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

Genset Plant

Engine Plant - I

Engine Plant - II

Total Employees As on date	Managers (TL, GL & UL)	Operators (Team Associates)
1092	**194**	**898**

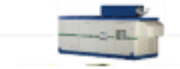
Plant Initiatives

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**

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

PROJECT 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)	Mr. Shailesh Tupe (Department- Process Engg.-TPS) Mr. Vilas Patil (Department- Gurukul) Mr. Shankar Govindkoppa (Department- Production) Mr. Mustafa Patel (Department - Production) Mr. Mangesh Jagdale (ME) Mr. Amol Yadav (Department - Production) Mr. Satish Patil (ME) Mr. Sachin Patil (ME) Mr. Ajit Patil (Department - Maintenance)
Supporting Members	Satish Patil , Prashant pawar
Start Date	05/09/2022
End Date	28/12/2022

METHODOLOGY FOLLOWED

kirloskar Oil Engines

Step 1
- Select the model

Step 2
- Observe and measure the total changeover time

Step 3
- Separate internal and external steps

Step 4
- Convert internal steps as possible to external steps

Step 5
- Eliminate waste from Internal steps

Step 6
- Eliminate waste from External steps

Step 7
- Standardize and maintain the new changeover procedure

PROCESS :-SINGLE MINUTE EXCHANGE OF DIES

START

Select Machine Form CFT Training of CFT

Take Video Film of set up change process

Write down the process & Segregate internal, External Activities

Convert Internal activities to External

List down the waste from internal & External Activities

Brainstorming to develop solution for waste elimination

Prioritize on Quality, Fatigue, Time Saving

Action implementation on short & long term basis

Start waste closing as prioritize from internal & external

Take Again Video Film

Check benefits

END

PROJECT PLANNING

kirloskar Oil Engines

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																

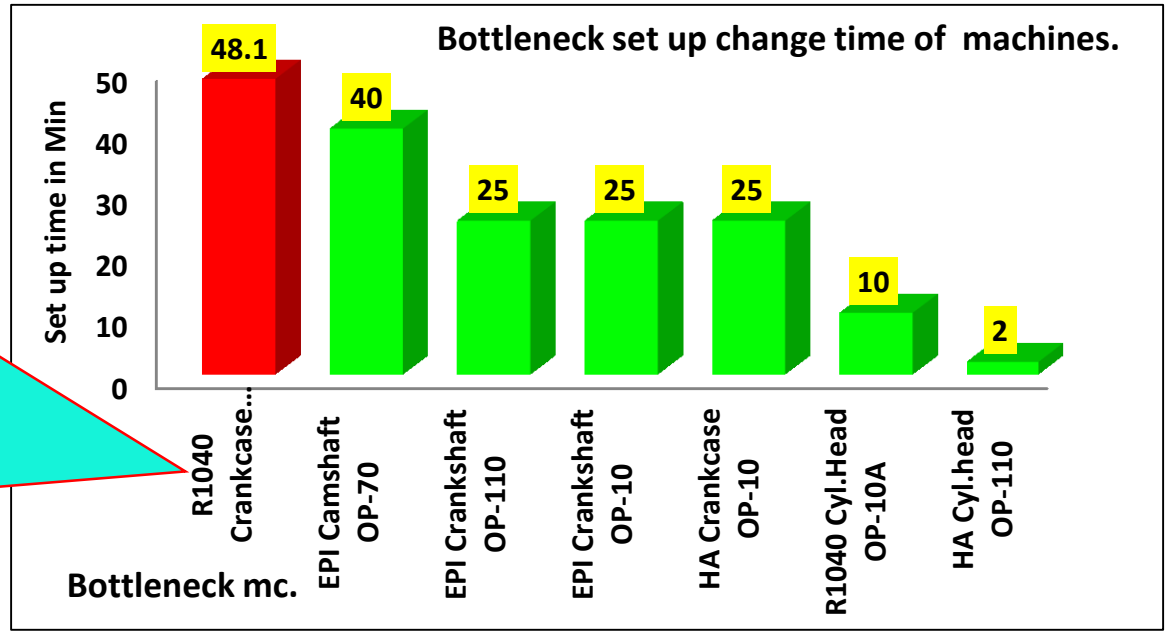
P D C A

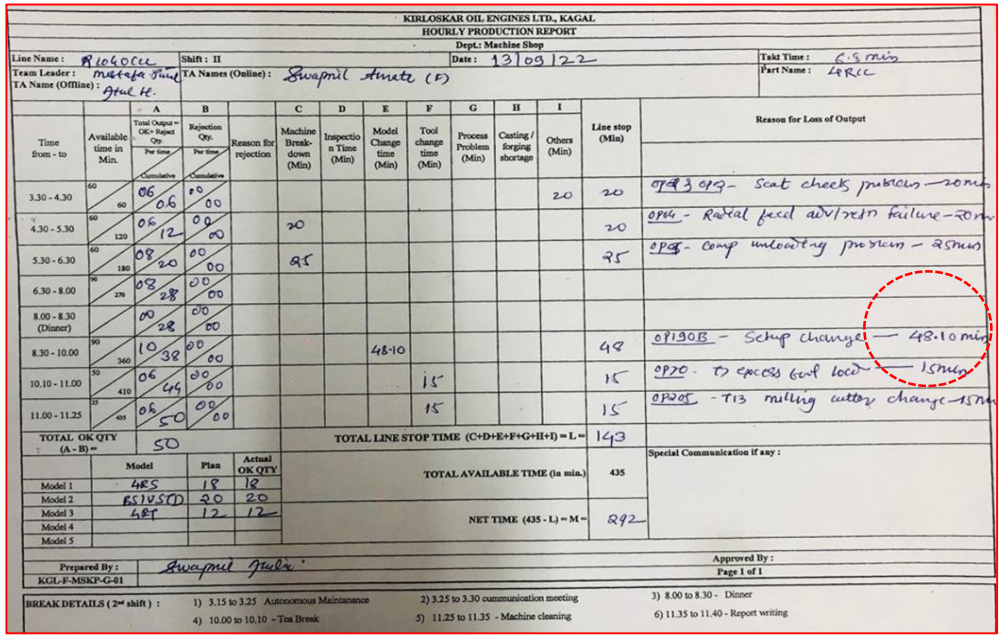
SELECTTION OF BOTTLENECK MACHINING LINE FOR SET UP CHANGE

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
Dept.: Machine Shop

Line Name : R1040CC | Shift : II | Date : 13/09/22 | Takt Time : 6.5 min
Team Leader : Mustafa Patel | TA Names (Online) : Swapnil Amate (F) | Part Name : 4R1CC
TA Name (Offline) : Atul H.

Time from - to	Available time in Min.	A Total Output = OK+ Rejected Qty. Per time	A Cumulative	B Rejection Qty. Per time	B Cumulative	Reason for rejection	C Machine Break-down (Min)	D Inspection Time (Min)	E Model Change time (Min)	F Tool change time (Min)	G Process Problem (Min)	H Casting / forging shortage	I Others (Min)	Line stop (Min)	Reason for Loss of Output
3.30 - 4.30	60 / 60	06	06	00	00								20	20	OP93 OP9 - Seat check problem - 20 min
4.30 - 5.30	60 / 120	06	12	00	00		20							20	OP96 - Radial feed adv/retn failure - 20 min
5.30 - 6.30	60 / 180	08	20	00	00		25							25	OP95 - Comp unloading problem - 25 min
6.30 - 8.00	90 / 270	08	28	00	00										
8.00 - 8.30 (Dinner)		00	28	00	00										
8.30 - 10.00	90 / 360	10	38	00	00				48.10					48	OP190B - Setup change — 48.10 min
10.10 - 11.00	50 / 410	06	44	00	00					15				15	OP20 - To access fuel lock — 15 min
11.00 - 11.25	25 / 435	06	50	00	00					15				15	OP20S - T13 milling cutter change 15 min
TOTAL OK QTY (A - B) =		50					TOTAL LINE STOP TIME (C+D+E+F+G+H+I) = L =							143	

	Model	Plan	Actual OK QTY
Model 1	485	18	18
Model 2	BS3 VST	20	20
Model 3	48T	12	12
Model 4			
Model 5			

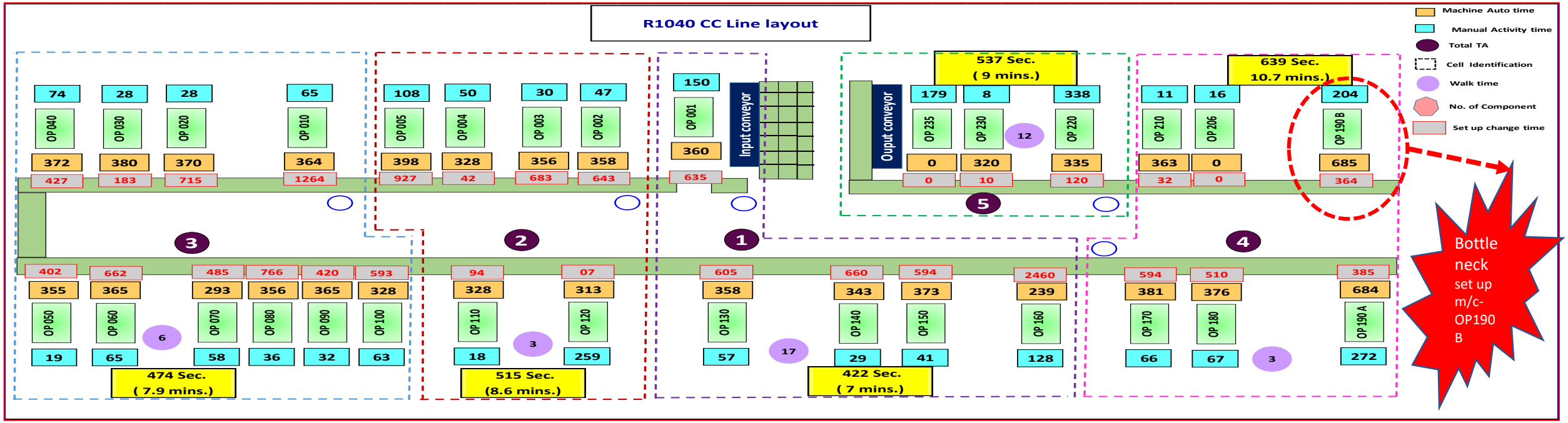
TOTAL AVAILABLE TIME (in min.) = 435
NET TIME (435 - L) = M = 292
Special Communication if any :

