 78

Month-May 78

Month-June 78

Month-July 78

Month-August 78

Month-September 78

Month-October 78

Month-November 78

Month-December 78

Month-January 79

Month-February 79

Month-March 79

Month-April 79

Month-May 79

Month-June 79

Month-July 79

Month-August 79

Month-September 79

Month-October 79

Month-November 79

Month-December 79

Month-January 80

Month-February 80

Month-March 80

Month-April 80

Month-May 80

Month-June 80

Month-July 80

Month-August 80

Month-September 80

Month-October 80

Month-November 80

Month-December 80

Month-January 81

Month-February 81

Month-March 81

Month-April 81

Month-May 81

Month-June 81

Month-July 81

Month-August 81

Month-September 81

Month-October 81

Month-November 81

Month-December 81

Month-January 82

Month-February 82

Month-March 82

Month-April 82

Month-May 82

Month-June 82

Month-July 82

Month-August 82

Month-September 82

Month-October 82

Month-November 82

Month-December 82

Month-January 83

Month-February 83

Month-March 83

Month-April 83

Month-May 83

Month-June 83

Month-July 83

Month-August 83

Month-September 83

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Month-January 84

Month-February 84

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Month-April 84

Month-May 84

Month-June 84

Month-July 84

Month-August 84

Month-September 84

Month-October 84

Month-November 84

Month-December 84

Month-January 85

Month-February 85

Month-March 85

Month-April 85

Month-May 85

Month-June 85

Month-July 85

Month-August 85

Month-September 85

Month-October 85

Month-November 85

Month-December 85

Month-January 86

Month-February 86

Month-March 86

Month-April 86

Month-May 86

Month-June 86

Month-July 86

Month-August 86

Month-September 86

Month-October 86

Month-November 86

Month-December 86

Month-January 87

Month-February 87

Month-March 87

Month-April 87

Month-May 87

Month-June 87

Month-July 87

Month-August 87

Month-September 87

Month-October 87

Month-November 87

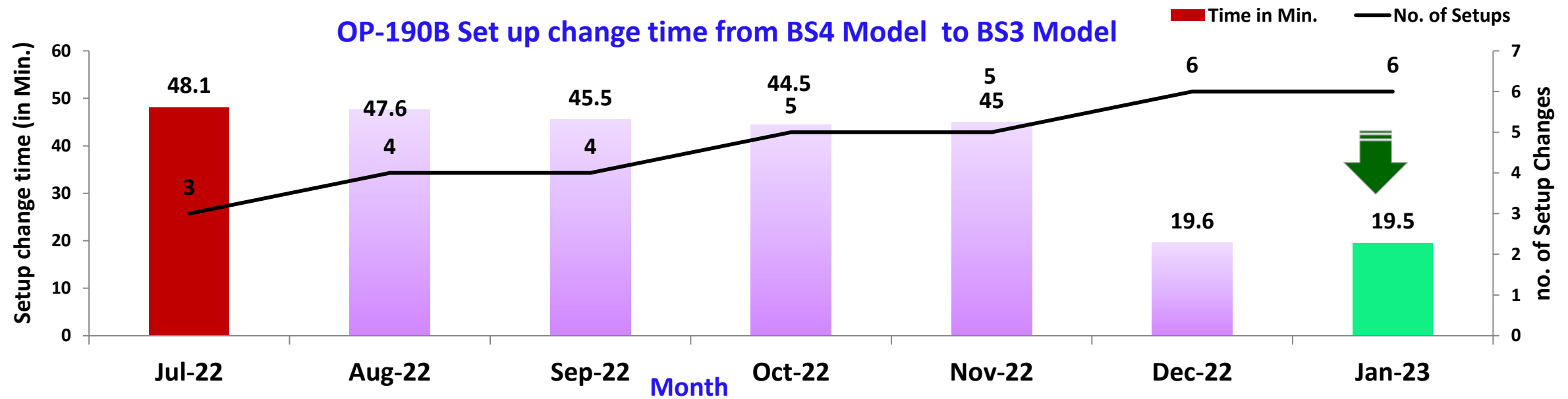
Month-December 87

Month-January 88

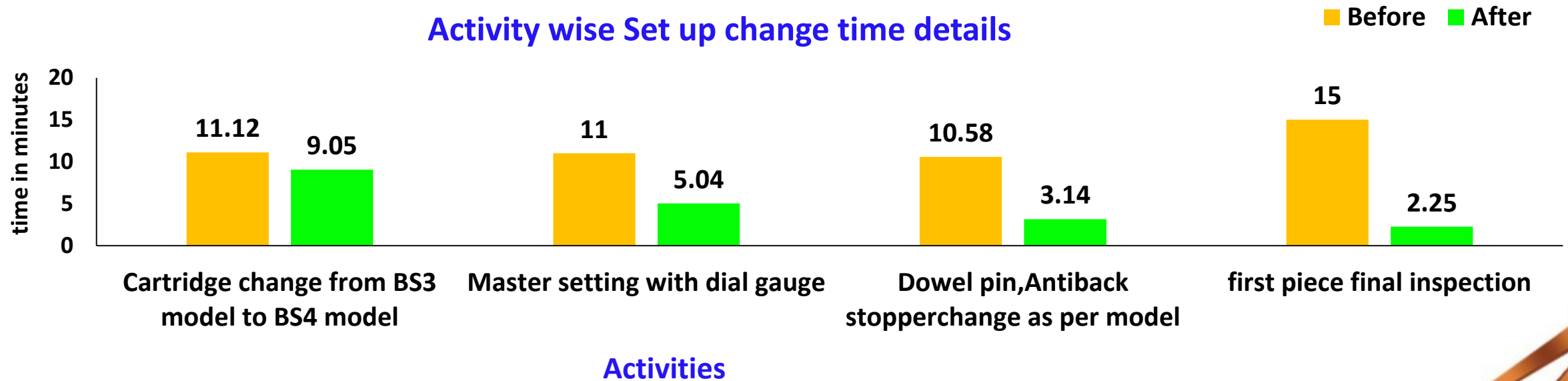
Month-February 88

