

**Productivity Improvement of Manufacturing Process of Diesel Engine by Time and Motion Study Method (M.O.S.T. Technique)**Ankit P. Vekariya¹, Ashutosh Kumar²¹P.G. Student, Mechanical Engineering Dept, A.I.T.S, Rajkot, India,²Asst. Professor, Mechanical Engineering Dept, A.I.T.S, Rajkot, India,

Abstract- Work study is most effective tool for any enterprise to determine standard time and increase the productivity. Time and motion study method is useful for simplify the operation and reduction of operation whenever possible. Automation is suitable for mass production but medium size enterprise it is not preferable. So Time and motion study technique is useful for investigation of the process. And by this method we can categorize unnecessary activity and reduce them. This method leads to modify in process layout for effective utilization of machinery and manpower for improving productivity. Work study technique is not limited only to the manufacturing industries but it can also be implemented in various sectors like textile industry, medical sector, bank, service organization and many more. This research work is carried out at Topland Engines Pvt. Ltd.

Keyword - Work study; Time study; Normal time; Productivity; Motion study; Standard time; MOST Technique

I. INTRODUCTION

Work study is simple but one of the most penetrating tools for research. It forms the basis for work system design. The purpose of work design is to identify the most effective means of achieving necessary functions. This work study aims at improving the existing and proposed ways of doing work and establishing standard times for work performance. Work-study is surround by two techniques, method study and work measurement.

There is a close link between method study and work measurement. Method study is concerned with the reduction of the work content and establishing the one best way of doing the job where as work measurement is concerned with investigation and reduction of any ineffective time associated with the job and establishing time standards for an operation carried out as per the standard method. [17]

A. Time Study Method:

Work measurement technique is known as time study method. The application of these techniques is to establish the time for a qualified worker to carry out a specified job at a defined level of performance. [17]

This method is carried out by following steps. [18]

1. Select the work to be study.
2. Breakdown the operation into elements.
3. Measure the time by means of a stop watch taken by the operator to perform each element of operation. Either continuous method or snap back method of timing could be used.
4. At the same time assess the operator's effective speed of work relative to the observer's concept of normal speed. This is called performance rating.
5. Adjust the observed time by rating factor to obtain normal time for each element. Normal time is calculated by below formula.

$$\text{Normal time} = \text{Observed time} \times \text{Performance rating} \dots\dots\dots (1)$$

Sum the normal times for each element to develop a total normal time for the task.

6. Determining the allowances to be made over and above the normal time for operation. Allowance is personal time allowance, fatigue allowance, delay allowance or any other allowance.
7. Determining the standard time for the operation.

Determining the standard time is,

$$\text{Standard time} = \text{Normal time} \times (1 + \text{Allowance fraction}) \dots\dots (2)$$

With the use of time and motion study method got a normal and standard time for carrying an operation.

B. Motion Study Method:

Motion study method is a part of work study. Method study is the systematic recording and critical examination of existing and proposed ways of doing work as a means of developing and applying easier and more effective methods, and reducing costs.

The basic approach to method study consists of the following eight steps. [17]

1. Select:

Select the work to be studied and define its boundaries.

2. Record:

Record the relevant facts about the job by direct observation and collect such additional data as may be needed from appropriate sources.

3. Examine:

Examine the way the job is being performed and challenge its purpose, place sequence and method of performance.

4. Develop:

Develop the most practical, economic and effective method, drawing on the contribution of those concerned.

5. Define:

Define the new method, as a result, in a clear manner and present it to those concerned i.e., management, supervisors and workers.

6. Install:

Install the new method as a standard practice and train the persons involved in applying it.

7. Maintain:

Maintain the new method and introduce control procedures to prevent a drifting back to the previous method of work.

II. LITERATURE REVIEW

Time study and motion study technique is useful for improving the productivity. This technique is an effective tool for industry to increasing its productivity. This technique is not limited up to industry but also useful for service area, hospital, private sector. ECR's concept is also applicable in this method. MOST technique is useful to arrange the operation in a proper sequence. It Reduce area of work station and man power requirement and improving utilization of resources and ergonomics also consider with Maynard operation sequence technique. By using this method we get the production time for process before its manufacturing. So it is useful in production planning.

III. PROBLEM DEFINITION

After the analysis of assembly of diesel engine manufacturing unit, it was found that most of works are done manually by workers. Industry does not have any standard time for each operation. Some operation sequences are not proper, that cause time loss.

IV. TIME AND MOTION STUDY METHOD

Time Study is carried out in Industry. In this method all operations are breakdown into elements and measured the time for each element. Then find out performance rating and allowance to set the normal and standard time for the operation.