Prepared By : Swapnil Jadhav
Approved By :
KGL-F-MSKP-G-01 | Page 1 of 1

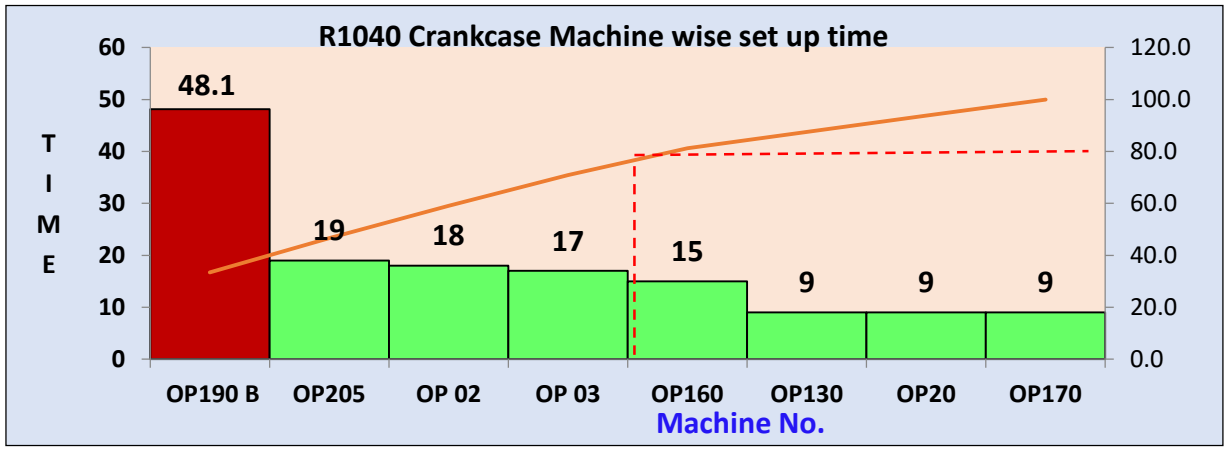
BREAK DETAILS (2nd shift) : 1) 3.15 to 3.25 Autonomous Maintanance | 2) 3.25 to 3.30 communication meeting | 3) 8.00 to 8.30 - Dinner | 4) 10.00 to 10.10 - Tea Break | 5) 11.25 to 11.35 - Machine cleaning | 6) 11.35 to 11.40 - Report writing

Prime Objective:- To reduce setup change time from **48.10 minutes** to **9 Minutes or less** (Single Digit) on **OP- 190 B M/C** (Top face finish milling ,finish & rough boring, rough and finish seat face) for Improving productivity

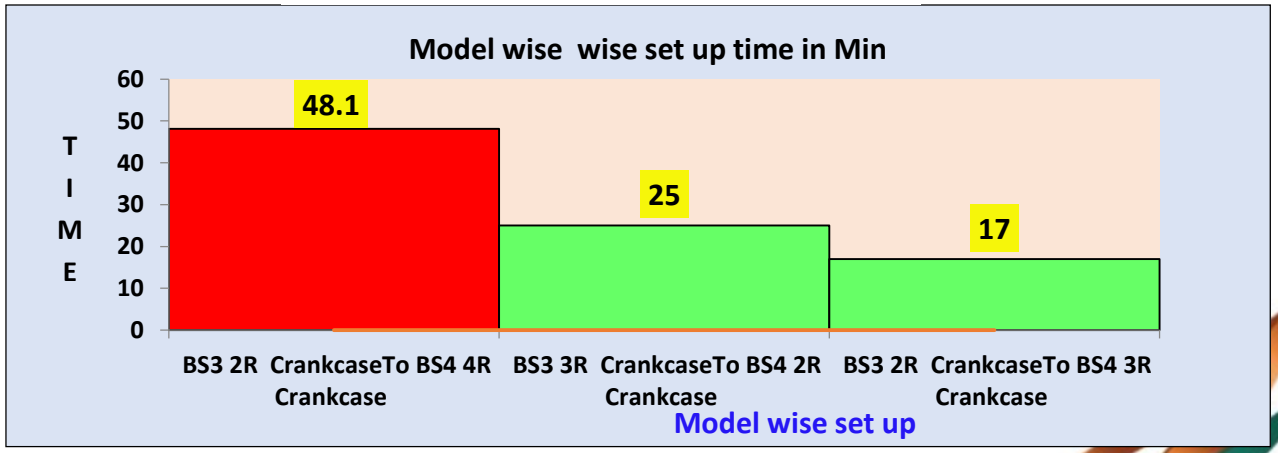
SELECT THE APPROPRIATE MODEL FOR SET UP CHANGE



