PROJECT REPORT

(Project Semester January-May 2018)

Establishing Work Productivity Standards In Indirect Areas

Submitted by

Upesh Nepal

Student ID: 15107008

Under the Guidance of

Dr Sushant Samir	Mr Jyoti Prakash Das
Associate Professor	Deputy General Manager
Mechanical Engineering	Productivity Service Department
Faculty coordinator	**Industry coordinator**

Department of Mechanical Engineering

PUNJAB ENGINEERING COLLEGE (DEEMED TO BE UNIVERSITY), Chandigarh

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DECLARATION

I hereby declare that the project work entitled "**Establishing Work Productivity Standards in Indirect Areas**" is an authentic record of my own work carried out at **TATA Motors Ltd Sanand** as requirements of six months project semester for the award of degree of B.E. **Mechanical Engineering**, PEC University of Technology, Chandigarh, under the guidance of Mr **Jyoti Prakash Das, Mr Jay modi** and **Mr Sushant Sameer**, during **January to May, 2018.**

(Signature of student)
Name of Student: Upesh Nepal
Student I D : 15107008

Date: _____

Certified that the above statement made by the student is correct to the best of our knowledge and belief.

Dr Sushant Samir	Mr Jyoti Prakash Das
Associate Professor	Deputy General Manager
Mechanical Engineering	Productivity Service Department
Faculty coordinator	**Industry coordinator**

ACKNOWLEDGEMENT

"It is not possible to do a project without the assistance & encouragement of other people. This one is undoubtedly no exception."

It has been a great opportunity to undertake training at TATA Motors Limited, Sanand and the experience of working here has been extremely enriching. My interaction with the company personnel of varied designations and functions has provided me with valuable insight into the operations of the company. I am extremely grateful to "TATA Motors Limited Sanand Plant, Gujarat" for the confidence bestowed in me and entrusting my project.

It also gives me immense pleasure to express my regards and profound gratitude to my project guide and mentor Mr. Jyoti Prakash Das (Head & Deputy General Manager, PSD) for his expert guidance during the course of my training. I am greatly indebted for his consideration and his valuable time towards my projects and suggestions that helped me to shape my project to excellence.

The acknowledgement shall not be complete without a vote of thanks to Mr. Jay Modi (Senior Manager, PSD) for his continuous guidance, encouragement and contributions not only towards my project, but also towards my professional growth as well. His way of working was a constant motivation and exposure to all aspects of the organization. He has provided me with invaluable support and has been a resource of technical knowledge all the way through my journey at TATA Motors Sanand.

I also would also like to take this opportunity to express my sincere gratitude to my faculty co - coordinator, Dr. Sushant Sameer, for his constant guidance, valuable suggestions, and moral support.

I gratefully acknowledge the help and suggestion of the other members of my PSD team (Vineet Tandon,Devesh Kulkarni,Aritra Biswas, and Manoj) who were always eager to help me with their warm attitude and technical knowledge, in spite of their busy schedule and a huge workload.

ABSTRACT

Indirect areas refer to the activities which are not directly linked to production. These mainly include inspection and maintenance activities.

Some of the indirect areas in Sanand plant are CQ (Customer Quality), CMM lab, CPA, CQ (central quality), Maintenance, CMS, Logistics, Metrology Lab, Tool Engineering, Metallurgy Lab.

Work Productivity measurement cannot be done in most of the indirect by using most technique because in indirect there is no repetitive work and defined work which is found in production line so we have used both time measurement and Most study in establishing the work content.

My Project deals with estimating manpower for these activities and establishing standards to improve the productivity. As we all know there is no point in doing business if there is no profit or less profit so my project also deals with Cost reduction by decreasing the excess manpower and finally increasing the profit of the company.

CONTENTS

Introduction

A. Company Overview

Tata Motors Group, a USD 42 billion organisation, is a leading automobile manufacturer with a portfolio that includes a wide range of cars, sports vehicles, trucks, buses and defence vehicles. Part of the USD100 billion Tata group founded by Jamsetji Tata in 1868, Tata Motors is among the world's leading manufacturers of automobiles.

Founded- 1945; 73 years ago **Founder-** J.R.D Tata
CEO & M.D. - Geunter Butscheck **Headquarter**- Mumbai
Industry- Automotive **Parent**-TATA group

B. TATA motors Sanand Plant Overview

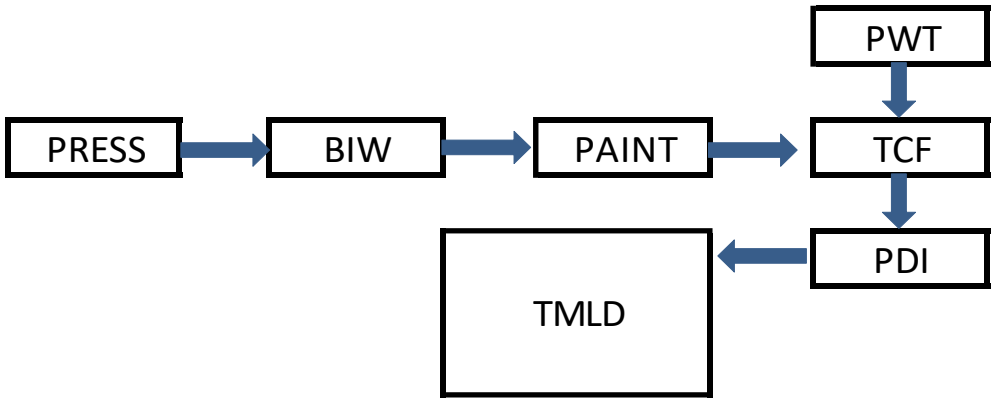
Tata Motors Sanand Plant is a PVBU unit of Tata motors which is a passenger vehicles manufacturing facility located in Sanand, Gujarat, India, and is famously known for manufacturing of the world's cheapest car, the Nano.

Plant Head: Mr. Neeraj Agrawal.

Products: Nano, Tiago (hatchback), Tigor (Compact Sedan), Nexon (SUV) petrol engines. The Sanand plant has recently started manufacturing electric version of the sedan Tigor after winning the contract floated by EESL for electric vehicles which was the world's largest single electric vehicle procurement initiative.

Salient features: Equipped with state-of-the-art equipment and follows world class manufacturing practices. An eco-friendly plant which has energy efficient motors consuming less electricity and systems to measure and monitor carbon levels to keep pollution in check.

C. Plant Flow Process



- The production starts in the press shop where various parts of the chassis are drawn using dies. Various dies are used for this operation where load varies from 1000T- 2000T. It is a fully automated process with very less human interference.
- The body then moves on to the weld shop (BIW shop), where various parts of the chassis are welded together. The whole shop employs a total of 136 robots for this purpose. Only spot welding is used for this purpose. For some regions, to fill up the holes, MIG welding is done. Also sealer is applied to ensure greater strength and high resistance to loading due to its adhesive nature. It also restricts the water flow inside the body during rainy seasons, etc.
- The car then moves on to the paint shop where the car is painted, and made resistant to corrosion, etc.
- Meanwhile, in a different shop called the power train shop, engine and the other components are assembled together. This includes assembly of engine, catalytic convertor, sensors, valve setup, etc.

- Now the painted body from the paint shop and the engine assembly from power train shop is sent to the TCF (Trim chassis and fitment) shop where they are brought together to make a car.
- The car is then sent for PDI (Pre deliver inspection) before dispatching it to the distributors.

D. Brief Overview of Shops:

Press Shop:

- Storage of plain sheet panels.
- Pressing of sheet metal panel according to plan in the KOMATSU Presses.
- Quality inspection of every panel by trained operators.
- Storage of pressed panels.

BIW (Body in White) shop:

- Quality Inspection of incoming parts by trained operators.
- Assembling the panels by spot welding & MIG welding.
- Hemming and mastic sealant applied for water proofing joint and reducing NVH.
- Quality Inspection of the car body at Quality Gates by skilled operators.

Paint Shop:

- PT loading
- ED coating to BIW after Quality Inspection.
- Sealer application for water proofing parts and joints.

- Base coat and finish coat on the robotic line.
- Quality inspection of the car body by skilled operators.

Power train Shop:

- Machining of the cylinder block, cam shaft, cylinder head in machine shop
- Assembling of transaxle
- Assembling of all parts of engine
- Cold test, hot test and Fire test for quality assurance.
- Assembling of engine and transaxle in dressing line

TCF Shop:

- Assembling of the various interior & exterior parts of the car.
- Cockpit, console, Fuel line, brake line, wiring etc. are assembled.
- Assembling of radiator etc in engine received from PWT shop
- Engine and Transmission merged with painted body.
- Vibration test, Shower test and drive test is done.
- Quality inspection by skilled operators.

E. Department Overview:

Productivity Services Department (PSD)

Head of department: Mr. Jyoti Prakash Das.

Team members: Jay Modi, Aritra Biswas, Vineet Tandon, Devesh Kulkarni, Manoj Makwana.

Functions:

- Labor Productivity monitoring.
- MOST® estimation/Analysis.
- Manpower Study and Approval.
- Work study and cycle time estimation.
- Guide Cost estimations for outsourced/Contract activities.
- SAP routing
- Organization and methods defining.
- MOP improvement

Project Brief
Establishing Work Productivity standards in indirect areas

Description: My whole Project was to find out manpower of indirect areas of production **(Only Blue collars)** and establishing standards to improve the productivity by identifying non value added activities and eliminating them.

Indirect area activities support the direct areas of production. They also help in maintaining adherence to quality. Maintenance of all the instruments that are directly and indirectly related to production and help in increasing productivity by eliminating breakdown.