Table 1.Observed, Normal and Standard cycle time for all department operation

Sr. No.	Department	Observed cycle time in seconds	Normal cycle time in seconds	Standard cycle time in seconds
1	Store and washing department	2,295.34	2,110.21	2,176.13

2	sub assembly department	1,548.66	1,298.06	1,350.20
3	Assembly department	3,645.34	3,292.29	3,408.61
4	Testing department	2,838.67	2,542.65	2,636.30
5	Packing department	4,052.33	3,661.08	3,794.89
Total		14,380.34 sec	12,904.29 sec	13,366.13 sec
		239.68 min	215.07 min	222.76 min

So one observed cycle time for production of one engine is 239.68 minutes, one normal cycle time for production of one engine is 215.07 minutes and one standard cycle time for production of one engine is 222.76 minutes.

In Motion Study method record the relevant facts about the job by direct observation and collect such additional data as may be needed from appropriate sources. Then examined all data and find out alternate method. Finally the new method is installing and maintain.

A. Existing Layout:

In Existing layout there are lots of material movement are there in industry. So travelling distance is improper. So it takes more time from one place to another place.

The existing layout of industry is given in below figure 1.

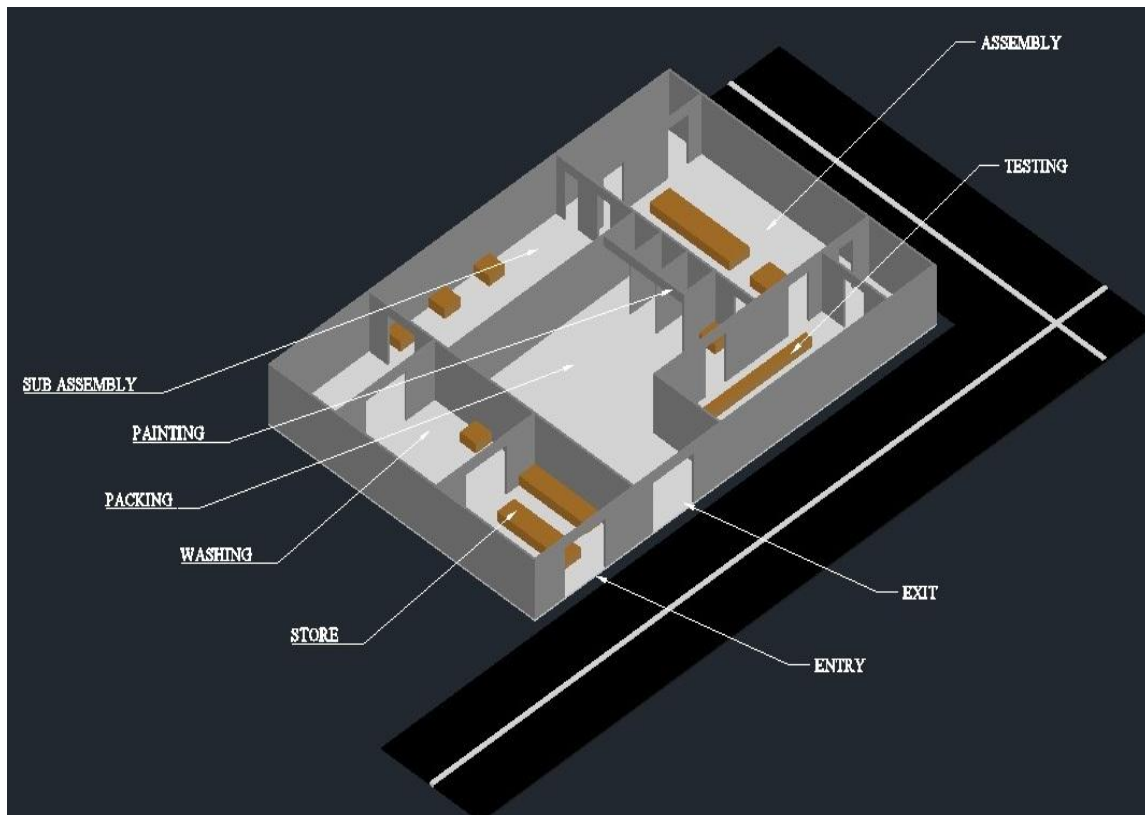


Figure 1.Existing layout of industry

B. Proposed Layout:

This proposed layout is designed that the travelling distance of engine is reduced in industry. Also improve material movements.

The proposed layout of industry is given in below figure 2.