Month-March 88

# Results



## Activity wise Set up change time details



# Daily Production Report

06 December 22

KIRLOSKAR OIL ENGINES LTD., KAGAL														
HOURLY PRODUCTION REPORT														
Dept: Machine Shop														
Date: 06/12/2022														
Task Time: 14.5 min														
Team Leader: S. G. A. TA Names (Online): Handyanwar Pawar (F), Pravin (D), Sunny (D), Anil (D)														
TA Name (Offline): Anil C. Prasad (A), Kishor (D)														
Time from - to	Available time in Min.	Total Output (OK Qty) - Op.	Rejection Qty - Op.	Reason for rejection	Machine Breakdown (Min)	Inspection Time (Min)	Model Change time (Min)	Tool change time (Min)	Process Problem (Min)	Casting / Forging shortage	Others (Min)	Line stop (Min)	Reason for Loss of Output	
7.15 - 8.00	45	04	00		20							20	OP205 - in function time new A to 10 min	
8.00 - 9.00	60	04	00		15							15	OP240 - stop in auto - 8-10-8-20-10 min	
9.00 - 10.00	60	05	13									20	OP100B - Setup change 3R-BSH to 15 min change change - BSH to BSH	
10.00 - 11.30	80	06	19			19-40						20	OP100 - Refurbishing problem - 20 min	
11.30 - 12.00 (Lunch)	30	00	19									20	OP180 - comp unloading problem - 20 min	
12.00 - 1.00	60	08	27									20	OP140 - light curtain problem - 15 min	
1.00 - 2.00	60	05	32									15		
2.10 - 3.10	60	06	38									11	TOTAL LINE STOP TIME (C+D+E+F+G+H+I) = 110	
TOTAL OK QTY (A - B) = 38														
TOTAL AVAILABLE TIME (in min.) = 435														
NET TIME (435 - L) = M = 325														
Special Communication if any:														
Approved By:														
Page 1 of 1														
Prepared By: KGL-3-MSKP-G-01														
BREAK DETAILS (1st shift):														
1) 07.00 to 7.05 - Return after exercise, Work/Machine allocation & PPE preparation														
2) 07.05 to 7.10 - Autonomous Maintenance														
3) 07.10 to 7.15 - Communication meeting														
4) 11.30 to 12.00 - Lunch														
5) 2.00 to 2.10 - Tea Break														
6) 3.10 to 3.20 - Machine cleaning														
7) 3.20 to 3.25 - Report writing														
8) 3.25 to 3.30 - Communication meeting (Shake hand)														

