IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE)
e-ISSN: 2278-1684,p-ISSN: 2320-334X, Volume 12, Issue 4 Ver. III (Jul. - Aug. 2015), PP 01-06
www.iosrjournals.org

Productivity Improvement in Assembly Line of an Automobile Industry

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Abstract : *Many factors are responsible in the successful operation and efficient working of a unit. To govern these factors work techniques are discovered. This gives an exposure to two of the technique employed in the production unit for calculation of time & motion involved and optimization Along with this it helps in a better understanding of an assembly line at the grass root level, realizing the complexity of the system & how difficult it is to just manage a production process let alone improvise it. The analysis of the listed techniques is implemented on two units –ADHITYA AUTOMOTIVES APPPLICATION PVT LTD, Lko and TATA MOTORS, Lko. Production of parts and an assembly in the units have been studied in the project with regard to the guidelines of the techniques. The aim of the project is to compare the result of both time &motion study and to bring out which of the study is utmost beneficial in calculation of time involved in assembling of the vehicles. Also on the improvement techniques of production which are responsible for worker fatigue and time loss. Thus enhancing productivity and heading towards optimization. In this Project we have tried to improve the productivity with minimizing time and distance of worker. The graph is plotted between the Motion v/s Distance & Motion v/s Time. A Relation is established between the two and then a minimized time and distance is calculated. The result which comes out after the calculation is a large difference in reduction of distance and time of worker.*

Keywords: *time &motion study, productivity, time and distance study, assembly line*.

I. I Introduction

1.1 Productivity :

The rate at which a company produces goods or services in relation to the amount of materials and number of employees needed. This is usually expressed in ratios of inputs to outputs. That is (input) cost per (output) good/service. For calculation purpose, expression of productivity is -:

Productivity = Output/ Input

1.1.1 :Input may be Classified as:

- Material, Machine, Man Hours, Methods, Land.

1.1.2: Output may be classified as:

- Parts & product, Services, Wastage of any type, Pollutants of any type, etc

It is quantitative relationship between what we produce and what we have spent to produce. Productivity is nothing but reduction in wastage of resources like men, material, machine, time, space, capital etc. It can be expressed as human efforts to produce more and more with less and less inputs of resources so that there will be maximum distribution of benefits among maximum number of people.

1.3: Roles and Responsibilities in the project:-

- Measures and monitoring of productivity.
- Work system design, assessment and resource requirement.
- Measures and monitor productivity of plant, cascading of targets and facilitate achievements of targets.
- Based on strategy and organization structure define organizational process, systems, work flow for attaining of plant's objectives.
- Based on the above, defined work content and role of each position.
- Study area wise resource requirement in line with productivity targets and work assessment.
- Recommendation of manpower nos. Along with the skill and competency requirement for management approval.

1.2 Objectives

1.2.1 Time Study

Time Study is a work Measurement technique which is involved to calculate the time of the operation in an assembly line with the help of an instrument (stopwatch).

- Initially calculating the time of the fitments in units (Adithya Automotive Applications Pvt Ltd / TATA MOTORS, Lucknow).
- Preparation of summary sheet.

1.2.2 Work Study

A generic term for all those techniques which are used in the examination of human working all its context and which lead systematically to the investigation of all the factors which effect the efficiency and economy of the situation being reviewed in order to effect the improvement. Basically it's a productivity raising technique by finding out the actual work content of a process and reduces it by proposing suitable improvements. It has two basic components viz:

a. Method Study b. Work Measurement

1.2.3 Motion Study

Motion study is a technique of analyzing the body motions employed in doing a task in order to eliminate or reduce ineffective movements and facilitates effective movements.

- By using motion study and the principles of motion economy the task is redesigned to be more effective and less time consuming.
- Objective of motion study is job simplification so that it is less fatiguing and less time consuming.

1.3. Productivity Improvement Techniques

Productivity improvement techniques can be applied effectively in enterprises of any size, from one-person companies to corporations with thousands of staff.