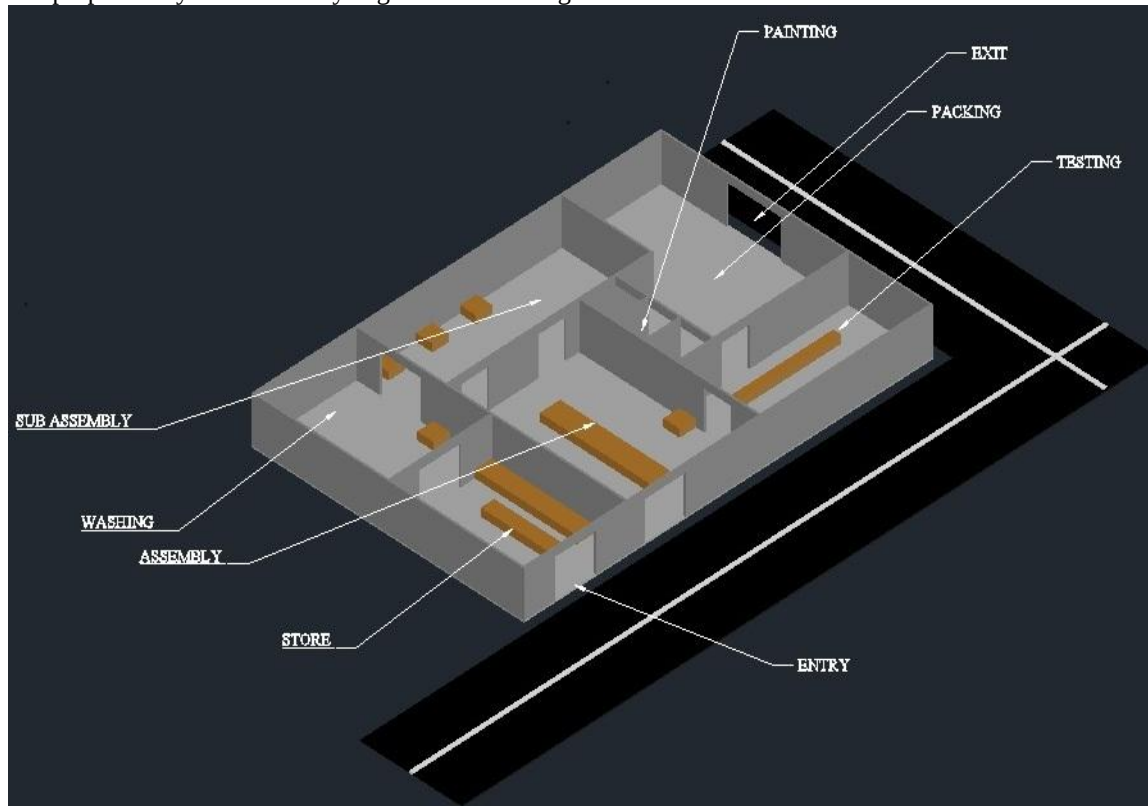


Figure 2.Proposed layout of industry

V. MOST TECHNIQUE

MOST is the latest work measurement technique that can be easily implemented and practically maintained to estimate the standard time and also improve methods which maximize the resource utilization. It was originally developed by H. B. Maynard & Company. This new system was brought into practice in United States in 1975.

This technique has a wide application and successfully applied in all type of industry from ship building, automobile, textile. It can be also applicable in assembly shop, material handling, offices, maintenance and other operation. It is the latest work measurement technique that can be easily implemented and practically maintained to not only estimate the standard time but also improve methods and maximize the resource utilization. [5]

A. MOST Analysis time for all sub assembly department:

In sub assembly department there are seven different departments are there. In all seven department material movement and movement of worker are noted and analysis. So it is possible to do analysis of each and every activity carried by workers in department.

Time taken by MOST analysis for all sub assembly department operation is given below.

Table 2.MOST Time for sub assembly operation

Op. No.	Operation Name	MOST Time in seconds
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1	Crankshaft sub assembly	127.80
2	Governor sub assembly	107.64
3	Rocker box sub assembly	161.64
4	Camshaft sub assembly	227.52
5	C-block sub assembly	133.20
6	C-head sub assembly	267.84
7	Fuel pump sub assembly	94.68
Total Time		1,120.32 sec
		18.67 min

B. Comparison of Time Study Method and MOST Technique:

Observed time is found by Time Study method and MOST technique time is found by MOST analysis of each and every operation. Here clearly shows the difference in Time Study time and MOST time. So the comparison of Time Study time and MOST time is given below.