Areas Covered

1. Warranty Shop
2. CMM
3. CMS
4. Product & Process Audit
5. MQ-Paint

Summary

Areas Covered	Existing Manpower	Calculated Manpower
Warranty Shop	9	7
Product & Process Audit	20	10
CMM	9	8
CMS	46	25
MQ-Paint	21	-
Total	105	50

Manpower Saving=84-50=34

Total cost saving Per Year=34*15000*12=6120000

Product & Process Audit

The key intent of **product audit** is to identify potential customer complaints, which correlates with customer feedback (Internal & external), through a systematic audit of vehicle in Static, Dynamic and through Functional Checks and seek improvements in order to improve product quality. Product Audit is conducted in all the shops

Process Audit is defined as a systematic and independent examination of data, statements, records, operations and performances of an operation for a stated purpose.

The purpose of the Process Audit is to disclose potential problem causes by evaluating each process comparing to its Quality Management System. It also helps to identify manufacturing process imperfections due to variation by applying an independent quality view through dedicated and trained auditors/ Inspectors.

Central Maintenance Service (CMS)

Central maintenance service is a place where maintenance related activity takes place. It is divided in 7 different areas i.e.

1. Procurement: Purchase of all the spare parts of the machines installed in plant and new machine installed by planning.
2. Vehicle maintenance cell: Maintenance and PM of all the Vehicles used inside Tata motors Plant.

3. MHE: Maintenance of material handling Equipment that is used in production and non-production area for material movement For e.g. Forklift, jost, dock, stacker, hand Pallet
4. Motor repair cell: Repair and maintenance of all the motors that is used in plant
5. Electronic Lab: Repair of electronics items.
6. Non-manufacturing Maintenance: Maintenance of non-manufacturing areas machine is done by non-manufacturing maintenance team
7. Central Spare Store: It is a place where all the machine spare that is purchased by procurement team is stored.

CMM

CMM lab activities include calibration of CMM instruments and inspections of critical dimension, Surface roughness, Cylindricity etc. of Head, Block & Crank shaft which cannot be checked on the shop floor.

Customer Quality

Customer Quality is responsible for inspection of the parts received from the dealer & received parts are debited either to dealer, supplier or TML according to analysis done by customer quality & dealer.

Methodology

1. **Observation**
2. **Activity mapping**
3. **Data Collection**
4. **Shop Floor Manpower Activity study**
5. **Data Analysis**
6. **Workout**
7. **Discussion**
8. **Manpower Approval**

Observation: First step of manpower study is observation where observation of shop floor, work done by the worker, type of work etc. are done and then lay out of shop floor is prepared in order to track all the activities of blue collar material movement etc.

Activity Mapping: Second Step Of manpower Study where each and every activity of manpower is mapped and then that activities are discussed with team. Analysis of that activity is done. Weather it is necessary or Not and VA and NVA are identified and then NVA are eliminated as well as white collar activities are also eliminated during activity mapping. In this stage we wil get rough idea about what method to use while calculating work content. If it is analysis kind of activity then no work content can be calculated. Manpower should be allocated by observation and understanding. If it is repetitive activity and has well defined working procedure then Most Analysis can be done which is most advanced work analysis technique. If it is audit kind of activity then time measurement can be used in calculating the work content. Work content of Repair Preventive maintenance Store activities Cleaning Activities etc. can also be calculated by time measurement

Data Collection: After Data Collection and activity mapping certain data has to be collected in order to study further. So, data is collected where needed. In order to collect data first type of work is identified and then respective person is informed to provide the data that is needed for further study such as parts receiving frequency, Plan, guidelines, issuing frequency, repairing frequency, etc.

Shop Floor Manpower Activity Study: After Data analysis study is done in the shop floor activity wise. If it is repetitive activity and has well defined working procedure then work sampling is done and then video is taken activity wise after that Most analysis is done by using Palmsys software and work content is generated

If It is inspection (Audit), maintenance Activity etc. which don't have definite working procedure then work sampling is done and time is noted activity wise for 5-10 times depending upon the type of activity and average of 5-10 readings is taken as average time taken to complete that activity. If it is analysis kind of activity then no work content can be established.

Data Analysis:

Workout: After data analysis, activity study, Data collection, & observation workout is done. If it is repetitive activity having definite working procedure then workout is done in Palmsys Software. If it is maintenance and audit kind of activity then workout is not done in palmsys. First format is made in excel, and then all the mapped activity are entered in that file after that observed avg time is entered against mapped activities. Now Per Day Per Month Per Frequency is generated by data analysis which is entered in the file and then work content is

generated. The generated work content is divided by available time which is 470 minutes in order to find manpower. After that manpower is rounded up in order to eliminate decimal. After manpower has been calculated 10 % absenteeism is added.

Discussion: After workout is completed discussion stage starts in order to settle the disputed points that are raised after manpower study. In this stage Meeting is held between shop in charge and PSD team

1. Warranty Shop

Customer Quality is responsible for inspection of the parts received from the dealer & received parts are debited either to dealer, supplier or TML according to analysis done by customer quality & dealer

Sr No.	Test Rig	Parts tested
1	Music system tester	Music system parts are tested in this rig Speaker tweeter woofer display etc. are checked
2	Light tester	electrical parts such as roof lamp head lamp fog lamp etc. are checked in this rig
3	Electrical system tester	Combi switch fuse box wiring harness ri switch battery etc. are tested in this rig
4	HVAC test rig	components of Hvac are tested in this rig such as compressor air vents ac pipes evaporators
5	Nano Electrical	all Nano electrical parts are checked in this rig
6	Door Latch Test rigs	door latch is tested in this test rig
7	Starter motor test rig	starter motor is tested in this rig
8	speed sensor	speedometer tachometer ets are tested in this rig
9	Alternator test rig	alternator is tested in this rig
10	Engine test rig	engine is tested in this rig
11	Fuel filter test rigs	fuel supply system is tested in this rig which include fuel pump oil rail fuel pump fuel filter air filter

Activities

A. Receiving Failed Parts from Customer Support and Physical Verification: Blue collar receive the parts from customer support manpower every week and verify them physically.

B. Classification & Analysis of parts NFT,ok,Damage,Out of warranty parts: After receiving the parts each part is classified first either it is in warranty or not and after that parts are transferred to analysis table and detailed analysis is done to find out the

root cause of the fault and the part is either debited to TML or supplier or dealer according to the analysis report

C. Fitment of failed parts on test rigs and Vehicle : If problem is not solved or not found by analysis then failed parts are fitted in test rigs or into the vehicle and then they are tested to know the cause of problem

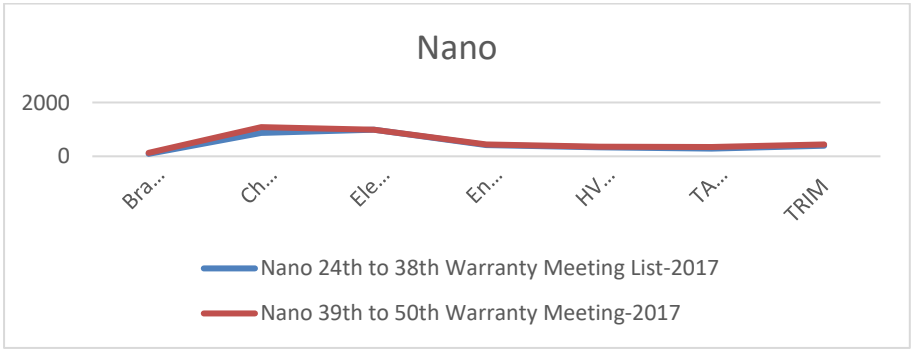
D. Supplier calling for Parts analysis: If analysis reports suggests fault of supplier then supplier is called and joint analysis is done with supplier and parts is debited to supplier

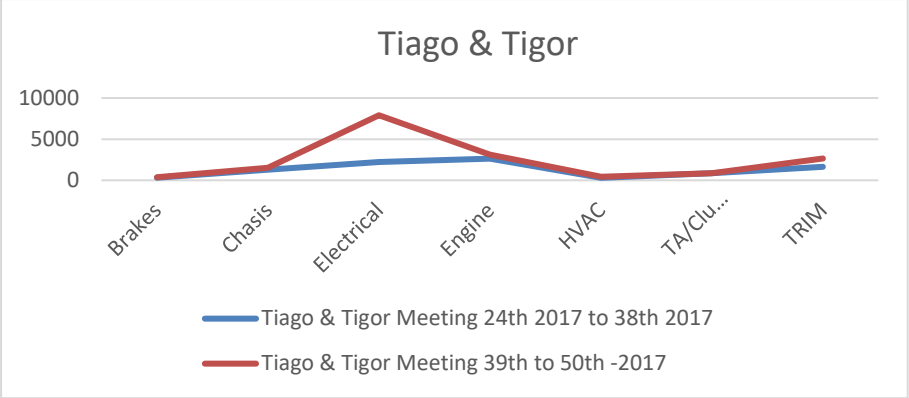
E. Warranty Meeting Updation : Warranty meeting list is updated date wise

F. Scrapping Out of Warranty Parts : If the issue is from TML or Erc then the parts are debited to TML and parts are scrapped out.

Commodity wise parts Received In warranty Shop			
Commodity	**Tiago- Tigor Parts**	**Nano Parts**	**Total Daily**
Brakes	684	221	3.02
CHASIS	2790	1952	15.81
Electrical	10135	1974	40.36
Engine	5730	851	21.94
HVAC	721	689	4.70
TA/Clutch/Exhaust	1745	631	7.92
TRIM	4281	833	17.05
TOTAL	26086	7151	110.79

Receiving trend





Manpower Distribution:

No workcontent can be established for any of these analysis related activities. Manpower fixed here is due to parts receiving trend, analysis & observation.