Set up  
change  
time 18.10  
min

30 December 2021

KIRLOSKAR OIL ENGINES LTD., KAGAL														
HOURLY PRODUCTION REPORT														
Dept: Machine Shop														
Date: 30/12/21														
Task Time: 14.5 min														
Team Leader: S. G. A. TA Names (Online): Anil yadav (F), Shantanu Chougale (D), Anand (D)														
TA Name (Offline): Kishor (D), Pravin (D), Anil (D)														
Time from - to	Available time in Min.	Total Output (OK Qty) - Op.	Rejection Qty - Op.	Reason for rejection	Machine Breakdown (Min)	Inspection Time (Min)	Model Change time (Min)	Tool change time (Min)	Process Problem (Min)	Casting / Forging shortage	Others (Min)	Line stop (Min)	Reason for Loss of Output	
7.15 - 8.00	45	05	05									20	OP203 - Seat check problem - 20 min	
8.00 - 9.00	60	04	09									20	OP100 - Refurbishing problem - 15 min	
9.00 - 10.00	60	05	13									15	OP100 - 3R-BSH still error lost 15 min	
10.00 - 11.30	80	09	22									15	OP100B - Setup change downtime - 15 min	
11.30 - 12.00 (Lunch)	30	00	22									19	OP110 - stop in Auto - 20 min	
12.00 - 1.00	60	07	29									20	OP100 - Arc send 20 min - 20 min	
1.00 - 2.00	60	07	36									20		
2.10 - 3.10	60	08	44									109	TOTAL LINE STOP TIME (C+D+E+F+G+H+I) = 109	
TOTAL OK QTY (A - B) = 44														
TOTAL AVAILABLE TIME (in min.) = 435														
NET TIME (435 - L) = M = 326														
Special Communication if any:														
Approved By:														
Page 1 of 1														
Prepared By: KGL-3-MSKP-G-01														
BREAK DETAILS (1st shift):														
1) 07.00 to 7.05 - Return after exercise, Work/Machine allocation & PPE preparation														
2) 07.05 to 7.10 - Autonomous Maintenance														
3) 07.10 to 7.15 - Communication meeting														
4) 11.30 to 12.00 - Lunch														
5) 2.00 to 2.10 - Tea Break														
6) 3.10 to 3.20 - Machine cleaning														
7) 3.20 to 3.25 - Report writing														
8) 3.25 to 3.30 - Communication meeting (Shake hand)														

23 December 2021

KIRLOSKAR OIL ENGINES LTD., KAGAL														
HOURLY PRODUCTION REPORT														
Dept: Machine Shop														
Date: 23/12/21														
Task Time: 6.8 min														
Team Leader: MUP TA Names (Online): Kishor Chougale (F), Anand yadav (D), Anand yadav (D)														
TA Name (Offline): Anil H. Pravin (D), Kishor (D), Shantanu C (D)														
Time from - to	Available time in Min.	Total Output (OK Qty) - Op.	Rejection Qty - Op.	Reason for rejection	Machine Breakdown (Min)	Inspection Time (Min)	Model Change time (Min)	Tool change time (Min)	Process Problem (Min)	Casting / Forging shortage	Others (Min)	Line stop (Min)	Reason for Loss of Output	
7.15 - 8.00	45	04	00									20	OP14 - Seat check problem - 20 min	
8.00 - 9.00	60	05	10		15							15	OP105 - comp unloading problem - 15 min	
9.00 - 10.00	60	05	23									15	OP104 - Seat check problem - 15 min	
10.00 - 11.30	80	08	23									20	OP100 - Setup change 2R-4R 3-10-20 min change change - BSH to BSH	
11.30 - 12.00 (Lunch)	30	00	23									18		
12.00 - 1.00	60	03	30									70	TOTAL LINE STOP TIME (C+D+E+F+G+H+I) = 70	
1.00 - 2.00	60	05	37									435	TOTAL AVAILABLE TIME (in min.) = 435	
2.10 - 3.10	60	05	42									365	NET TIME (435 - L) = M = 365	
TOTAL OK QTY (A - B) = 42														
Special Communication if any:														
Approved By:														
Page 1 of 1														
Prepared By: KGL-3-MSKP-G-01														
BREAK DETAILS (1st shift):														
1) 07.00 to 7.05 - Return after exercise, Work/Machine allocation & PPE preparation														
2) 07.05 to 7.10 - Autonomous Maintenance														
3) 07.10 to 7.15 - Communication meeting														
4) 11.30 to 12.00 - Lunch														
5) 2.00 to 2.10 - Tea Break														
6) 3.10 to 3.20 - Machine cleaning														
7) 3.20 to 3.25 - Report writing														
8) 3.25 to 3.30 - Communication meeting (Shake hand)														

Set up  
change  
time 19.20  
sec

Set up  
change  
time 19 min  
16 sec

# Benefits

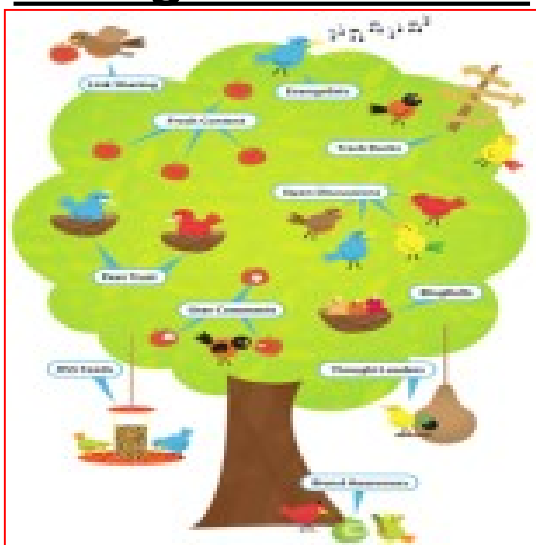
## Tangible Benefits:



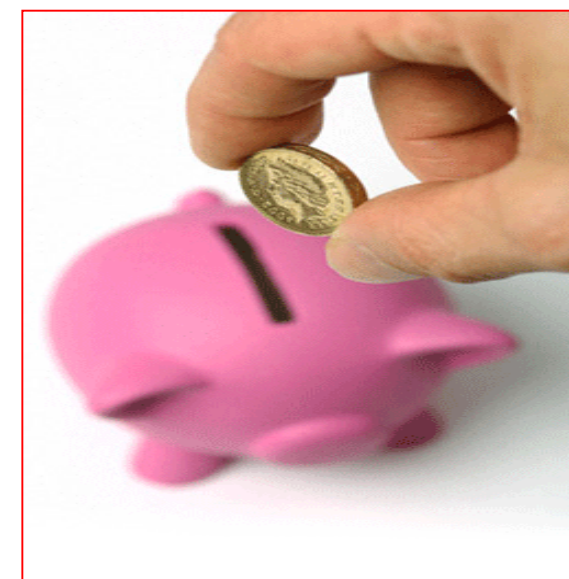
Sr. No.	Description	Savings
1	Engine Manufacturing capability improved (in Rs./Month)	96,00,000 /-
2	Assembly loss (downtime) due Crankcase shortage per month	320 minutes



## Intangible Benefits:



- Satisfaction Of Accomplishing Given Task
- Team Work Increased
- Gain In Member's Knowledge
- Saving In Natural Resources



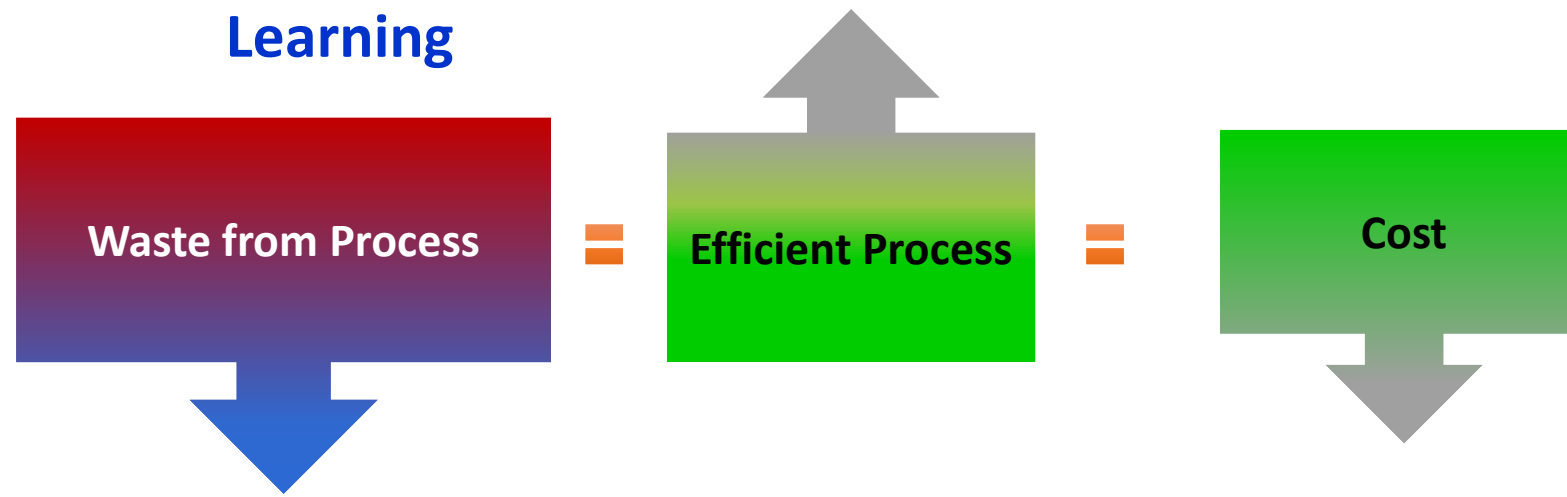
# Future Focus

## Horizontal Deployment

- However similar methodology is used currently for productivity improvement on EPII Camshaft, EPI Crankshaft & Connecting rod lines

## Uniqueness of Project

- No requirement of any Major Investment
- Usage of very simple but important methodology to observe, identify and correct the process with systematic approach



Thank You

Presented by : Kirloskar Oil Engines, Kagal Plant

<https://koel.kirloskar.com>