Table 3.Comparison of time study method and MOST technique for sub assembly department

Op. No.	Operation Name	Time study Time (sec)	MOST Time (sec)	Difference of Time (sec)
1	Crankshaft sub assembly	172.33	127.80	44.53
2	Governor sub assembly	151.67	107.64	44.03
3	Rocker box sub assembly	285.33	161.64	123.69
4	Camshaft sub assembly	306.33	227.52	78.81
5	C-block sub assembly	156.00	133.20	22.80
6	C-head sub assembly	341.67	267.84	73.83
7	Fuel pump sub assembly	135.33	94.68	40.65
Total Time		1,548.66 sec	1,120.32 sec	428.34 sec
		25.81 min	18.67 min	7.14 min

- Time taken by time study method = 1,548.66 seconds (25.81 minutes)
- Time taken by MOST Analysis = 1,120.32 seconds (18.67 minutes)
- Reduction of time in sub assembly department = 428.34 (7.14 minutes)

The total decrease in time by MOST method is

$$= \frac{1,548.66 - 1120.32}{1548.66} \times 100$$

$$= 27.66 \%$$

By using MOST method in sub assembly department we reduce 27.66 % of total assembly time.

C. MOST Time for Assembly Department All Stages:

Time taken by MOST analysis for all assembly department operation is given below.

Table 4.MOST Technique time for assembly line all stages

Op. No.	Operation Name	MOST Time in seconds
1	Crankcase stud fitting	333.7
2	Crankshaft fitting	160.2
3	Connecting rod & Governor assembly	169.56
4	Camshaft, Extension shaft, Crank gear, Fuel pump window fitting	224.64
5	Bumping clearance, Piston inserting, Block inserting	163.08
6	Piston ring, C-block, C-head assembly	215.64
7	Gear cover, Push rod, Rocker box, Atomizer fitting	184.95
8	Gear cover, Oil seal, Tappet setting	178.2
9	Fuel pump fitting, Fuel timing	218.88
10	Flywheel, Oil seal fitting	196.2
11	C-head & C-block leakage checking by hyd. machine	215.64
12	Push rod cover, Rocker cover	146.88
13	Water inlet flange, Window fitting, Water outlet flange	226.08
14	Crankcase leakage checking	175.68
15	TDC marking, Flywheel balancing	160.2
Total Time		2,969.53 sec
		49.49 min

D. Comparison of Time Study Method and MOST Technique:

Table 5.Comparison of time study method and MOST technique for assembly department

Op. No.	Operation Name	Time study	MOST Time	Difference of
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		Time (sec)	(sec)	Time (sec)
1	Crankcase stud fitting	369.33	333.7	35.63
2	Crankshaft fitting	246.33	160.2	86.13
3	Connecting rod & Governor assembly	243.33	169.56	73.77
4	Camshaft, Extension shaft, Crank gear, Fuel pump window fitting	291.67	224.64	67.03
5	Bumping clearance, Piston inserting, Block inserting	226.67	163.08	63.59
6	Piston ring, C-block, C-head assembly	250.67	215.64	35.03
7	Gear cover, Push rod, Rocker box, Atomizer fitting	237.33	184.95	52.38
8	Gear cover, Oil seal, Tappet setting	245.67	178.2	67.47
9	Fuel pump fitting, Fuel timing	234	218.88	15.12
10	Flywheel, Oil seal fitting	226.33	196.2	30.13
11	C-head & C-block leakage checking by hyd. machine	241.33	215.64	25.69
12	Push rod cover, Rocker cover	191.67	146.88	44.79
13	Water inlet flange, Window fitting, Water outlet flange	234.33	226.08	8.25
14	Crankcase leakage checking	205.67	175.68	29.99
15	TDC marking, Flywheel balancing	186	160.2	25.8
Total Time		3,630.33 sec	2,969.53 sec	660.8 sec
		60.51 min	49.49 min	11.01 min

- Time taken by time study method = 3,630.33 seconds (60.51 minutes)
- Time taken by MOST Analysis = 2,969.53 seconds (49.49 minutes)
- Reduction of time in assembly department = 660.8 seconds (11.01 minutes)

The total decrease in time by MOST method is

$$= \frac{3,630.33 - 2,969.53}{3,630.33} \times 100$$

$$= 18.20 \%$$

By using MOST method in assembly department we reduce 18.20 % of total assembly time.

VI. CONCLUSION

In this study, it was observe that Time study method is consuming more time as compare to MOST technique. Using MOST technique the proper operation and its sequence has been found. In proposed method proper material movement and flow of material has been improved. So by time and motion study method and most analysis the overall efficiency improvement is 7.70%.

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