Manpower distribution is done considering avg 20 parts per day

Manpower for Engine=1

Manpower For Electrical=2

Manpower for Trim=1

Manpower for Chassis/Brakes=1

Manpower for TA/Clutch/Exhaust/HVAC=1

Manpower Distribution		
Commodity	**No of parts to be handled/Day**	**Manpower considering avg 20 parts /day**
Engine	22	1
Electrical	40	2
Trim	17	1
Chassis/Brake	19	1
TA/Clutch/Exhaust/HVAC	13	1
		6

Total Manpower for Warranty Shop=1+2+1+1+1

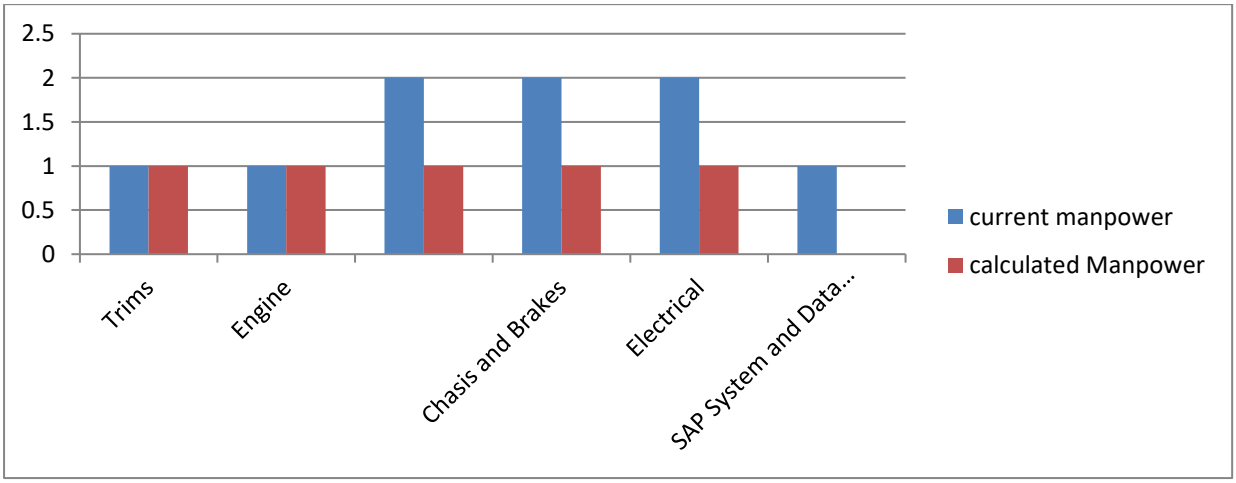
= 6

Total manpower including Absenteeism = 10% of total manpower + total manpower

= 1+6

= 7

Summary



CMM LAB

Machine Used

Category	Testing Instrument	Parts Checked	Machine Capability
Geometric Inspection	Roughness Tester Marposs	Head Block CrankShaft Camshaft	Surface roughness
	Zeiss countura G2	Head Block CrankShaft CamShaft	Critical Geometric dimensions of parts, Coordinate method machining
	Hexagone	Head Block	Critical Geometric dimensions of parts, Coordinate method machining
	Adcole	Crankshaft,Camshaft	Cylindricity of crankshaft Finishing and critical dimension of crankshaft
Calibration	Master gauge	Roughness Tester Marposs	calibration of roughness tester
	Master gauge	Zeiss countura G2	calibration of Zeiss
	Master gauge	Hexagone	Calibration of hexagone
	Master gauge	Adcole	Calibration of adcole

Activities

1. Geometric Inspection
   A. Inspection of Crankshaft in Adcole
   B. Inspection Of Crankshaft In Zeiss
   C. Roughness Inspection of crankshaft in mapross Roughness tester
   D. Inspection of Cylinder Head in Zeiss
   E. Inspection of cylinder head in Hexagone
   F. Roughness Inspection of cylinder Head in Marposs roughness tester
   G. Inspection of cylinder Block in Hexagone
   H. Inspection of Cylinder Block in Zeiss
   I. Roughness Inspection of Cylinder Block in Marposs ROUGHNESS TESTER

2. Calibration
   A. Calibration of zeiss
   B. Calibration of Hexagone
   C. Calibration of adcole

3. Other Activities
   A. Material Movement
   B. Inspection Of parts from planning
   C. Report Writing

Manpower Calculation

1. Calculation Of Manpower For Geometric Inspection In Cmm Area 1

Activities Mapping in CMM					
Major Activies	**Sub Activities**	**WC Per Part**	**WC Per Part in Sec**	**Parts Frequency**	**Total WC in min**
1	Transfer Material From Prod Line To CMM Room	-		1.00	-
2	Calibration Of ZEISS	25.00	1,500.00	1.00	25.00
3	Cleaning (Air Blowing) Of Block	1.50	90.00	26.00	39.00
4	Incoming Block Record In File	0.20	12.00	26.00	5.20
5	Incoming Head Record In File	0.20	12.00	39.00	7.80
6	Receive CS From Workers	0.33	20.00	33.00	11.00
7	Handover CS To Workers	0.33	20.00	33.00	11.00
8	Handover Head & Block To Line	25.00	1,500.00	1.00	25.00
9	Report Not Ok Parts in Production Line	20.00	1,200.00	1.00	20.00
10	Report Writing In Excel	30.00	1,800.00	1.00	30.00
11	Meeting	15.00	900.00	1.00	15.00
CS Roughness					
1	Cleaning Of CS	0.33	19.80	26.00	8.58
2	MB/Flange/CP/Timing/Pulley Roughness Inspection	5.67	340.20	26.00	147.42
CS ZEISS					
1	Loading fixture in Zeiss	0.16	9.36	9.00	1.40
2	Loading CS in Zeiss	0.81	48.72	9.00	7.31
3	Manual Use Of CMM	9.00	540.00	9.00	81.00
4	Printing Analysis & Saving Report	2.00	120.00	9.00	18.00

5	Removing Fixture From Zeiss	0.16	9.36	9.00	1.40
6	Removing CS From Zeiss	0.16	9.36	9.00	1.40
CS ADCOLE					
1	Cleaning CS	0.33	20.00	33.00	11.00
2	Loading CS in ADCOLE	0.75	45.00	33.00	24.75
3	Printing Analysis & Saving Report	2.00	120.00	33.00	66.00
4	Removing CS From ADCOLE	0.33	20.00	33.00	11.00
Block ZEISS					
1	Loading fixture in Zeiss	0.23	13.68	21.00	4.79
2	Loading Block in Zeiss	0.23	13.68	21.00	4.79
3	Block Cleaning & Aligning In Zeiss	2.16	129.60	21.00	45.36
4	Probe Change	0.47	28.08	21.00	9.83
5	Report analysis & Saving	2.50	150.00	21.00	52.50
6	Removing Fixture From Zeiss	0.23	13.68	21.00	4.79
7	Removing Block From Zeiss	0.23	13.68	21.00	4.79
Head Zeiss					
1	Loading fixture in Zeiss	0.23	13.68	10.00	2.28
2	Loading Block in Zeiss	0.23	13.68	10.00	2.28
3	Block Cleaning & Aligning In Zeiss	2.16	129.60	10.00	21.60
4	Probe Change	0.31	18.72	10.00	3.12
5	Report analysis & Saving	2.50	150.00	10.00	25.00
6	Removing Fixture From Zeiss	0.23	13.68	10.00	2.28
7	Removing Block From Zeiss	0.23	13.68	10.00	2.28
Block Roughness					
1	Transfer Head From Racks To Testing Area	0.23	13.6	10	2.27
2	Final Finishing Roughness Insp	5.00	300.00	10	50.00
3	Transfer Heads From Testing Areas To Rack	0.10	5.76	10	0.96
Head Roughness					
1	Transfer Block From Racks To Testing Area	0.23	13.6	5	1.13
2	Head Roughness Insp	3.33	199.80	5	16.65
3	Transfer Heads From Testing Areas To Rack	0.10	5.76	5	0.48
Homing Roughness					
1	Transfer Head From Racks To Testing Area	0.23	13.6	17	3.85
2	Homing Roughness Insp	5.20	312	17	88.40
3	Transfer Block From Testing Areas To Rack	0.23	13.6	17	3.85

	Total WC/day	***921.55***
	Line Issue+Others+Planning	***92.15***
	Total Time/day Including Line Issue+Others+Planning	***1,013.70***
	Available Time/shift	***470.00***
	Th Manpower	***2.16***
	Actual Manpower	***3.00***

*Due to Cycle time of cmm machines 1 extra manpower is allocated in cmm area 1 in order to Fulfil the current demand of inspection. Without 1 extra manpower There would be Production Stoppage And Loss Of MOP of whole plant.

2. Calculation Of Manpower For Geometric Inspection In Cmm Area 2

Activities Mapping in CMM					
Major Activies	**Sub Activities**	**Avg Time in Min**	**Avg Time in Sec**	**Part Frequency**	**Total Time**
1	Transfer Material From Prod Line To CMM Room	90	5400	1	90
2	Calibration Time Hexagone				
3	Incoming Head & Block Record In File	0.20	12	33	6.6
4	Handover Head & Block To Line	30.00	1800	1	30
5	Report Not Ok Parts in Production Line	20	1200	1	20
6	Meeting	15	900	1	15
Block Hexagon					
1	Loading fixture in Zeiss	0.16	9.36	5	0.78
2	Loading Block in Zeiss	0.17	10.08	5	0.84
3	Block Cleaning & Aligning In Zeiss	0.50	30	5	2.50
4	Report analysis & Saving	2.50	150	5	12.50
5	Removing Fixture From Zeiss	0.16	9.36	5	0.78
6	Removing Block From Zeiss	0.17	10.08	5	0.84
Head Hexagon					
1	Loading fixture in Zeiss	0.16	9.36	28	4.37

2	Loading Block in Zeiss	0.17	10.08	28	4.70
3	Block Cleaning & Aligning In Zeiss	0.50	30	28	14.00
4	Report analysis & Saving	2.50	150	28	70.00
5	Removing Fixture From Zeiss	0.16	9.36	28	4.37
6	Removing Block From Zeiss	0.17	10.08	28	4.70
	Total Time/day				**281.984**
	Line Issue+Others+Planning				***28.20***
	Total Time/day Including Line Issue+Others+Planning				***310.18***
	Available Time/shift				***470.00***
	Th Manpower				***0.60***
	Actual Manpower				***1.00***

*Due To positional Constrain Manpower is 1 Per Shift and 3 per day as Machine shop is running in all 3 Shift

Total WC is the

Manpower Summary

Sr, No.	Shop	Major Activies	Existing Manpower			Calculated Manpower		
			A	B	C	A	B	C
1	TCF	CMM	3	3	3	3	2	2

Absenteeism= 10% of calculated Manpower

= 1

Total Manpower= Calculated Manpower + Absenteeism

= 7+1

= 8

Product & Process Audit

The key intent of **product audit** is to identify potential customer complaints, which correlates with customer feedback (Internal & external), through a systematic audit of vehicle in Static, Dynamic and through Functional Checks and seek improvements in order to improve product quality. Product Audit is conducted in all the shops

Process Audit is defined as a systematic and independent examination of data, statements, records, operations and performances of an operation for a stated purpose.