Machine wise Set up Change time

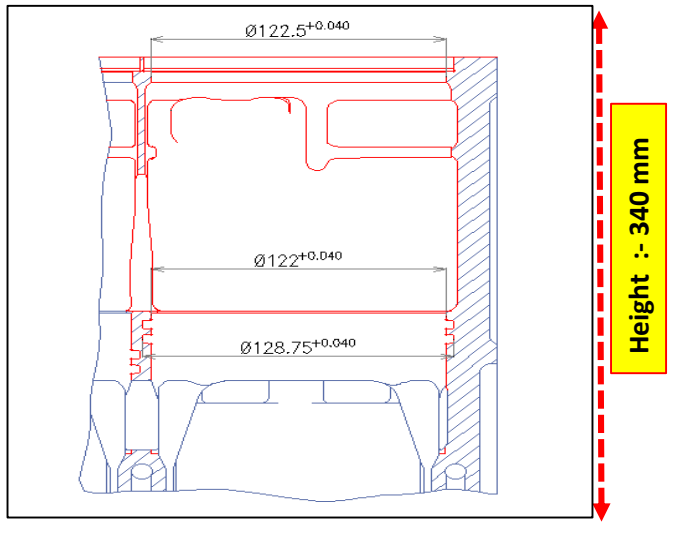


Model wise Set up Change time

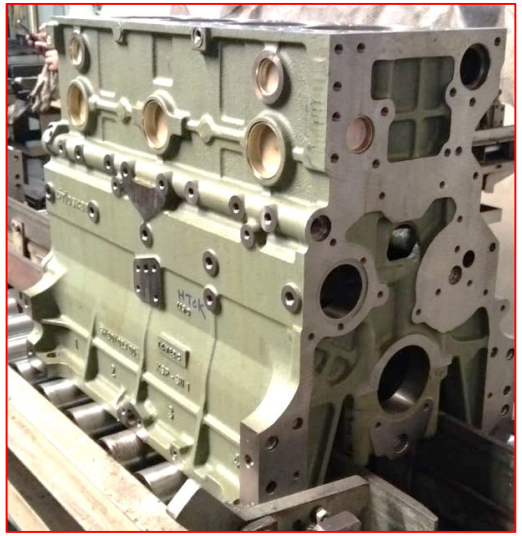


NEEDS FOR SET UP CHANGE

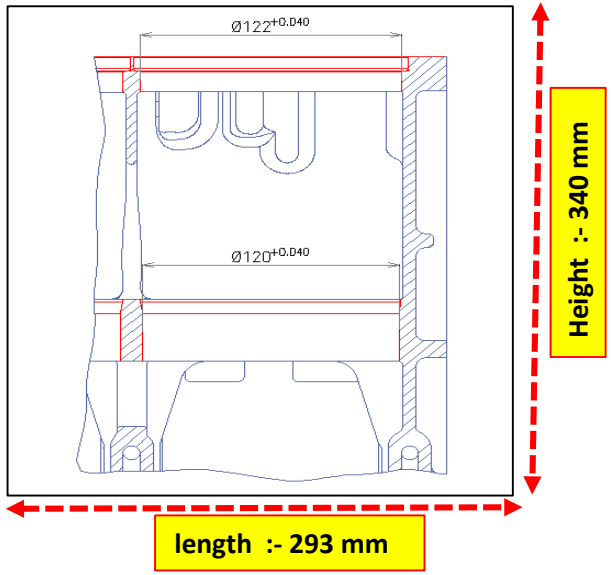
BS4 (4R) Cartridge change view



BS4-4R CRANKCASE

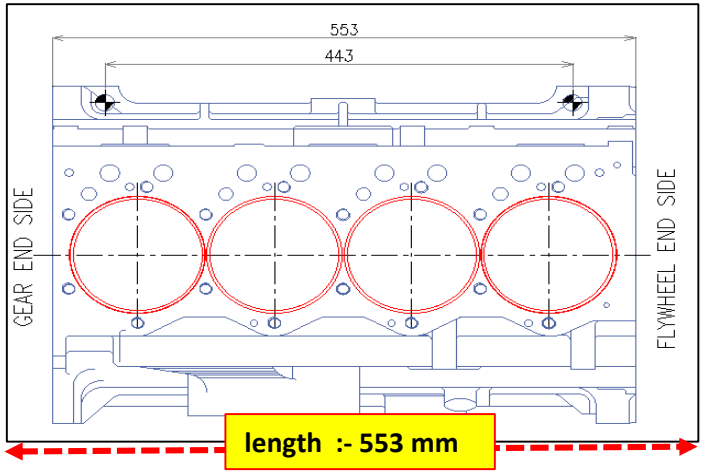


BS3 (2R) Cartridge change view

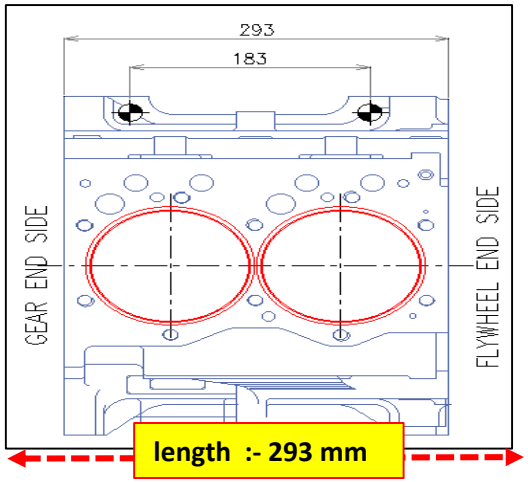


BS3-2R CRANKCASE

BS4 (4R) Fixture change view



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

kirloskar Oil Engines

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**

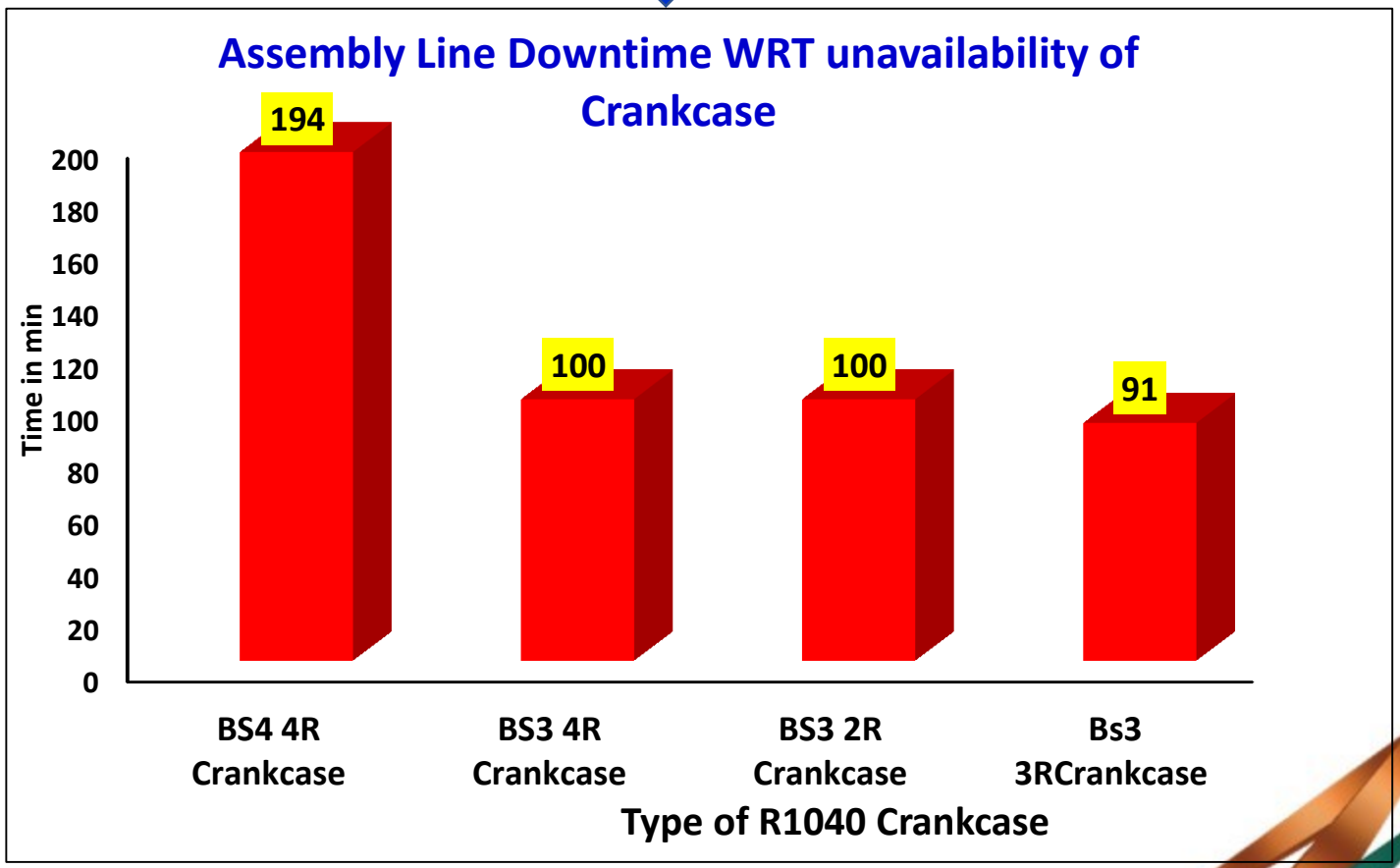
Monthly average production - 4100 / Month
Cycle Time - 6 Minutes

Average monthly Set up change down time – 48.5*10 times = 485 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

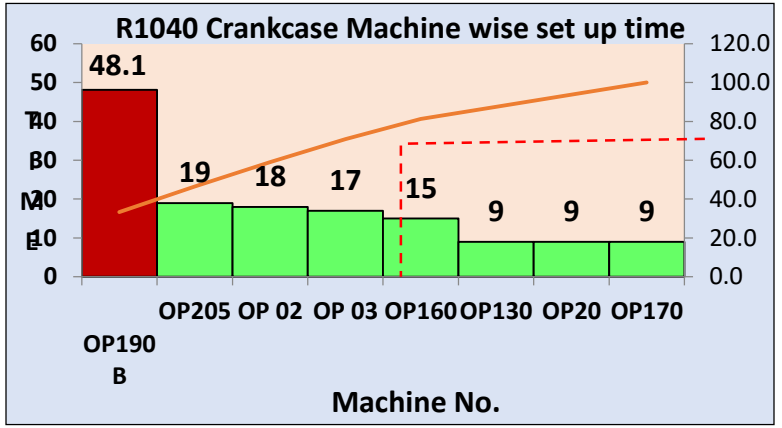


Analysis ,Observe & measure the current set up Cycles

- Training given to concern line Team members with CFT. (12 nos.)

- Video Shooting taken of Selected model

- Machine wise set up change time

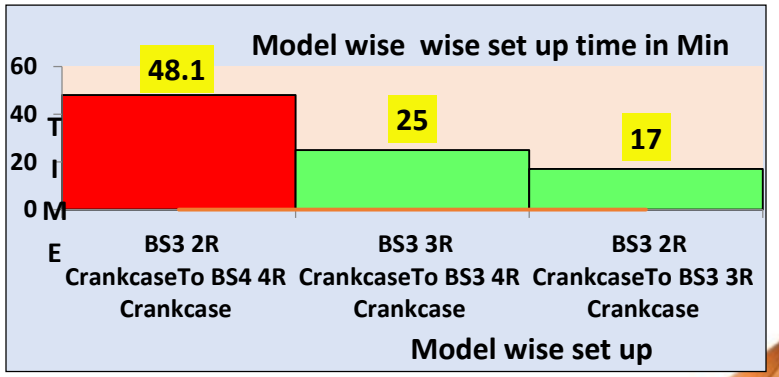


- With the help of CFT, Activities are listed down accordingly.

- Activity & Time of Each activity had recorded.

Process Study Sheet							
Line Name :- R1040 Crankcase					Responsibility :- Vilas Patil & Shailesh 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	

- Model wise set up time in time



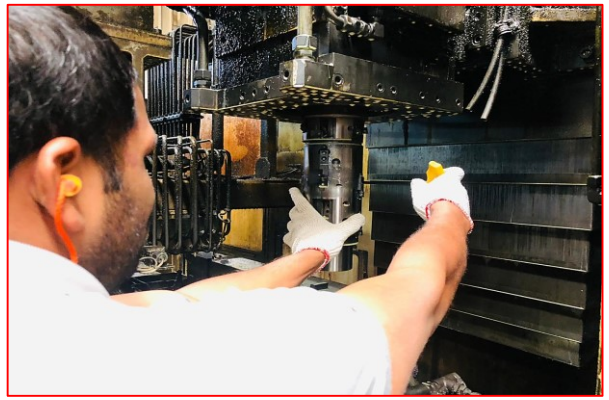
Analysis ,Observe & measure the current set up Cycles

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

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

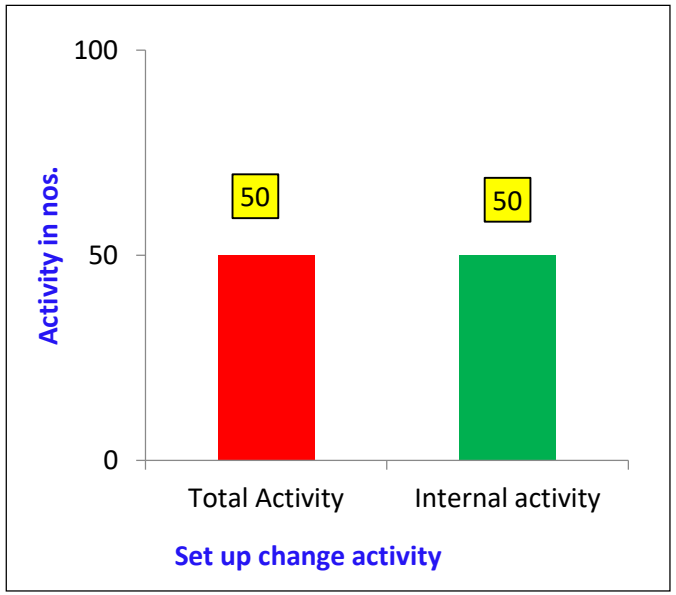
First piece inspection of BS4 component

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.

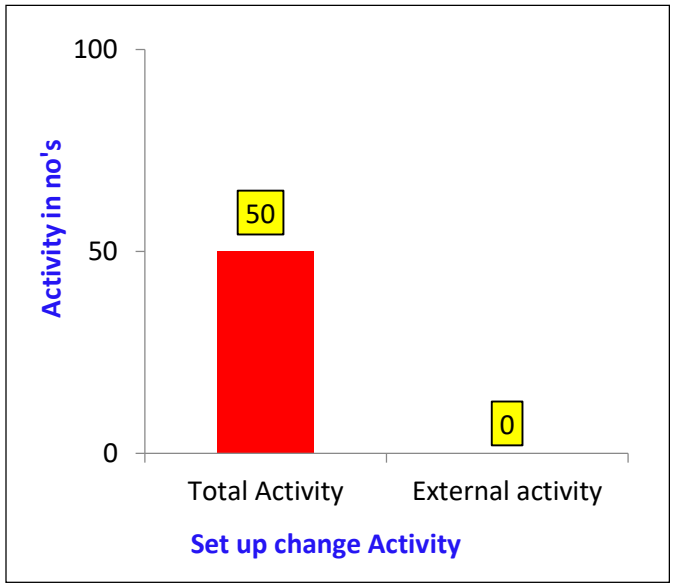
Internal Activities

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*

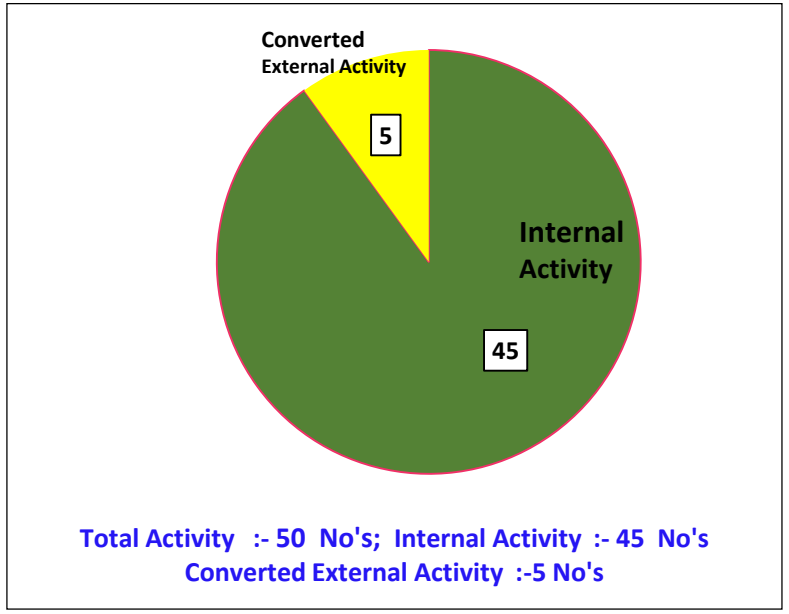


Process Study Sheet						
Line Name :- R1040 Crankcase				Responsibility :- Vilas Patil & Tupe Sir.		
Machine Name :- OP-190 B				Total Video Time:- 2.01 Min.		
Process Name :- Set up change of OP-190 B Machine.					Catagory	
Sr.No.	Main Set Up work Elements	Start	End	Total	Internal	External
1	Operator 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