- JIDOKA , HEIJUNKA, KAIZEN, JIT, KANBAN, POM

II. Studies At Tata Motors

2.1 Movement Description Chart

Sl. No.	TASK	MOVEMENT	DISTANCE(m)	TIME(SEC)
1	accelerator pedal is picked from the rack and placed on the work table	0-1,1-0	21.6	25
2	stopper is picked from the rack and placed on the work table	0-2,2-0	18	16
3	stopper cap is picked from the rack and placed on the work table	0-3,3-0	12	12
4	stopper cap is mounted upon the stopper	operation	0	3
5	stopper cap is assembled on the front end of the accelerator pedal	operation	0	10
6	stopper cap is tightened by a spanner	operation	0	3
7	stopper cap is assembled on the back end of the accelerator pedal	operation	0	10
8	stopper cap is tightened by a spanner	operation	0	3
9	ball and ball end are picked from the rack and placed on the work table	0-4,4-0	19.2	20
10	pin is removed from the ball end and ball is put into it	operation	0	5
11	pin is put back into the ball end	operation	0	2
12	ball end subassembly is put into the accelerator pedal end	operation	0	3
13	ball end is hand tightened into the accelerator pedal	operation	0	2
14	accelerator pedal subassembly is picked from the work table and placed on the subassemly rack	0-5, 5-0	2.4	10
			73.2	124

Total Movement During Accelerator Pedal Sub Assembly = 73.2m

2.2 Time Description Sheet

Sl. No.	TASK	MOVEMENT	DISTANCE(m)	TIME(SEC)	VA/NVA
1	accelerator pedal is picked from the rack and placed on the work table	0-1,1-0	21.6	25	NVA
2	stopper is picked from the rack and placed on the work table	0-2,2-0	18	16	NVA
3	stopper cap is picked from the rack and placed on the work table	0-3,3-0	12	12	NVA
4	stopper cap is mounted upon the stopper	operation	0	3	VA
5	stopper cap is assembled on the front end of the accelerator pedal	operation	0	10	VA
6	stopper cap is tightened by a spanner	operation	0	3	VA
7	stopper cap is assembled on the back end of the accelerator pedal	operation	0	10	VA
8	stopper cap is tightened by a spanner	operation	0	3	VA
9	ball and ball end are picked from the rack and placed on the work table	0-4,4-0	19.2	20	NVA
10	pin is removed from the ball end and ball is put into it	operation	0	5	VA
11	pin is put back into the ball end	operation	0	2	VA
12	ball end subassembly is put into the accelerator pedal end	operation	0	3	VA
13	ball end is hand tightened into the accelerator pedal	operation	0	2	VA
14	accelerator pedal subassembly is picked from the work table and placed on the subassemly rack	0-5, 5-0	2.4	10	NVA
			73.2	124	

Total Time Taken=124 Sec Value Added Time=41sec Non Value Added=83sec

Final Analysis

sl. No.	TASK	MOVEMENT	DISTANCE(m)	TIME(sec)	VA/NVA
1	trolley is taken from the stand to accelerator pedal rack	0-1	2.4	3	NVA
2	accelerator pedal are taken from the rack and kept on to the trolley	operation	0	35	NVA
3	trolley is taken to the ball and ball end rack	1-4	1.8	2	NVA
4	ball and ball end are are taken from the rack and kept upon the Spare hold	operation	0	20	NVA
5	trolley is taken to the stopper rack	4-2	0.6	1	NVA
6	stoppers are are taken from the rack and kept upon the Spare hold	operation	0	25	NVA
7	trolley is taken to the stopper cap rack	2-3	7.2	6	NVA
8	stopper caps are are taken from the rack and kept upon the Spare hold	operation	0	20	NVA
9	trolley is taken back to the stand	3-0	20	15	NVA
10	accelerator pedal is kept upon the work area of the trolley	operation	0	20	VA
11	stopper caps are picked from spare hold and kept upon the work area of the trolley	operation	0	20	VA
12	stoppers are picked from spare hold and kept upon the work area of the trolley	operation	0	20	VA
13	stopper caps are put upon the stoppers and nuts are put	operation	0	20	VA
14	stoppers are assembled on the accelerator pedal and tightened by spanner	operation	0	20	VA
15	ball and ball end are are picked from the Spare hold and kept on the work area of the trolley	operation	0	30	VA
16	pin is removed from the ball end and ball is inserted into it	operation	0	100	VA
17	pin is put back on the ball end	operation	0	30	VA
18	ball and ball end are assembled on to the accelerator pedal and is hand tightened	operation	0	100	VA
19	the complete accelerator pedal assembly is kept back upon the spare hold	operation	0	20	VA
			32	507	

TOTAL TIME= 507sec Non Value Added= 127sec Value Added= 380sec

Before Sub Assembly (Table Was Used) (Trolley In Use)

Before **After**

Motion Reduction	73.2 m	32 m
Time Reduction	124 Sec	51 Sec
Space Reduction	Subassembly table was stopped to be used	Introduction of movable trolley reduced space
Fatigue Reduction	High Fatigue due to high movement	Fatigue reduced due to movement reduction
Improved Ergonomics	Worker had to bend to pick up parts	Part kept at the level of worker
Improved Quality	Metal to metal contact between parts	Metal to metal contact reduced