The purpose of the Process Audit is to disclose potential problem causes by evaluating each process comparing to its Quality Management System. It also helps to identify manufacturing process imperfections due to variation by applying an independent quality view through dedicated and trained auditors/ Inspectors.

BIW CPA

The key intent of **BIW CPA** is to identify potential customer complaints, which correlates with customer feedback (Internal & external), through a systematic audit of BIW body and seek improvements in order to improve product as well as process quality.

Activities

A. **Product Audit:** Product audit is divided into 5 main segments. Each vehicle must be audited in all five segments. Audit content is arranged to require evaluation of only those items that can be checked without disassembly of vehicle subassemblies*. For example, it is not necessary to remove the door panel to check for Door panel welding. The sequence of these segments can be varied based on facility constraints at the individual location, as long as the quality of the audit is not compromised Total 1 BIW body is audited per day

B. **Material Movement**: This activity include transfer from production line to product area and transfer of body from product audit area to production line after insuring all the rework done is ok.

C. **Ensuring Reworks:** This activity include the inspection of the vehicle after rework.

D. **Meeting With In charge:** This activity includes Discussion of Defects that are found during audit with audit in charge

Manpower Calculation

In case of positional activities the manpower was determined as per the user requirement or through analysis.

For the other activities,

Manpower = Average time (considering 10 readings) / Total Available time (470 min).

Major Activies	Sub activities	Avg Time in Min
Product Audit		
1	Transfer Of BIW Body From Product Audit Area To Production Line Using Trolley	15.00
2	Transfer Of BIW Body From Production To Product Audit Area Line Using Trolley	15.00
3	Body Loading in two Post Lift	3.00
4	Under Body Inspection	14.73
5	Under Body Inspection & Hammering	7.33
6	Time taken to lower the Body	0.50
7	LH Rear door Inspection	3.00
8	Incab Inspection Of Front Floor &BSI	

		15.50
9	Body Outer Surface Checking	17.95
10	Trunk Inner Inspection	2.33
11	Trunk Outer Inspection	1.00
12	Inside Hood Inspection	3.50
13	Defect Shown to BIW Product Audit Incharge	8.33
14	Gap & Hood Outer Checking	10.50
15	Filling Up Product Audit Plan	0.50
16	Showing Defect To White Colar And Checking	4.00
17	Meeting	9.00
18	Updation Of VIN No. Defect Type & Demerit Point In Note Book	23.67
19	Filling Up Issue Tracking Sheet	0.50
20	Report Writing In Excel	30.00
21	Ensuring Reworks Of All The Defect Noted During Audit	15.00
	Total Time	***200.34***
	Available Time/shift	***470.00***
	Th Manpower	***0.43***
	Actual Manpower	***1.00***

Total Manpower for BIW CPA = 1

Paint shop CPA

The key intent of **Paint CPA** is to identify potential customer complaints, which correlates with customer feedback (Internal & external), through a systematic audit of Painted body and seek improvements in order to improve product as well as process quality.

Activities

A. **Product Audit:** Product audit is divided into 5 main segments. Each vehicle must be audited in all five segments. Audit content is arranged to require evaluation of only those items that can be checked without disassembly of vehicle subassemblies*. For example, it is not necessary to remove the door panel to check for Door panel Paint. The sequence of these segments can be varied based on facility constraints at the individual location, as long as the quality of the audit is not compromised Total 1 Painted body is audited per day

B. **Defect Classification**: This activity include defect classification and discrepancy weighting to all the defects that are noted during the audit.

C. **Defect Inspection in Production Line:** This activity includes inspection of cause of defect in production line and no. of vehicles having same kind of defects. Worker ot first goes to production line and starts to inspect vehicles for serious defect if defect is found in other vehicle too then he moves forward in production line to see the root cause of the defect after root cause is found production team is informed and then all the vehicles with defects are made defect free.

D. **Meeting:** This activity includes defect shown by worker to audit in charge and other white collar of production

E. **Material Movement**: This activity includes transfer of painted body from production line to audit area and transfer of painted Body from audit area to production line after ensuring all the defects are gone.

Manpower Calculation

In case of positional activities the manpower was determined as per the user requirement or through analysis.

For the other activities,

Manpower = Average time (considering 10 readings) / Total Available time (470 min).

Major Activies	Sub activities	Avg Time in Min
Product Audit		
1	Bring Body to Audit Area	1.20
2	Hood Outer inspection	2.23
3	Front RH Door inspection	4.25
4	Rear RH Door inspection	5.00
5	Tail Gate inspection	2.00
6	Rear LH Door inspection	5.25
7	Front LH Door inspection	4.63
8	Roof inspection	3.50
9	Hood Inner inspection	2.00
10	Front RH Door Inner inspection	4.00
11	Rear RH Door Inner inspection	4.50
12	Tail Gate Inner inspection	6.00
13	Rear LH Door Inner inspection	5.25
14	Front LH Door Inner inspection	4.12

15	All Doors Melt Sheet & Groomet Inspection	2.00
16	Tail Gate Sealer And Melt Sheet Inspection	3.75
17	Sealer Inspection LH side	2.00
18	Sealer Inspection RH side	2.55
19	Sealer inspection Hood Interior	1.00
20	sealer Inspection TG Interior	2.00
21	Water Leakage Test (for Shower leakage)	2.09
22	Check the positioning of SBT clips on roof	0.50
23	Defect Classification	7.13
24	Defect Inspection In production Line	20.00
25	Meetings With Different People In Audit Area	40.00
26	Filling Up Audit Defect Count	5.00
	Total Time	***141.95***
	Available Time/shift	***470.00***
	Th Manpower	***0.30***
	Actual Manpower	***1.00***

Total Manpower for Paint CPA = 1

TCF shop CPA

The key intent of **TCF CPA** is to identify potential customer complaints, which correlates with customer feedback (Internal & external), through a systematic audit of vehicle in Static, Dynamic and through Functional Checks and seek improvements in order to improve product quality.

Activities

A. **Product audit:** Product audit is divided into 10 main segments. Each vehicle must be audited in all ten segments. Audit content is arranged to require evaluation of only those items that can be checked without disassembly of vehicle subassemblies*. For example, it is not necessary to remove the rear seat to check for seat belt anchorage. The sequence of these segments can be varied based on facility constraints at the individual location, as long as the quality of the audit is not compromised Total 3 vehicles are audited per day

B. **Material Movement:** This Activity includes Movement of manpower from TCF area to PDI select vehicle Drive to Gas station Fill 3ltrs Fuel and then drive the vehicle to audit area. Total Vehicle Movement is 3 per day

C. **BIW EBHS Audit:** This is a monthly activity where a BIW body is selected from BIW shop And then transferred from BIW to TCF CPA And Then EBHS test is done according to guidelines and after that the body is transferred to BIW shop

D. **TMLD Audit:** This is daily Activity where three vehicles are audited in TMLD yard. Selection of vehicle is done randomly from the yard and the audit procedure is same as product audit. This activity includes movement of manpower to TMLD yard

selection of vehicle audit ensuring rework and Movement of manpower from TMLD to TCF Shop.

E. **Vehicle Layout Audit:** In this audit layout of vehicle is audited. 3 cars are audited in a week

F. **Craftsmanship Audit**: The quality of design, parts, and work that is done by worker is checked in this audit. Done by skilled worker. Worker has defined check points and he audit that points moreover he also has to check the warranty complaints**.**

G. **Meeting**: This activity includes Discussion of Defects that are found during audit with audit in charge

H. **Insuring Reworks:** This activity include the inspection of the vehicle after rework.

I. **Report Writing With Defect Classification:** This activity include defect classification and discrepancy weighting to all the defects that are noted during the audit. This is done in specially designed software for CPA discrepancy weighting.

Manpower Calculation

In case of positional activities the manpower was determined as per the user requirement or through analysis.

For the other activities,

Manpower = Average time (considering 10 readings) / Total Available time (470 min).