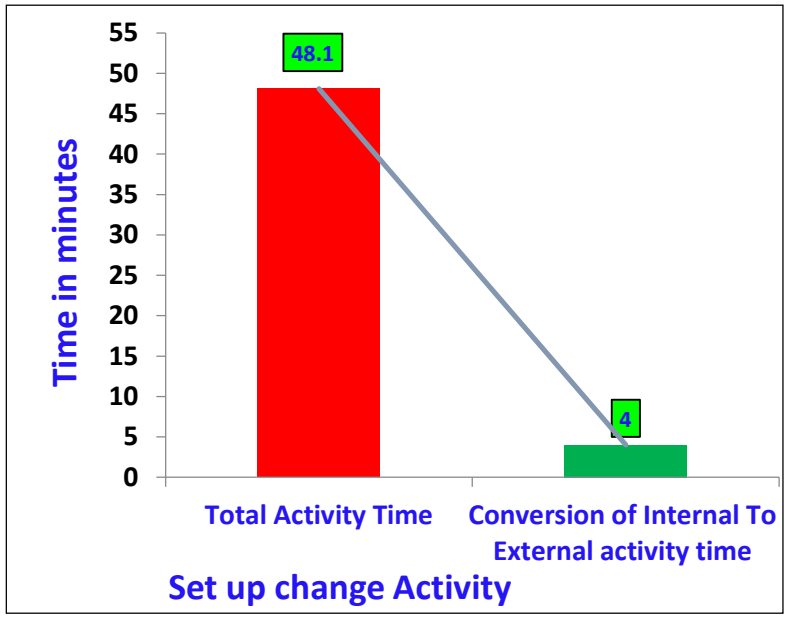
- Out of **50 activities** , **05 no's** of the activities are converted from Internal activities to External activities
- **Total Time saving** from Internal activities to external activity is **4 minutes/** set up change

Conversion of Internal/External activities



Total Activity :- 50 No's; Internal Activity :- 45 No's
Converted External Activity :-5 No's

Time saving due to Conversion of Internal/External activities



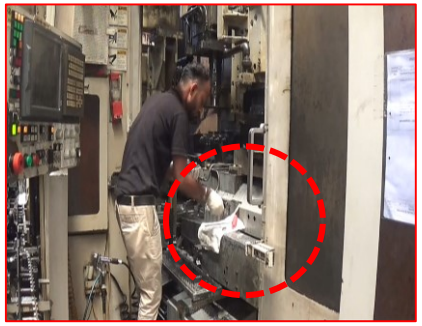
Activity conversion sheet

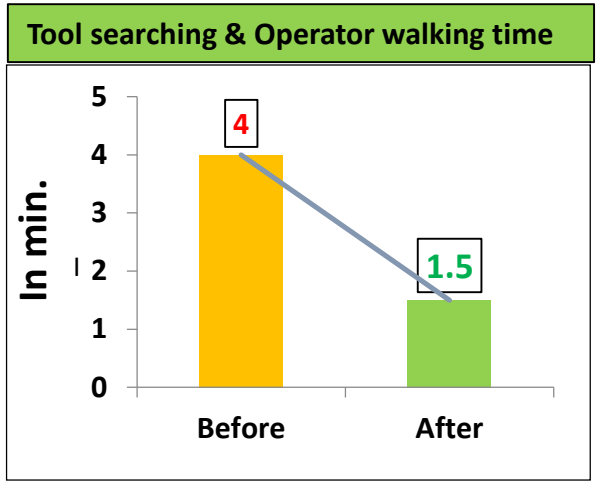
Internal Activity Converted into External Activity							
Line Name :- R1040 Crankcase						Responsibility :- Vilas Patil & Tupe Sir.	
Machine Name :- OP-190 B						Total Video Time:- 613 Sec.	
Process Name :- Set up change of OP-190 B Machine.						Catagory	
Sr.No.	Main Set Up work Elements	Start	End	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	Opertor 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

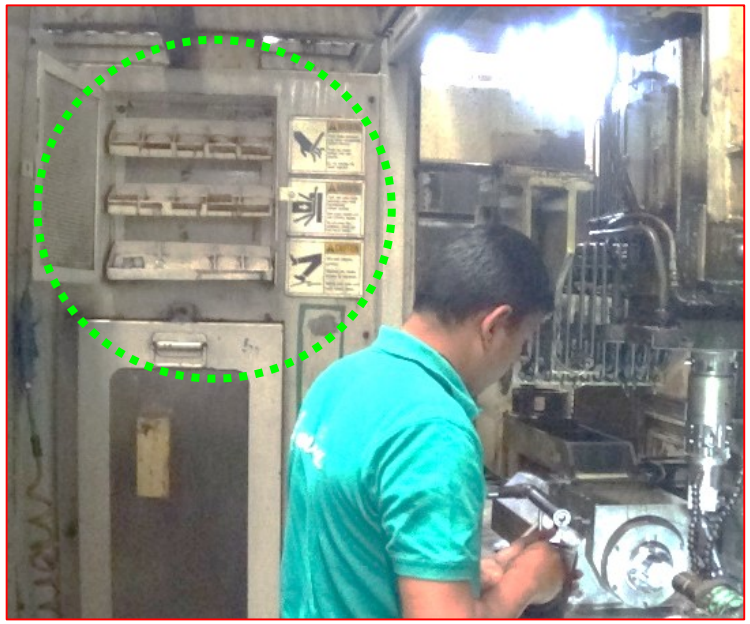
Shifting internal set up activities to External set up activities

BEFORE IMPROVEMENT





AFTER IMPROVEMENT



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

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).**

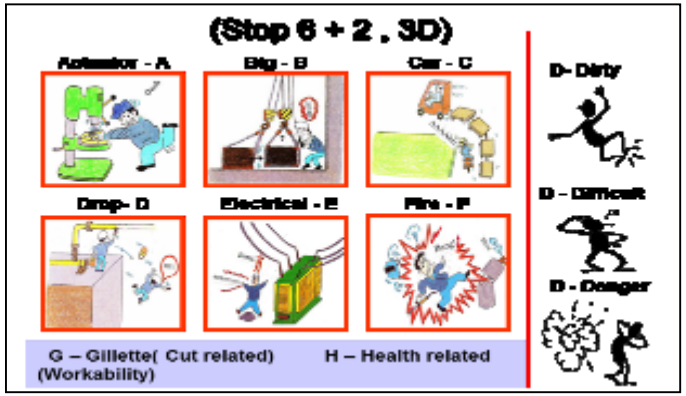
Categorization Of Wastes

Muda

Mura

Muri

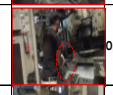
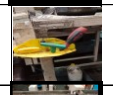
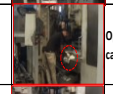
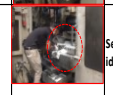
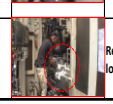
7 Types of Waste



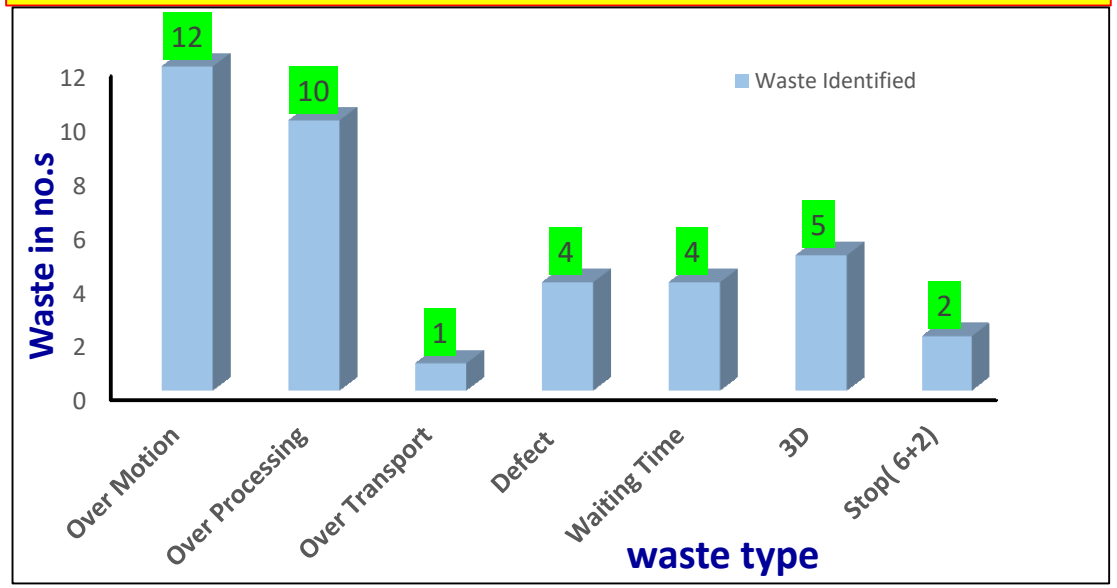
Unsafe Conditions

Waste Identification list

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		Cartiradge loosening sequence is not defined	Defect	Cartridge loosning sequence is defined for first semifinish, second time finish and last time groove operations.		ME	closed
	3		Operator has more time to remove the cartirage	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 cartirage	Over Processing	Cleaning sequence to be defined		Production	closed
	5		Semifinish,Finish and grooving cartirage 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 cartirage have not separate keeping location to near the machine	Over Motion	Two seprate boxes are kept for BS3 and BS4 cartridge.		Gurukul	closed

Categorization of internal step waste



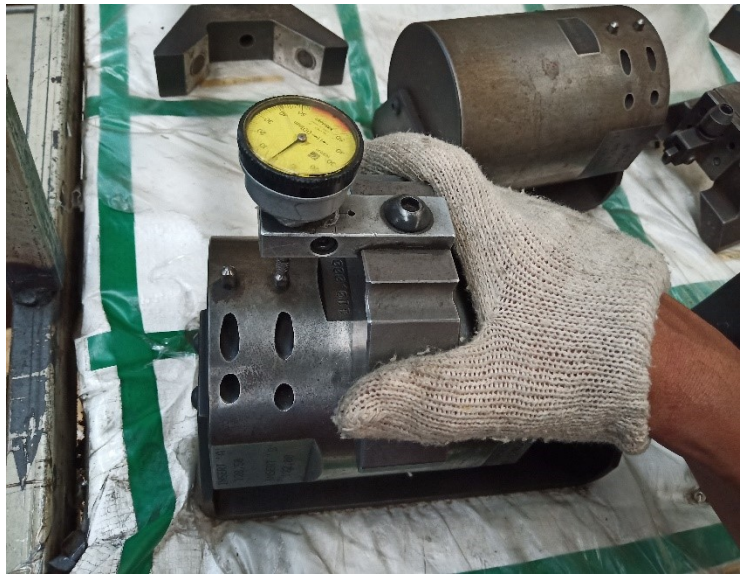
Total Internal step identified waste 38 no's

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

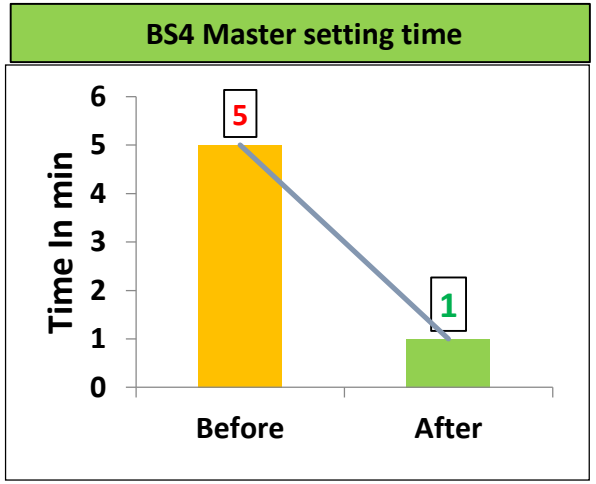
Why? Both BS3 & BS4 model dial gauge setting and adjusting on BS3 master for cartridge setting