III. Result Analysis And Discussion

The percentage decrease in time by the above study is

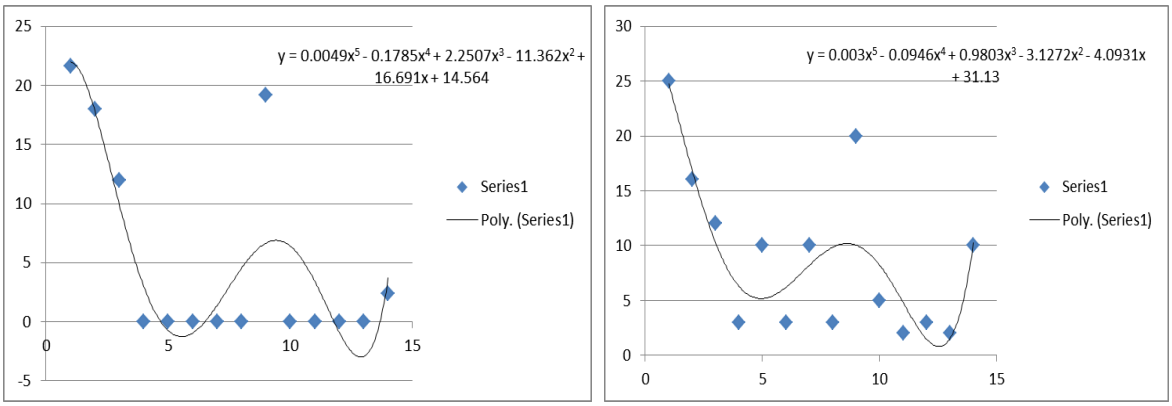
= (124 - 51)/124 x 100

= 58.3%

The percentage decrease in the motion of the worker is

= (73.2 – 32)/73.2 x100

=56.3%



(Here graph distance variation graph is ploteed with the help of collected data).

(On differiating the equation mentioned above and equalisisng that equation to zero,we get):

X=1.0026 **X=-0.519**

Where negative sign shows the reduction in time.

This shows that Time and Motion Study is the best Study for the calculation of Work and time and the content optimizes the enhancement in the productivity.

Hence we saved a total time of <u>73secs</u> and reduced the motion up to <u>38 m.</u>

(This finally leading to new method to improve our production.)

Iii Studies At Adithya Automotive Applications Pvt. Ltd.

Before:

Fixture used for the Tack Welding (BEFORE)

After studying the time for the tack welding of side board sub assembly frame we found that time calculated was **111 mins.**

After:

Fixture used for tack welding of 12, 14, 16 and HD model Tipper Vehicles

When the improvements were made in the fixture the calculated time was found to be **45 mins.**

	BEFORE	AFTER
Time Reduction	**111 mins**	**45 mins**

IV. Result Analysis And Discussion

Hence percentage reduction in time is given as

= (111-45)/111 x100

= 59.45%

IT, show that up to **60%** time is reduced with the advancement in fixture which increased the production of Tippers from **30 to 75** Tippers in the month.

V. Problems And Suggestions

1.5 Tata Motors

Problem 1: When the accelerator pedal assembly was done the worker has to travel more distance to collect the accelerator pedal parts and 5S was not maintained on the sub-assembly table.
Suggestion: An accelerator pedal sub assembly trolley was made to reduce the motion of worker and 5S was maintained on the table hence productivity improved.
Problem 2: Time required for the assembly of the accelerator pedal was more and there were more Non Varying Activities.
Suggestion: Using a trolley reduced the motion of worker as well as improved ergonomics and fatigue was also reduced.

1.6 Aaditya Automotives Applications Pvt Ltd

Problem 1: The table was used for side board tack welding; it was only for 12 cubic meter tipper model. Workers were having a difficulty in placing the side board on the table too.
Suggestion: A new fixture was designed to do tack welding for 12, 10, 14, and heavy duty vehicles with different.
Problem 2: It consumes more time for side board tack welding table as there were no holding devices.
Suggestion: According to the design of new fixture the time required for the side board tack welding was reduced with a huge difference.

VI. Conclusion

The purpose of this project was to give the idea of basic functioning of real industry. This PROJECT has not only given an exposure to various techniques employed in production units but also has added the new dimension to vision of knowledge. It has given the basic idea of the working of an industry and core of every industry lie in its fundamentals MAN, MACHINE AND MATERIAL and how the cohesion between them is needed for the smooth running of nay industrial organization. TIME has acted as the main factor to be studied.
It is therefore concluded from the study that TIME STUDY AND WORK STUDY are the techniques which can be used to increase the productivity.
Also, the result shows a big fraction of time is being saved, hence saving time is saving money.

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