Major Activies	Sub activities	Avg Time in Min	TML Guidelines	TML Guidelines including EBHS & AC Test
Product Audit				
1	Bring Vehicle From Care to Audit Area & Fill 3 ltrs Petrol	20.00	20	20
2	LH Front Door Inner Inspection	5.10	80	80
3	LH Front Door outer Inspection	3.10		
4	LH Rear Door Inner Inspection	6.20		
5	LH Rear Door Outer Inspection	1.85		
6	Bumper Inspection	3.45		
7	Tailgate Inspection	2.60		
8	Trunk Inspection	6.00		
9	RH Rear Door Inner Inspection	6.10		
10	RH Rear Door Outer Inspection	2.30		
11	BSO Visual Check Inspection	3.80		
12	Hood Inner Inspection	6.20		
13	Interior Function Check	10.00	30	30
14	Door Velocity Check	3.83		
15	Efforts and Force Measurement	37.00		
16	EBHS Test	25.00	-	25
17	Headlight Alignment Test	7.00	7	7
18	Shower Test	40.00	10	10
19	AC Test (Both Closed And Open Door)	30.00	-	30
20	Underbody Inspection (Before drive test)	10.00	20	20
21	Drive Test	50.00	50	50
22	Underbody Inspection (After drive test)	20.00	20	20
23	Upper body Torque test	15.00	15	15

24	use of Two post Lift	5.00	5	5
25	Underbody Torque Inspection	23.00	23	23
26	Bring Vehicle Back to its Origional Position	5.00	5	5
27	Ensuring Reworks Of All The Defect Noted During Audit	10.00	10	10
28	Report Writing In MINT	30.00	30	30
29	Vehicle Layout Audit On line	48.00	48	48
	Total Time For One Veh	435.53	373	428
BIW EBHS Test				
29	EBHS Test	18.80	-	
	Total Time	***1325.39***		
	Available Time/shift	***470.00***		
	Actual Manpower	***2.82***		
	Roundup	***3.00***		

TMLD Audit				
1	time to reach TMLD	10.00		
2	Bring Vehicle to audit area (TMLD)	10.00	-	
3	Static Audit Per Vehicle	20.00	-	
4	Interior Function Check	20.00	-	
5	Bring Vehicle Back to its Original Position	5.00	-	
6	Ensuring Reworks Of All The Defect Noted During Audit	15.00	-	
7	Review Meeting	15.00	-	
	Total Time	80.00	-	
	Total For 3 Vehicle	220.00		
Craftsmanship Audit				
1	Total WC for craftsmanship audit per Day	235.00	-	
	Total Time	***455.00***		

	Available Time/shift	***470.00***		
	Th Manpower	***0.97***		
	Actual Manpower	***1.00***		

Total Manpower For TCF CPA = 3+0.5+0.5

=4

PWT CPA

The key intent of **PWT CPA** is to identify potential customer complaints, which correlates with customer feedback (Internal & external), through a systematic audit of Engine in Static, Dynamic and through Functional Checks and seek improvements in order to improve product quality.

Activities

A. **Strip Down:** This activity include random selection of engine from EA line transfer of that engine to audit area Dismantle of that engine according to WIS And check abnormalities as per audit check sheet and note down all the defects and communicate the defects with audit in charge

B. **Material Movement**: This activity include assembly of Half block manually and distribution of parts to respective stations.

C. **Machine Shop Product Audit:** This includes the product audit of machine shop I.e. CS CB CH. First Worker goes to line randomly picks 1 cs or cb or ch in 1 working day according to inspection plan. And then starts to inspect the product, identifies the defects, fill the defect in in check sheet transfer the material to respective line and communicate the defects with audit in charge

D. **Millipore Endoscopy Test:**

E. **100 hrs. Inspection:** Engine transfer from line to hot test area mounting engine in most test bed note the readings regularly identify issues regularly dismantle the engine after 100 hrs is completed and note down abnormalities**.**

F. **Dressing Line Torque audit:** Torque audit of engine present in dressing line (on line) and note down the torque in check sheet.

G. **Assembly Line torque audit:** Torque audit of engine present in EA line (on line) and note down the torque in check sheet.

H. **Dynamic Torque test**: Torque test of CQ pass engine against dynamic torque audit checkpoints

Manpower Calculation

In case of positional activities the manpower was determined as per the user requirement or through analysis.

For the other activities,

Manpower = Average time (considering 10 readings) / Total Available time (470 min).

Major Activies	Sub Activities	Avg Time in Min	Frequency per month
Product Audit			
1	Bring engine from line to product Audit area	15	3 Engine in a Week
2	Strip Down Activity and check sheet updating	350	
3	Machine shop product Audit (Cylinder Head/block/crankshaft any two) & dynamic audit and report updation	360	25
4	Millipore/Endoscopy tests and report updation	420	25
5	100Hr Inspection (OC) and report update	52	once in a month
6	Dressing Line Torque test and check sheet filling	65	25
7	Assy line Torque Test online	82	25
8	Dynamic Torque test final check sheet filling	20	25
	Total Time	***1364***	
	Available Time/shift	***470.00***	
	Th Manpower	***2.90***	
	Actual Manpower	***3.00***	

Total Manpower For PWT CPA = 3

Manpower Summary For CPA Sanand Plant

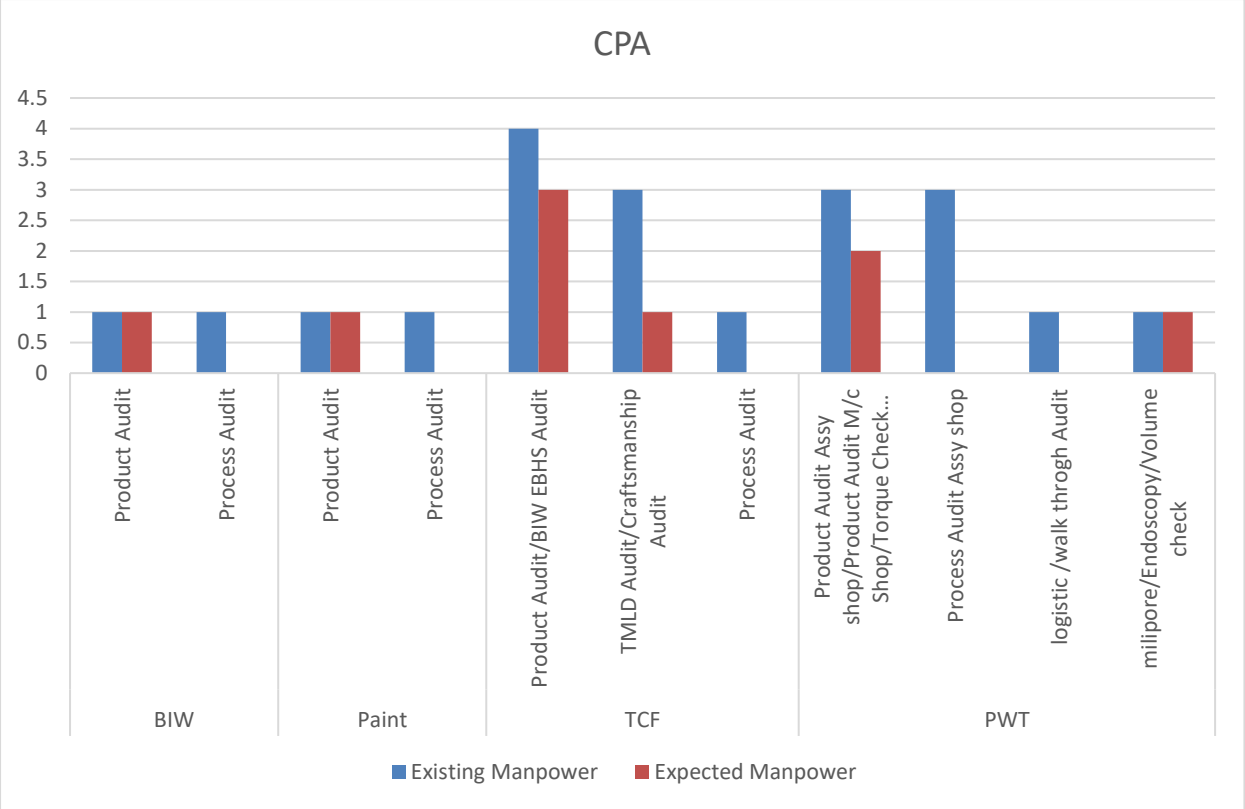
Sr, No.	Shop	Major Activities	Existing Manpower	Expected Manpower
1	BIW	Product Audit	1	1
2		Process Audit	1	0
1	Paint	Product Audit	1	1
2		Process Audit	1	0
1	TCF	Product Audit	3	3
2		BIW EBHS Audit	1	
3		TMLD Audit	1	1
4		Craftsmanship Audit	2	
5		Process Audit	1	0
1	PWT	Product Audit Assy shop	2	2
2		Product Audit M/c Shop		
3		Torque Check dressing/assy line	4	
4		Process Audit Assy shop		0
5		logistic /walk through Audit	1	0
9		milipore/Endoscopy/Volume check	1	1
	ALL Shop	***Total Manpower***	***20***	***9***

Absenteeism = 10% of total Calculated Manpower

= 1

Total Calculated Manpower including Absenteeism= 9+1

=10


CPA
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Product Audit
Process Audit
Product Audit
Process Audit
Product Audit/BIW EBHS Audit
TMLD Audit/Craftsmanship Audit
Process Audit
Product Audit Assy shop/Product Audit M/c Shop/Torque Check...
Process Audit Assy shop
logistic /walk throgh Audit
milipore/Endoscopy/Volume check
BIW
Paint
TCF
PWT
Existing Manpower
Expected Manpower

Central Maintenance Service (CMS)

Central maintenance service is a place where maintenance related activity takes place. It has 7 different Verticals i.e.

1. Procurement: Purchase of all the spare parts of the machines installed in plant and new machine installed by planning.
2. Vehicle maintenance cell: Maintenance and PM of all the Vehicles used inside Tata motors Plant.
3. MHE: Maintenance of material handling Equipment that is used in production and non-production area for material movement For e.g. Forklift, jost, dock, stacker, hand Pallet
4. Motor repair cell: Repair and maintenance of all the motors that is used in plant
5. Electronic Lab: Repair of electronics items.
6. Non-manufacturing Maintenance: Maintenance of non-manufacturing areas machine is done by non-manufacturing maintenance team
7. Central Spare Store: It is a place where all the machine spare that is purchased by procurement team is stored.

Central Spare Store

It is a place where all the machine spare that is purchased by procurement team is stored.