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

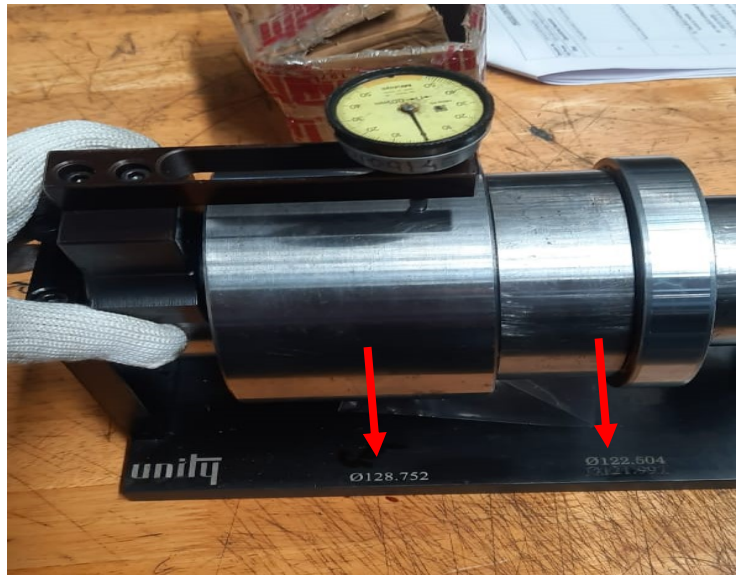
Root cause :- BS4 Model master not available for Cartridge setting

Eliminate waste from Internal steps
MUDA - OVER PROCESSING

BEFORE IMPROVEMENT



AFTER IMPROVEMENT



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

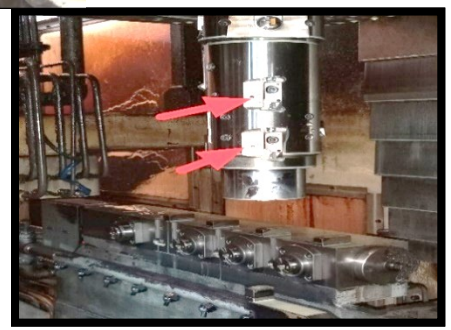
BS4 master provided with setting gauge for BS4 model cartridge setting

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

Eliminate Waste from Internal steps
MUDA - OVER PROCESSING

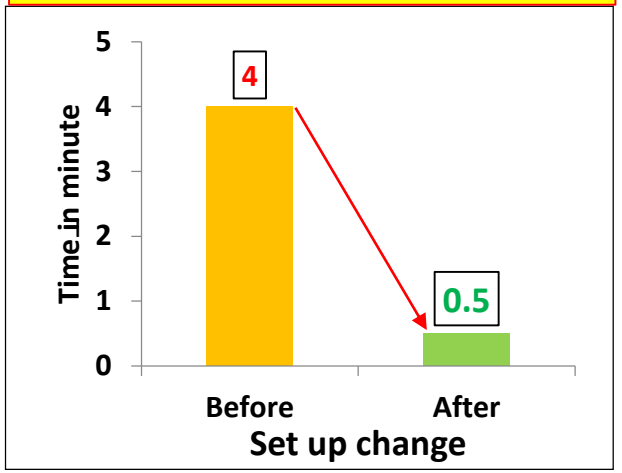
kirloskar Oil Engines

BEFORE IMPROVEMENT

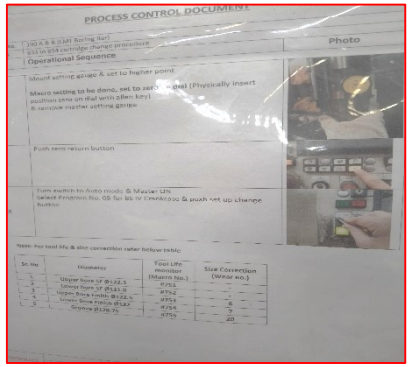


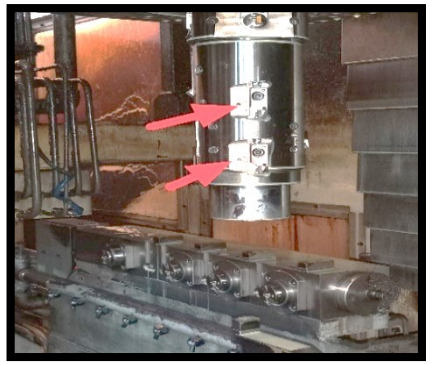
Operator required more time for fitment of cartridge because no sequence of cartridge fitment Cartridge fitment procedure not defined

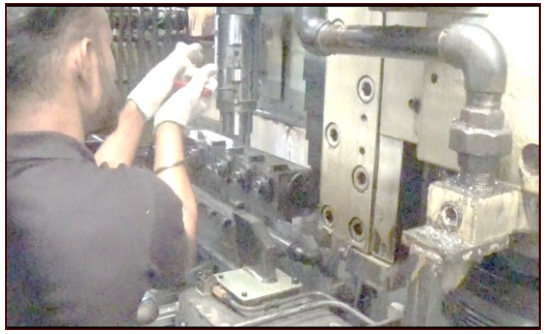
Loosening and tightening sequence defined.



AFTER IMPROVEMENT







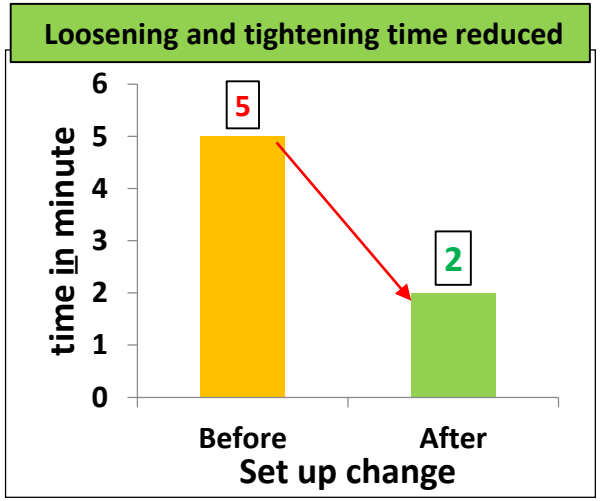
Cartridge fitment and loosening sequence defined and identification done procedure defined. Cartridge loosening sequence is defined for first semi finish, second time finish and last time groove operations.

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

Eliminate Waste from Internal steps
MUDA - OVER PROCESSING

kirloskar Oil Engines

BEFORE IMPROVEMENT



AFTER IMPROVEMENT

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

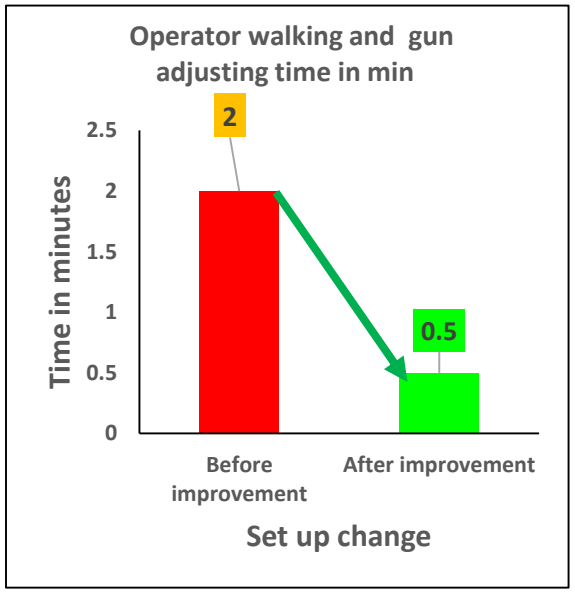
Special Thorx key with Torque provided for insert clamping

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

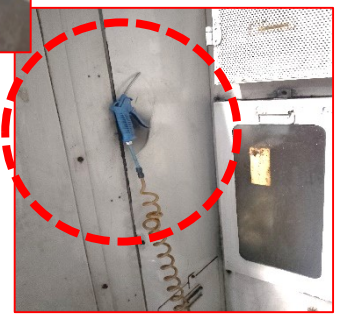
Eliminate Waste from Internal steps
MUDA – Over Motion

kirloskar Oil Engines

BEFORE IMPROVEMENT



AFTER 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

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

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

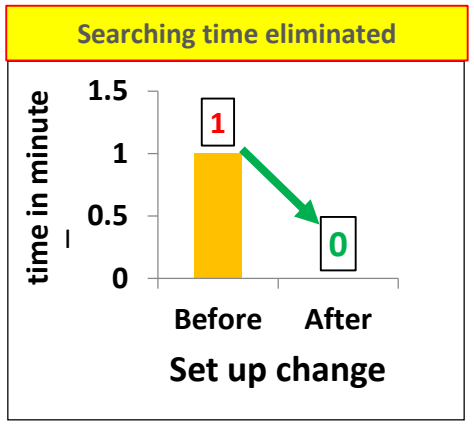
Eliminate Waste from Internal steps

MUDA - OVER PROCESSING

kirloskar Oil Engines

BEFORE IMPROVEMENT

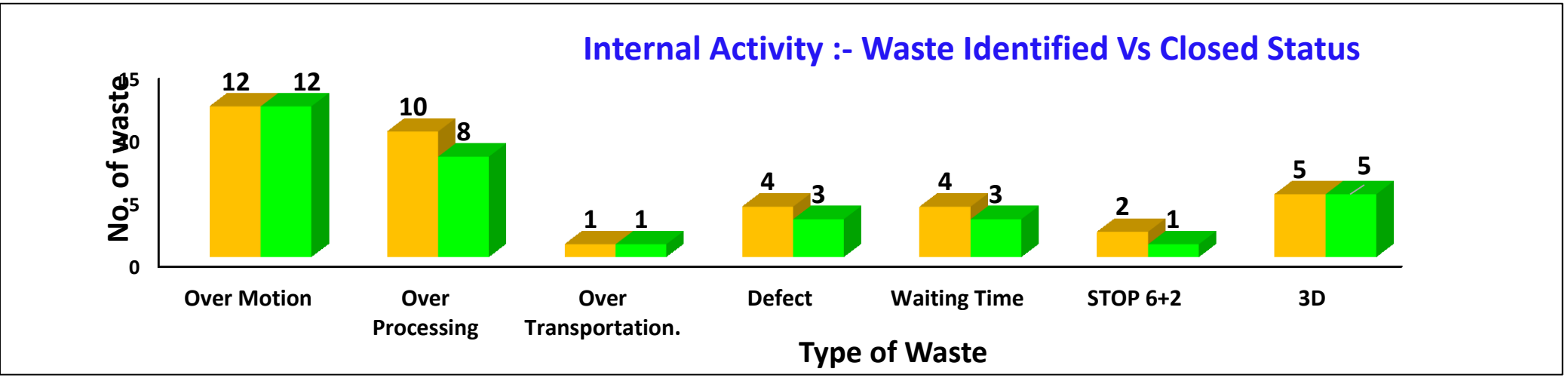
Operator has more time required for searching the cartridge of BS4 and BS3 model.



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

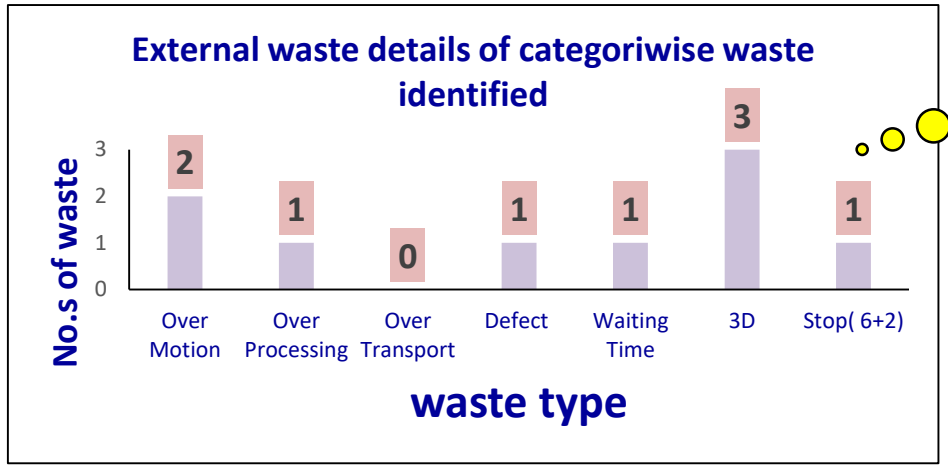


Internal Waste Identified 38 No's

Waste closed 34 No's

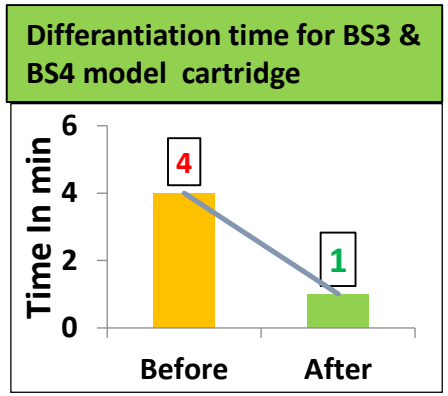
Eliminate Waste from External steps

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 component 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

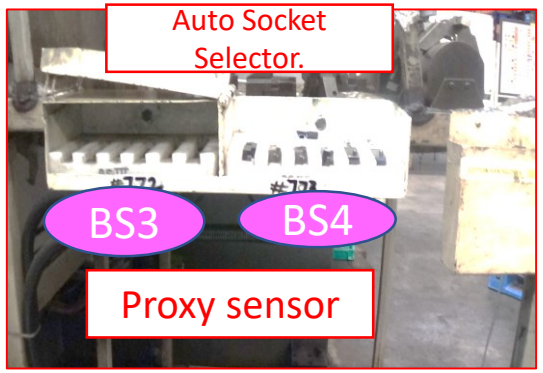


BEFORE IMPROVEMENT

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

kirloskar Oil Engines

BEFORE IMPROVEMENT

Set up change

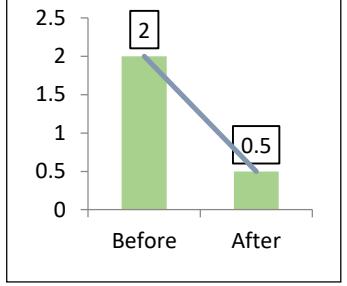
Procedure

sheet

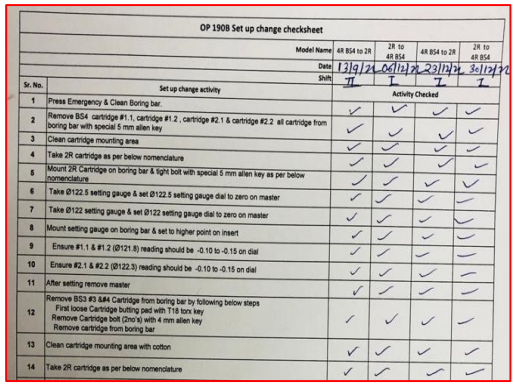
not

defined

Sequential Process time

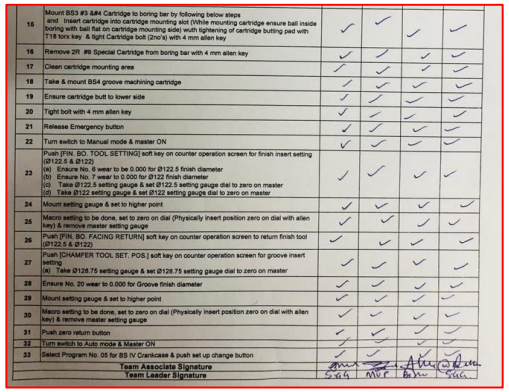


AFTER IMPROVEMENT



OP 1908 Set up change checksheet

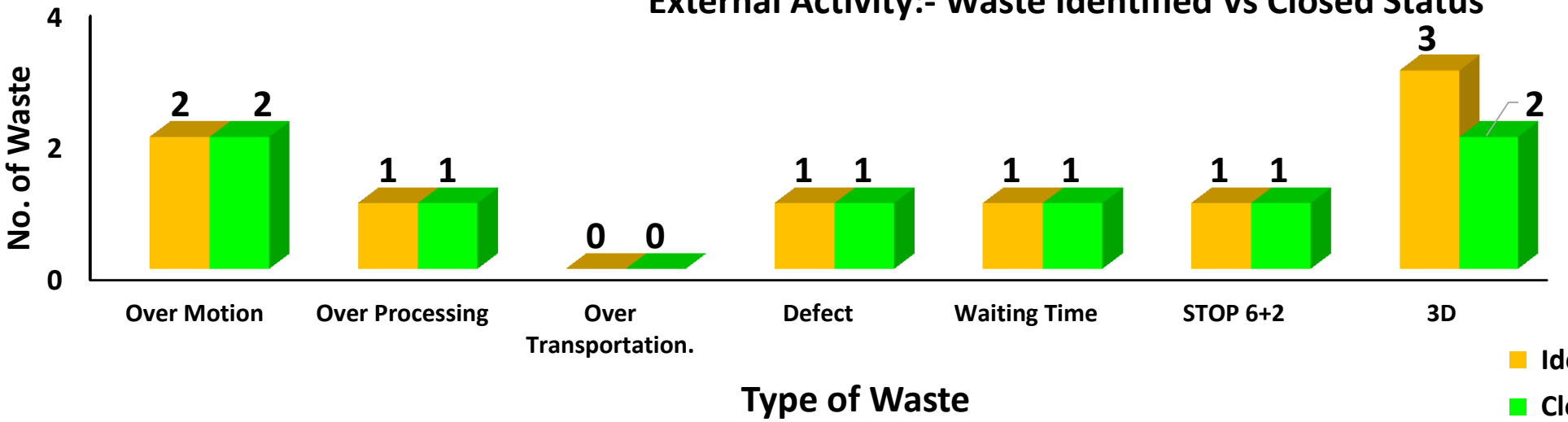
Sr. No.	Set up change activity	Activity Checked			
1	Press Emergency & Clean Boring bar.	✓	✓	✓	✓
2	Remove BS4 cartridge #1.1, cartridge #1.2 , cartridge #2.1 & cartridge #2.2 all cartridge from boring bar with special 5 mm allen key	✓	✓	✓	✓
3	Clean cartridge mounting area	✓	✓	✓	✓
4	Take 2R cartridge 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) wuth 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				