Activity

A. **Receiving Materials**: This activity include receiving of material from courier or procurement manpower, counting, verification, Sap updation, Storage in respective bins as well as other unplanned activities that occurs during receiving materials.

   Work content per part = 8.5 min

Frequency = 46 per day

Total work content = 394.68 min

Total Work content per shift= 195.5 min

B. **Issuing Materials**: This activity includes issuing of materials from store to user. First request is checked and verified and then material is issued to user and then material issued is entered in SAP system.

Work content per part=9.5 min

Frequency=29 per day

Total work content= 275.5 min

Total Work content per shift= 137.75 min

C. **Physical Inventory Verification**: This activity includes Pre audit and audit related activity which is conducted thrice a week

Work content of audit = 60

Work content of pre audit = 120

Frequency= 3 times a week

Total work content = 90

D. **Other Activities**: This activity includes daily material retrieval time calculation. Daily consumption Volume calculation and its display in display board. It also includes 5s audit that is conducted in store.

Work content of consumption receiving data updation= 5 min

Work content of material retrival time calculatin= 4 min

Frequency = 1 per day

Total work content= 17 per day

Manpower Calculation

In case of positional activities the manpower was determined as per the user requirement or through analysis.

For the other activities,

Manpower = Average time (considering 10 readings) / Total Available time (470 min).

Sr No	Activities	Avg Time in Min	No of parts/ Lot	WC/ Part	Freq/ Day	Total Time/ Day
Receiving Materials						
1	GR tag received at Central Machinery spare store	20.00	8.00	2.50	46.00	115.00
2	Check the GR Tag & invoice for qty, part no. UOM, make as per TML PO No.					
3	Check Physical Qty of materials received in Central Store					
4	Actual acknowledgement (MB02) of received spare in SAP System	4.00	8.00	0.50	46.00	23.00
5	Central store Material Receipt Stamping & Signature on Invoices/ bills of Couriers partners	1.00	8.00	0.13	46.00	5.75
6	Documentation of GR Tag & Invoices	1.00	8.00	0.13	46.00	5.75
7	Receiving date & part code no. writing on materials to implement FIFO	8.00	8.00	1.00	46.00	46.00
8	Place the received Material in quality inspection rack in central store	5.00	8.00	0.63	46.00	28.75
9	Display the received items to user as he comes to store	5.00	8.00	0.63	46.00	28.75

10	Place the material in designated bins with proper classification, part code numbering with FIFO	16.00	8.00	2.00	46.00	92.00
11	Entry of Material with qty, store location, received by received date & Material Bin Location	4.00	8.00	0.50	46.00	23.00
12	Material Bin Location updation in SAP System	4.00	8.00	0.50	46.00	23.00
		Total generated WC/Day				*391.00*
		Total generated WC/ shift				*195.50*
1	Inform to user for quality check of received material	10.00			1.00	-
2	Make an entry of rubber parts in excel file with received date to maintain self-life of rubber parts	2.00	1.00	2.00	3.00	-
3	Create a new bin location for new arrival materials after got clearance of quality check from user	3.00	1.00	3.00	10.00	30.00
4	If received material not found as per PO then execute MIGO (GR Cancel) in SAP System	15.00			0.20	-
		Total generated WC/Day				*30.00*
		Total generated WC/ shift				*15.00*
Issuing Materials						
1	MIR slip received with desired part code, Qty & authorized signatory	6.00			29.00	174.00
2	Verify the authorized person signature with authorization matrix sheet available in store.					
3	Check MIR slip i.e. proper reservation/order No. Cost Centre No. part code no., Store Location, Qty & Name of Requested person					
4	Check availability & Bin location of Material in SAP System					
5	If material available in other store location then ask to user to take approval from that user					
6	Material Movement form one store location to other store location after got approval from user by using MB1B Tcode in SAP System					
7	If Material showing in QA Inspection in SAP then ask to user to clear QA in SAP System					
8	Retrieve Material from bin location by using FIFO System within Retrieval time					
9	Material Handed over to user					
10	Take Signature of user in Material receiving Column on MIR Slip					

11	Give a unique No. on MIR Slips to trace MIR slips for Physical Inventory Verification Audit	3.50			29.00	101.50
12	Entry of material with qty, store location, received by, cost center, order No. & Retrieval time					
13	Actual Material booking in SAP System (MB1A T Code)					
14	Material booking document no. written on MIR Slip with signature of store person.					
15	MIR slip documented in the file					
		Total generated WC/ Day				275.50
		Total generated WC/ Shift				137.75

Physical Inventory Verification						
1	Check system vs Physical spares qty before Conducting Physical Inventory Verification by Material Audit Team	120.00			1/2	60.00
2	Conduct Audit	60.00			1/2	30.00
		Total generated WC/Day				90.00

Other Activities						
1	Daily Inventory & receiving/Consumption data display on DWM Board	5.00			1.00	5.00
2	Calculate Material Retrieval Time & display on DWM Board on daily basis.	4.00			1.00	4.00
3	Conduct 5s Audit of central store on daily basis & Status display on DWM Board	8.00			1.00	8.00
		Total generated WC/Day				17.00

Total generated WC/ shift	455.25
Available Time/ Shift	470.00
Calculated Manpower/Shift	0.97
Manpower for 2 shifts	2.00

Total Manpower=2 & 1 reliever for Sunday working

***Assumptions**

Store remains open during Sunday shift 1 reliever manpower is given to central spare store

Procurement

Purchase of all the spare parts of the machines installed in plant and new machine installed by planning.

Activities

A. **Material Movement:** This activity includes Material movement from main gate to central spare store through material gate.

   Work content per GR=5 min

   Frequency= 31

   Total work content=155 min per day

Manpower Calculation

In case of positional activities the manpower was determined as per the user requirement or through analysis.

For the other activities,

Manpower = Average time (considering 10 readings) / Total Available time (470 min).

Sr No.	Activities	Avg Time in Min	Frequency /Shift	Total Time/Shift
Material movement (Main Gate to central Spare Store)				
1	Travel to main gate from Cms load material and move to material gate	30.00	1.00	30.00
2	Reach Material gate from main gate	9.00	1.00	9.00
3	Count material in material Gate & make lesi	24.00	1.00	24.00
4	Make GR	49.00	1.00	49.00
5	Reach Store From Material Gate	19.00	1.00	19.00
6	count material in central spare store	19.00	1.00	19.00
7	Reach Cms from central spare store	5.00	1.00	5.00

Total generated WC/ shift	*155.00*
Available Time/ Shift	*470*
Calculated Manpower	*0.33*
Total Manpower	*1.00*

Total Manpower: 1

Vehicle Maintenance Cell

Activities

1. **Preventive Maintenance:** Also known as PM. Carried out once in every 3 months to prevent vehicle from breakdown in the future.
2. **Washing and Cleaning:** washing of vehicles to remove dust.
3. **Oil Change Service**: changing of lubricating oil of passenger vehicles which is carried out once in a year

4. **Part Replacement:** Replacement of parts of vehicle which is defective and cannot be repaired.

Manpower Calculation

A. Preventive Maintenance

Total No of vehicles= 102

Nano=55, indica=22, sumo=7, Aria=3, Cab Crew facelift=2, Winger=2, Ace Magic=6, Fire tender=2, Mobile crane=1, tractor=3, car washer=1, tyre changer=1, two post lift=1, Grinder=1, vacuum cleaner=1

Frequency = Quarterly once in 3 months i.e. 75 days

WC of Preventive maintenance Nano = WC of Nano*quantity*frequency*man

=3.17*55*4*1

WC of Preventive maintenance indica = WC of indica*quantity*frequency*man

=3.12*22*4*1

WC of Preventive maintenance sumo = WC of sumo*quantity*frequency*man

3.28*7*4*1

WC of Preventive maintenance aria = WC of aria*quantity*frequency*man

=3.58*3*4*1

WC of Preventive maintenance facelift = WC of facelift *quantity*frequency*man

=3.12*2*4*1

WC of Preventive maintenance Winger = WC of Winger*quantity*frequency*man

=3.57*2*4*1

WC of Preventive maintenance Ace = WC of ace*quantity*frequency*man

WC of Preventive maintenance tractor = WC of tractor*quantity*frequency*man

=

WC of Preventive maintenance car washer = WC of car washer*quantity*frequency*man

WC of Preventive maintenance tyre changer = WC of tyre changer*quantity*frequency*man

WC of Preventive maintenance two post lift = WC of two post lift*quantity*frequency*man

WC of Preventive maintenance grinder = WC of grinder*quantity*frequency*man

WC of PM vacuum cleaner = WC of vacuum cleaner*quantity*frequency*man

WC of pm per year= 1507

Sr. No.	Equipment	HRS / Month	Qty.	Man	Monthly Man Hrs.	Total Yearly Man Hrs.
1	Nano	3.17	55	1	174	696.67
2	Indica Vista	3.12	22	1	69	274.27
3	Sumo, Grande	3.28	7	1	23	91.93
4	Aria	3.53	3	1	11	42.40
5		4.00	2	1	8	96.00
6	Crew Cab Facelift	3.12	2	1	6	24.93
7	Winger	3.57	2	1	7	28.53
8	Ace Magic	3.45	6	1	21	82.80
9	Fire Tender	3.87	2	2	15	61.87
10	Escort Mobile Crane	2.92	1	2	6	23.33
11	Mitsubishi Tractor	2.50	3	1	8	30.00
12	Elgi Car Washer	1.27	1	1	1	5.07

13	Tyre Changer	1.22	1	1	1	14.60
14	Two post lift	1.23	1	1	1	14.80
15	Pedestal Grinder	0.87	1	1	1	10.40
16	Vacuum cleaner	0.78	1	1	1	9.40
A		**41.88**	**110**		**353**	**1507.00**