New set up change sheet prepared and defined

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

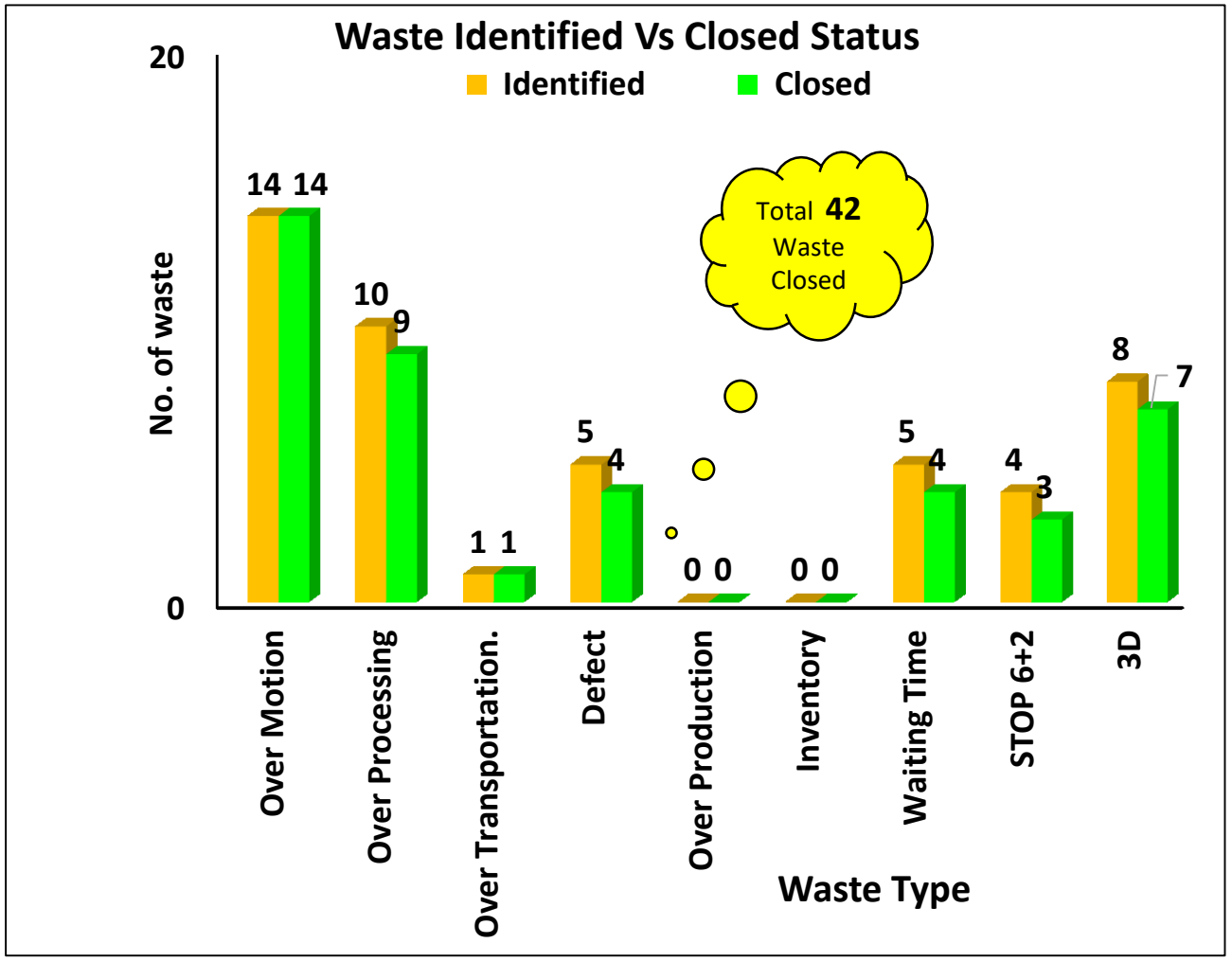


External Waste Identified 9 No's

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



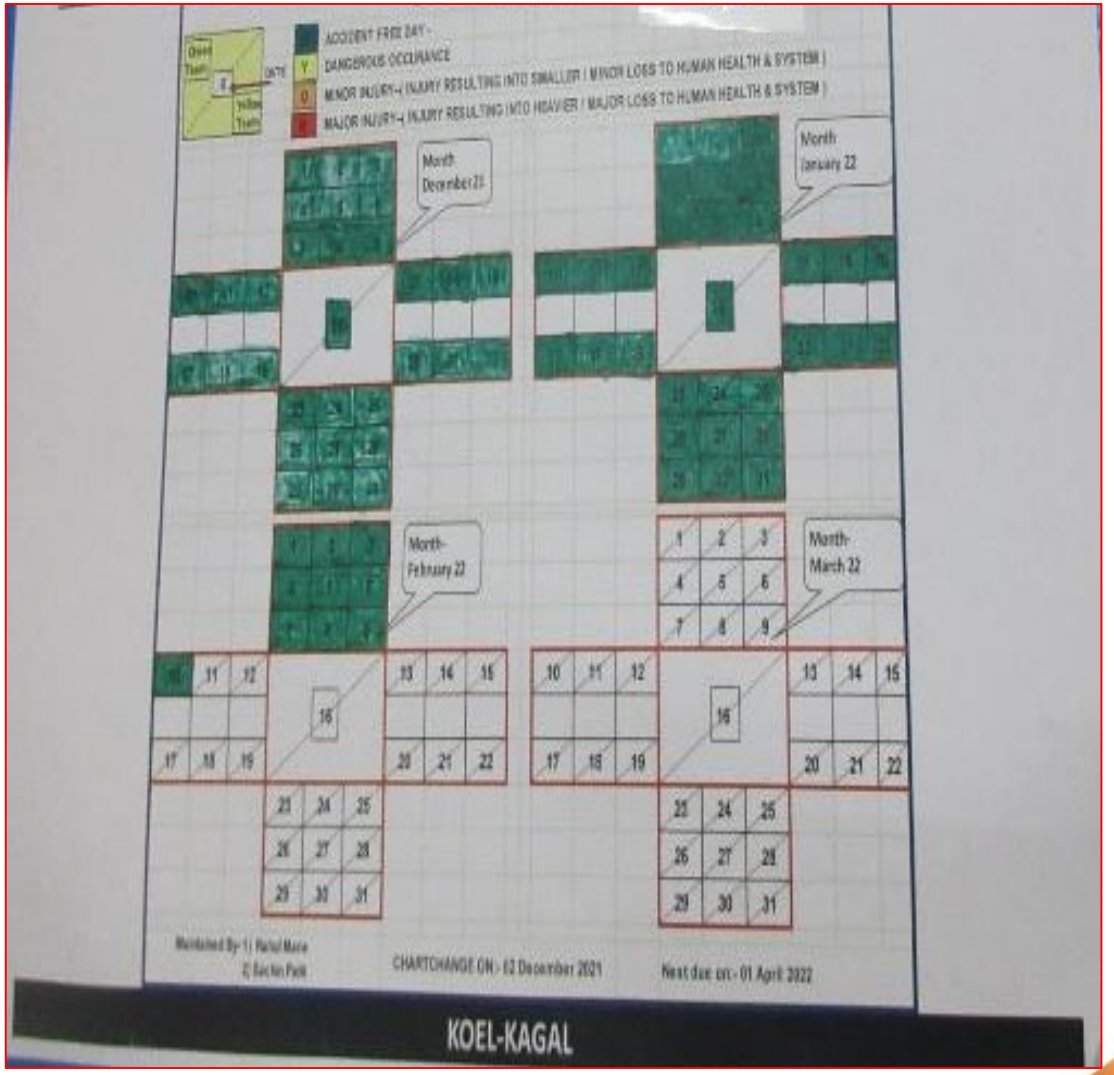
- **Total Waste (Internal & external) Identified :– 47 nos.**
- **Total Waste (Internal & external) Closed :– 42 nos.**
- **In process Waste -Management related waste :- 5 nos.**

Standardization -Set Up Change Check Sheet & Safety Calendar

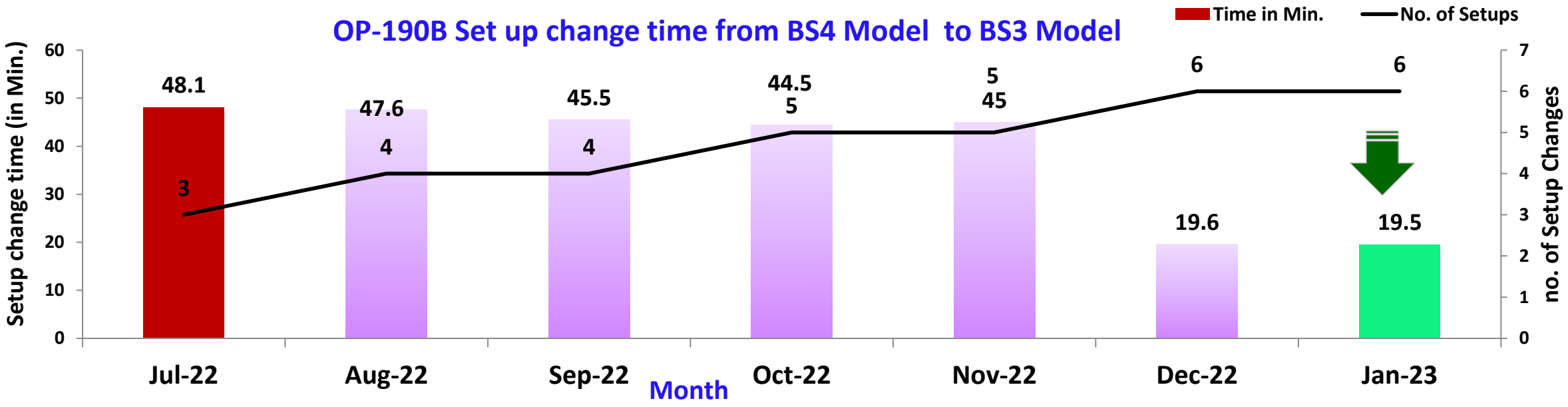
kirloskar Oil Engines

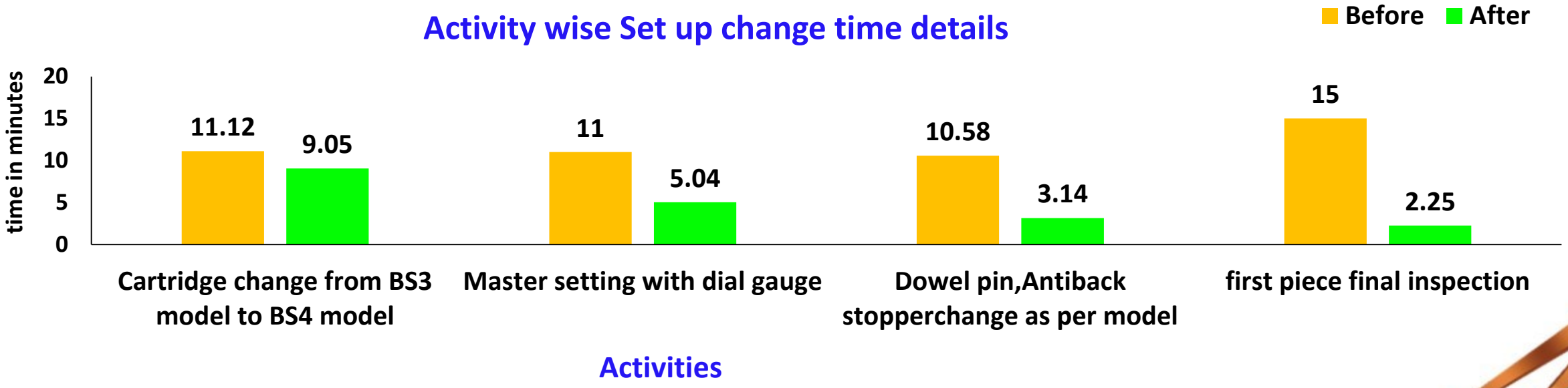
OP 190B Set up change checksheet

Sr. No.	Set up change activity	Model Name	4R BS4 to 2R	2R to 4R BS4	4R BS4 to 2R	2R to 4R BS4
		Date	13/9/22	06/12/22	23/12/22	30/12/22
		Shift	II	I	I	I
			Activity Checked			
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) wuth 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		Suraj	MVP	Akash	Suraj
	Team Leader Signature					



Results

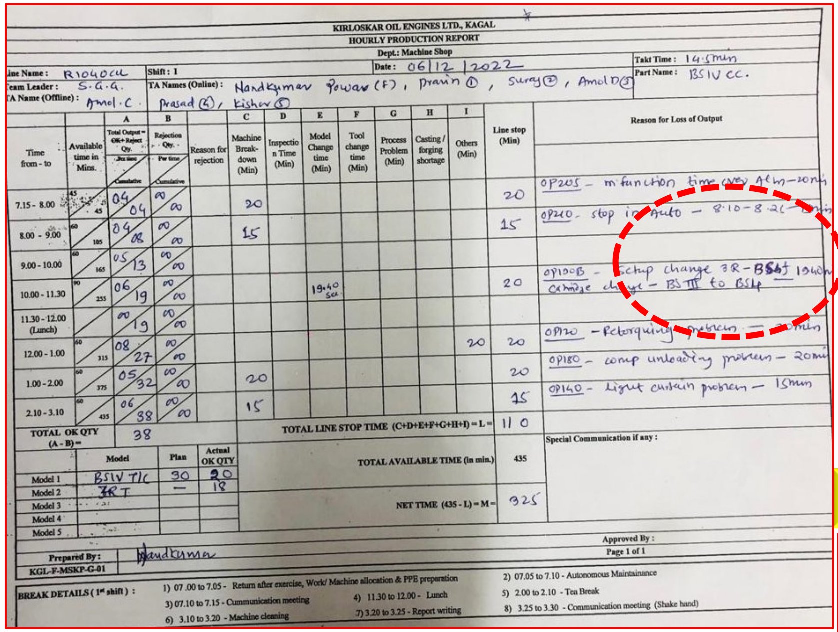

OP-190B Set up change time from BS4 Model to BS3 Model
Time in Min.
No. of Setups
Setup change time (in Min.)
no. of Setup Changes
48.1
47.6
45.5
44.5
5
45
6
6
3
4
4
5
19.6
19.5
Jul-22
Aug-22
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Month


Activity wise Set up change time details
Before
After
time in minutes
11.12
9.05
11
5.04
10.58
3.14
15
2.25
Cartridge change from BS3 model to BS4 model
Master setting with dial gauge
Dowel pin,Antiback stopperchange as per model
first piece final inspection
Activities

Daily Production Report

Kirloskar Oil Engines

06 December 22


KIRLOSKAR OIL ENGINES LTD., KAGAL
HOURLY PRODUCTION REPORT
Dept.: Machine Shop

Line Name: R1040CC | Shift: 1 | Date: 06/12/2022 | Takt Time: 14.5 min | Part Name: BSIV CC

Time from - to	Total OK Qty (cumulative)	Line stop (Min)	Reason for Loss of Output
7.15 - 8.00	04	20	OP205 – malfunction time
8.00 - 9.00	08	15	OP210 – stop in Auto – 8.10-8.25
9.00 - 10.00	13		
10.00 - 11.30	19	20	OP100B – setup change 3R-BS4 19.40 min, change over – BSIII to BS4
11.30 - 12.00 (Lunch)	19		
12.00 - 1.00	27	20	OP120 – Retorquing problem – 20 min
1.00 - 2.00	32	20	OP180 – comp unloading problem – 20 min
2.10 - 3.10	38	15	OP140 – Light curtain problem – 15 min

TOTAL OK QTY (A - B) = 38
TOTAL LINE STOP TIME (C+D+E+F+G+H+I) = L = 110
TOTAL AVAILABLE TIME (in min.) 435
NET TIME (435 - L) = M = 325

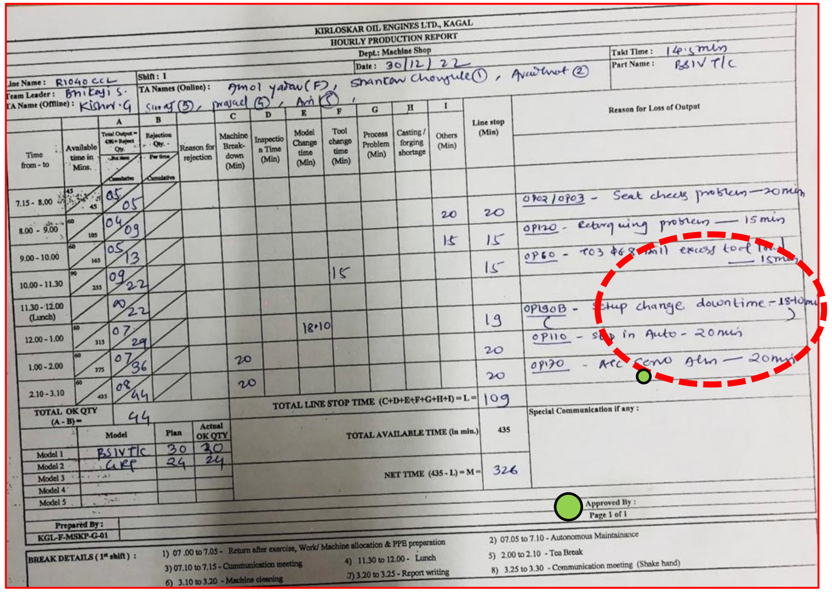
Model	Plan	Actual OK QTY
Model 1 BSIV T/C	30	20
Model 2 3R T	–	18

Prepared By: Nandkumar
KGL-F-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 Maintainance 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

Line Name: R1040CC | Shift: 1 | Date: 30/12/22 | Takt Time: 14.5 min | Part Name: BSIV T/C

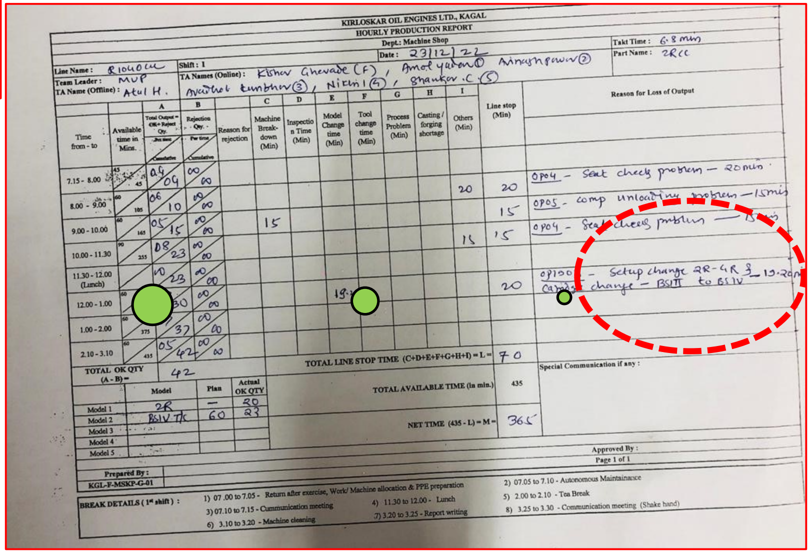
Time from - to	Total OK Qty (cumulative)	Line stop (Min)	Reason for Loss of Output
7.15 - 8.00	05	20	OP102/OP103 – Seat check problem – 20 min
8.00 - 9.00	09	15	OP120 – Retorquing problem – 15 min
9.00 - 10.00	13	15	OP60 – T03 excess tool – 15 min
10.00 - 11.30	22		
11.30 - 12.00 (Lunch)	22	19	OP190B – Setup change downtime – 18.10 min
12.00 - 1.00	29	20	OP110 – Stop in Auto – 20 min
1.00 - 2.00	36	20	OP170 – ATC servo alarm – 20 min
2.10 - 3.10	44		

TOTAL OK QTY (A - B) = 44
TOTAL LINE STOP TIME (C+D+E+F+G+H+I) = L = 109
TOTAL AVAILABLE TIME (in min.) 435
NET TIME (435 - L) = M = 326

Model	Plan	Actual OK QTY
Model 1 BSIV T/C	30	30
Model 2 GRP	24	24

KGL-F-MSKP-G-01

23 December 2021


KIRLOSKAR OIL ENGINES LTD., KAGAL
HOURLY PRODUCTION REPORT
Dept.: Machine Shop

Line Name: R1040CC | Shift: 1 | Date: 23/12/22 | Takt Time: 6.8 min | Part Name: 2RCC

Time from - to	Total OK Qty (cumulative)	Line stop (Min)	Reason for Loss of Output
7.15 - 8.00	04	20	OP04 – Seat check problem – 20 min
8.00 - 9.00	10	15	OP05 – comp unloading problem – 15 min
9.00 - 10.00	15	15	OP04 – Seat check problem – 15 min
10.00 - 11.30	23		
11.30 - 12.00 (Lunch)	23	20	OP150 – Setup change 2R-4R 19.20 min, change – BSIII to BSIV
12.00 - 1.00	30		
1.00 - 2.00	37		
2.10 - 3.10	42		

TOTAL OK QTY (A - B) = 42
TOTAL LINE STOP TIME (C+D+E+F+G+H+I) = L = 70
TOTAL AVAILABLE TIME (in min.) 435
NET TIME (435 - L) = M = 365

Model	Plan	Actual OK QTY
Model 1 2R		20
Model 2 BSIV T/C	60	23

KGL-F-MSKP-G-01

Set up change 19.20 sec

Set up change time 19 min 16 sec

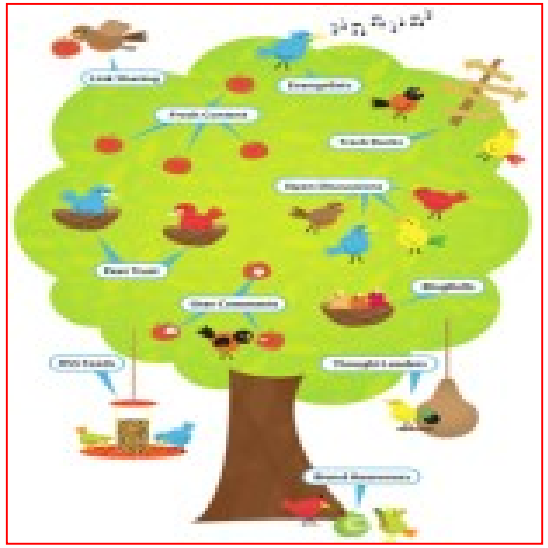
Benefits

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

One Time Investment : Rs. 14,000/-

Intangible Benefits:



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

Future Focus

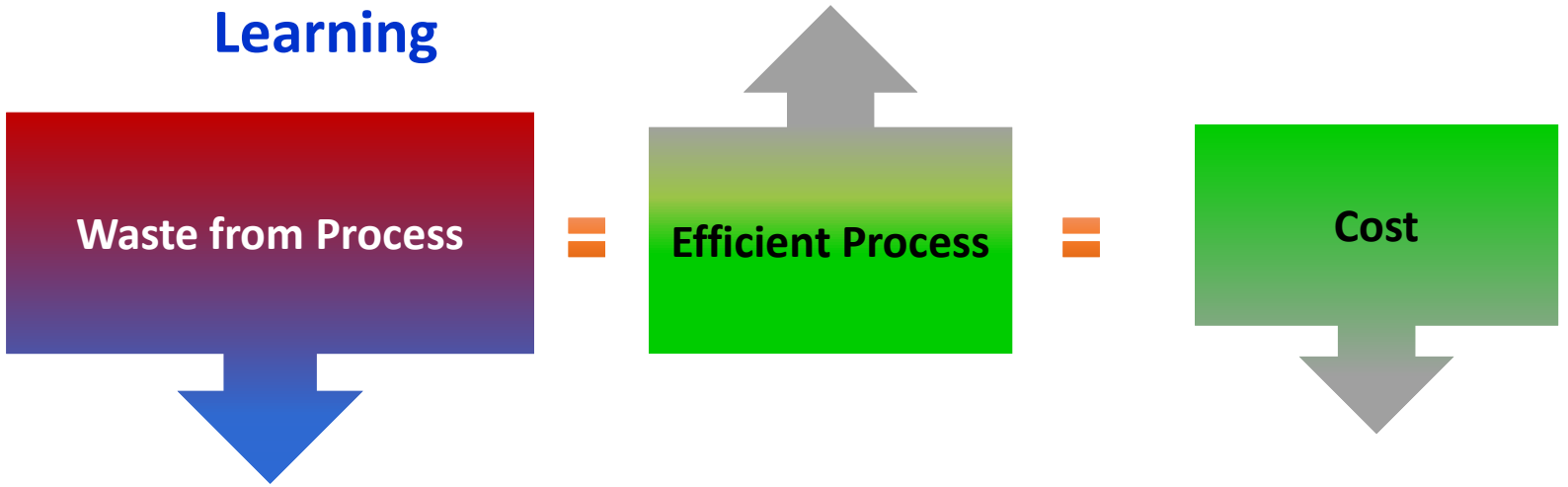
Horizontal Deployment

- 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

Learning



Thank You

Presented by : Kirloskar Oil Engines, Kagal Plant

https://koel.kirloskar.com