Work Content of PM

B. Washing and cleaning

Total No of vehicles= 102

Nano=55, indica=22, sumo=7, Aria=3, Cab Crew facelift=2, Winger=2, Ace Magic=6, Fire tender=2, Mobile crane=1, tractor=3, car washer=1, tyre changer=1, two post lift=1, Grinder=1, vacuum cleaner=1

Frequency= monthly

WC of cleaning and washing = WC of washing*quantity*frequency*man

Wc of Nano per year = WC *freq*man*quantity

= 146.67

WC of indica per year = WC*freq*man*quantity

= 58.67

WC of sumo per year = WC*freq*man*quantity

= 23.33

WC of aria per year = WC*freq*man*quantity

=10+36

WC of cab crew facelift per year= WC*freq*man*quantity

= 6.67

WC of winger per year=WC*freq*man*quantity

= 8

WC of ace per year= WC*freq*man*quantity'

= 16

WC of fire tender per year =WC*freq*quantity

= 8

Sr. No.	Equipment	HRS / Month	Qty.	Man	Washing in Hrs/year
1	Nano		55	1	146.67
2	Indica Vista		22	1	58.67
3	Sumo, Grande		7	1	23.33
4	Aria		3	1	10.00
5			2	1	→
6	Crew Cab Facelift		2	1	6.67
7	Winger		2	1	8.00
8	Ace Magic		6	1	16.00
9	Fire Tender		2	2	8.00
10	Escort Mobile Crane		1	2	-
11	Mitsubishi Tractor		3	1	
12	Elgi Car Washer		1	1	
13	Tyre Changer		1	1	
14	Two post lift		1	1	
15	Pedestal Grinder		1	1	
16	Vacuum cleaner		1	1	
A		**0.00**	**110**		**277.33**

WC of cleaning and washing

Total Wc of Cleaning and washing per year= 277.33 hrs.

C. Oil Change

Total No of vehicles= 102

Nano=55, indica=22, sumo=7, Aria=3, Cab Crew facelift=2, Winger=2, Ace Magic=6, Fire tender=2, Mobile crane=1, tractor=3, car washer=1, tyre changer=1, two post lift=1, Grinder=1, vacuum cleaner=1

Frequency= Yearly

Wc of Nano per year = WC *freq*man*quantity

= 567.88

WC of indica per year = WC*freq*man*quantity

= 239.80

WC of sumo per year = WC*freq*man*quantity

= 86.63

WC of aria per year = WC*freq*man*quantity

=38.93

WC of cab crew facelift per year= WC*freq*man*quantity

= 24.45

WC of winger per year=WC*freq*man*quantity

= 23.40

WC of ace per year= WC*freq*man*quantity'

= 63.90

WC of fire tender per year =WC*freq*man*quantity

= 15.45

WC of mobile crane per year= WC*freq*man*quantity

= 8.45

WC of tractor per year= WC*freq*man*quantity

= 37.95

WC of car washer per year= WC*freq*man*quantity

= 4.15

Sr. No.	Equipment	Time (hrs)	Qty.	Man	Total Yearly ManHr
1	Nano	6.9	55	1.5	567.88
2	Indica Vista	7.3	22	1.5	239.80
3	Sumo, Grande	8.3	7	1.5	86.63
4	Aria	8.7	3	1.5	38.93
5	Crew Cab Facelift	8.2	2	1.5	24.45
6	Winger	7.8	2	1.5	23.40
7	Ace Magic	7.1	6	1.5	63.90
8	Fire Tender	5.2	2	1.5	15.45
9	Escort Mobile Crane	5.6	1	1.5	8.45
10	Mitsubishi Tractor	4.2	3	1.5	37.95
11	Elgi Car Washer	1.4	1	1.5	4.15
B		**70.5**	**104**		**1110.975**

Oil changing WC of different types of vehicle

Total Wc of Oil change service per year= 1111 hrs.

D. Part Repair

Total No of vehicles= 102

Nano=55, indica=22, sumo=7, Aria=3, Cab Crew facelift=2, Winger=2, Ace Magic=6, Fire tender=2, Mobile crane=1, tractor=3, car washer=1, tyre changer=1, two post lift=1, Grinder=1, vacuum cleaner=1

D	Requirement of Time for Part Repair	Man Hr/yr
1	Time for Nano Repair	1532.40
2	Time for Indica Vista Repair	838.97
3	Time for Sumo, Grande Repair	304.20
4	Time for Aria Repair	15.40
5	Time for Ace Magic Repair	56.70
6	Time for Crew Cab Facelift Repair	11.20
7	Time for Winger Repair	10.29
8	Time for Fire Tender Repair	5.47
9	Time for Escort Mobile Crane Repair	0.53
10	Time for Mitsubishi Tractor Repair	1.95
D		2777.12

Part Repair WC per Year

Total WC of part repair= 2777.12

E. Total WC generated Per year= PM + cleaning + oil change + part repair

= 5672hrs

F. Available man hours per year= total working day*available time per shift

= 300*(470/60)

= 2350hrs.

G. Daily Requirement of manpower = total WC per year/Available man hours per year

= 3+1 (1 Extra manpower to handle Veh BD outside TML)

Material handling Equipment

Activities

1. **Preventive maintenance** Also known as PM. Carried out every month to prevent vehicle from breakdown in the future. PM has defined check points and worker check vehicles against those points. PM check points are divided into 4 categories monthly, quarterly, half yearly, and yearly.
2. **Break Down maintenance:** Repairing of equipments if they don't work.
3. **Other activity:** Shop inspection is included in other activity. Every day 2 workers go to different shop to inspect the vehicle and charging points and repair the vehicles if any problem is found.

Manpower Calculation

In case of positional activities the manpower was determined as per the user requirement or through analysis.

For the other activities,

Manpower = Average time (considering 10 readings) / Total Available time (470 min).

A. Preventive Maintenance

Total No of Equipment= 102

Forklift=56, jost=27, Voltas Stacker=11, Dock=12

WC per Pm taken from Log book = 4.29

Total no. of PM conducted in a month = 66

No. of Pm per day = 2.64

WC of PM per Day = WC per PM * Frequency

= 4.29*2.64

= 11.326

B. Breakdown Maintenance

Total No of Equipment= 102

Forklift=56, jost=27, Voltas Stacker=11, Dock=12

WC per BD taken from Log book = 3.39

Total no. of BD occurred in a month = 138

No. of BD per day = 5.52

WC **BD** per Day = WC per PM * Frequency

= 3.39*5.52

= 18.713

C. Shop Inspection

WC of shop inspection per day= 2.5

Man per day = 2

Frequency per day =1

Total WC of shop inspection per day= WC*man*frequency

= 2.5*2*1

= 5hrs.

D. Total WC generated per day= WC of PM + WC of BD + WC of Shop Inspection

= 11.326+18.713+5

= 35hrs.

E. Daily requirement of manpower=Total WC generated per day/available time per day

= 35/ (470/60)

= 5+1 **(Extra manpower For Equipments movement)**

Non-manufacturing area maintenance

Activities

1. **Preventive maintenance:** Also known as PM. Carried out every month to prevent machines from breakdown in the future. PM has defined check points and worker check machines against those points. PM check points are divided into 4 categories monthly, quarterly, half yearly, and yearly.
2. **Break Down maintenance:** Repairing of machines is included in breakdown maintenance

Manpower Calculation

In case of positional activities the manpower was determined as per the user requirement or through analysis.

For the other activities,

Manpower = Average time (considering 10 readings) / Total Available time (470 min).

A. Preventive Maintenance

Avg time to conduct 1 PM = 44.12 min

Total no. of machines = 105

Frequency = monthly

WC of Pm Per month= avg time to conduct PM*Total Machines*frequency

= (44.12*105*1) min

= 4633min

B. Travelling time to conduct PM

Worker has to travel 31 times in a month to conduct PM

Sr no.	Destination	Distance		Time
		M	KM	Minute
1	TMLD	1515	1.5	3.0
2	HDT	920	0.9	1.8
3	Coil storage	2280	2.3	4.6
4	Canteen	530	0.5	1.1
5	Paint Canteen	300	0.3	0.6
6	Tcf Canteen	470	0.5	0.9
7	Vendor Canteen	640	0.6	1.3
8	Admin	1190	1.2	2.4
9	Boom Barrier	580	0.6	1.2
10	Main gate	1300	1.3	2.6
11	Weighing Bridge	1400	1.4	2.8

Distance from cms to diff areas inside plant

Total WC generated in travelling = 590.66min

***Assumptions**

1. **2min is considered as an Avg for a worker to board a bus and reach Pm area.**
2. **15min is considered as an avg bus waiting time.**

C. Breakdown maintenance

Total WC generated in 13 months = 18584min

Total WC generated in a month = 1429min

Total WC generated per day = 57 min

Total WC generated per shift= 19.6 min

***Assumptions**

1. **For breakdown maintenance positional manpower are required for all shift**
2. **Max manpower required for a breakdown is 4 since 4 manpower are already allocated in breakdown maintenance so bigger breakdown can be addressed in a single day**
3. **Since WC per day of Breakdown maintenance is very less, BD manpower should also help to conduct PM**

Total Manpower = 1+1+1+1

= 4

Electronics Lab

Activities

Repair

1. **Troubleshooting:** Identifying the problems and repairing of parts is known as troubleshooting in electronics lab.

2. **Cold test :** Testing of parts in test rigs is known as cold test.

3. **Preventive maintenance**: Also known as PM. Carried out every month to prevent machines from breakdown in the future. PM has defined check points and worker check machines against those points.

Manpower Calculation

In case of positional activities the manpower was determined as per the user requirement or through analysis.

For the other activities,

Manpower = Average time (considering 10 readings) / Total Available time (470 min).

A. Repair

Total no. of parts that are repaired in a day= 5

Steps

1. Trouble shooting

   Avg WC in troubleshooting= 240min

   Total WC in troubleshooting= Avg WC*No. of parts

   = 240*5

   = 1200min per day

2. Cold test

Avg WC in cold test= 30 min

Total WC in Troubleshooting= Avg WC*No. of parts

= 30*5

= 150 min per day

Sr No.	Activities	Avg Time in Min	No. Of Manpower	Frequency/day	Total Time/Day
1	Troubleshooting	240.00	1.00	5.00	1,200.00
2	Cold Test	30.00	1.00	5.00	150.00
		Total Generated WC/Day			*1,350.00*

B. Preventive Maintenance

Wc of Ultra sonic cleaning machine Per Month= 46 min

Wc of EIE incubator Per Month= 54min

WC of ATE per Month= 41 min

WC of DC Power Supply per Month= 46 min

WC of 802D jig Per Month= 74min

WC of Allen Bradley Jig per Month= 74 min

Wc of Siemens test jig Per Month= 74 min

Wc of Mitsubishi test jig Per Month= 74 min

Total Generated WC per month = Sum of WC of PM

= 483 min

Total Generated WC Per Day= WC generated per month/25

= 19.32

Sr No.	Activities	Avg Time in Min	No. Of Manpower	Frequency/day	Total Time/Day
1	EIE Incubator Model-201	46.00	1.00	0.04	1.84
2	Ultra sonic cleaning Machine	54.00	1.00	0.04	2.16
3	ATE	41.00	1.00	0.04	1.64
4	DC Power Supply 12 KW	46.00	1.00	0.04	1.84
5	802D Jig	74.00	1.00	0.04	2.96
6	Allen Bradley Jig	74.00	1.00	0.04	2.96
7	Siemens Test Jig	74.00	1.00	0.04	2.96
8	Mitsubishi Servo Jig	74.00	1.00	0.04	2.96
		Total Generated WC/Day			*19.32*

Wc of PM of electronics lab equipments

C. Total generated WC per day in Electronics lab= WC repair + WC PM

= 1200+150+19.32

= 1369.32 min per shift

Total WC Generated Per Shift= Total Generated WC of Electronics Lab/3

= 1369/3

= 457 min per shift

D. Manpower Per Day= 1+1+1

= 3

Motor Repair and CCTV

Activities

1. **Motor Repair:**
2. **CCTV PM**
3. **CCTV Repair**

Manpower Calculation

In case of positional activities the manpower was determined as per the user requirement or through analysis.

For the other activities,

Manpower = Average time (considering 10 readings) / Total Available time (470 min).

1. Motor Repair:

Total no. of parts received per day= 1.26

Motor Repair				
1	Receive Motor In Electronics Lab	1.00	1.26	1.26
2	Fill Up Request Form	1.00	1.26	1.26
3	Check The Motor through Multimeter	2.00	1.26	2.51
4	Dismantle	10.00	0.37	3.67
5	Bearing Change and Cleaning	15.00	0.37	5.50
6	Motor Clean and Grease	10.00	0.37	3.67
7	Assemble	10.00	0.37	3.67
8	Test of Repaired Motor	1.00	0.37	0.37
		Total Generated WC/Day		*21.89*

Total Generated WC per day= 21.89

2. CCTV PM

AMC

3. CCTV Repair

AMC

Manpower Summary for CMS Sanand Plant

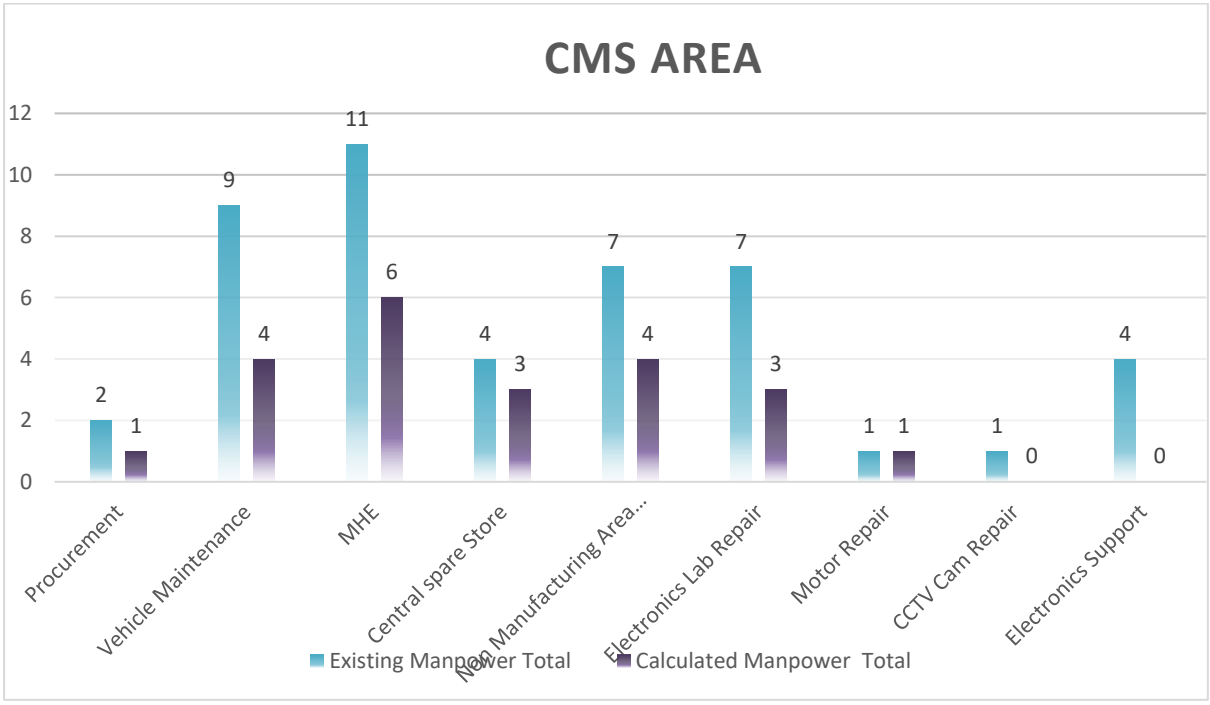
Sr, No.	Area	Existing Manpower					Calculated Manpower				
		A	G	B	C	Total	A	G	B	C	Total
1	Procurement	-	2	-	-	2	-	1	-	-	1
2	Vehicle Maintenance	-	9	-	-	9	-	4	-	-	4
3	MHE	4	2	5	-	11	3	-	3	-	5
4	Central spare Store	2	1	1	-	4	1	1	1	-	3
5	Non-Manufacturing Area Maintenance	1	4	1	1	7	2	-	2	-	4
6	Electronics Lab Repair	3	-	3	1	7	1	1	1	-	3
7	Motor Repair	-	1	-	-	1	-	1	-	-	-
8	CCTV Cam Repair	-	1	-	-	1	-	-	-	-	-
9	Electronics Support	2	-	2	-	4	-	-	-	-	-

Total Manpower	**12**	**20**	**12**	**2**	**46**	**7**	**8**	**7**		**22**

Absenteeism = 10% of total Calculated Manpower

= 3

Total Calculated Manpower including Absenteeism= 25



MQ-Paint

Paint MQ manpower is deployed along the Production line and they are responsible to check the quality of the product produced by the line

Activities:

1. **PT Loading:** Inspection of Properly locking of the BIW body in skid before entering in ED tank and inspection of the quality of BIW body.
2. **ED inspection:** Inspection of Car body after ED operation.
3. **Sealer line:** Inspection of white sealer melt sheets and grommets after sealer application.
4. **Sanding Line:** Inspection of car body after sanding operation.
5. **Polishing line:** Inspection of car body after polishing operation and ensuring proper polishing of vehicle.

Manpower Calculation:

In case of positional activities the manpower was determined as per the user requirement or through analysis.

For the other activities,

Manpower = WC (Most) / Takt time (available time).

Sr. No.	Line	WC (Most)	Manpower	
			Takt time	Line 1
1	PT loading		62	
2	ED inspection		128	
3	Sealer line		128	
4	Sanding Line		128	
5	Polishing Line		128	
	Total(for 2 shift operations)			

Total Manpower For MQ paint=

Contribution:

Areas Covered	Existing Manpower	Calculated Manpower
Warranty Shop	9	7
Product & Process Audit	20	10
CMM	9	8
CMS	46	25
MQ paint	-	-
Total	84	50

Manpower Saving=84-50=34

Total cost saving Per Year=34*15000*12=6120000

Conclusion

This internship has been an excellent opportunity for me. It served me with the best knowledge of working in this field. The training has helped me to bridge the gap between theory and practical. My allotment to PSD made me experience how both working in an office as well as the shop floor is like. It gave me an in-depth exposure to the various aspects of an automobile company. I learned about manpower estimation, Contract Guide cost estimation, MOST® analysis, Time study, etc. Now I have got an insight about how a fortune 500 company does its labour productivity monitoring and improvement.

I am now better equipped with skills and knowledge which would help me in the future. This important learning will be very helpful in the days to come.

Moreover Manpower is one of the biggest costs in an automobile industry. My project study that covered only five areas has resulted in cost savings of around 61 lakh rupees. And in almost every area covered there has been excess manpower. So these types of studies should be done on every area to remove the manpower that is surplus. This will lead to significant cost savings for the plant.

Also efforts should be made by TATA motors to retain the skilled operators. Frequent changes in manpower have led to quality issues. Therefore skilled Manpower should be retained which will lead to cost increase in the near term but will be beneficial to the company in the long run.

Glossary

PWT –Power train shop

BIW- Body in white shop

TCF- Trim, chassis and fitment shop

CQ- Customer Quality

CQ-Central quality

CPA-Customer Product Audit

VLO-Vehicle Layout Audit

CMM-Coordinate Method Machining

CMS-Central Maintenance Service

MHE- Material Handling Equipment

WC- Work content

CT-Cycle Time

MOST- Maynard operation sequence technique

PVBU-Passenger vehicle business unit

MOP-Measurement of performance

TMLD- Tata Motors logistics division.

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