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Increasing Productivity by Reducing Cycle Time in Assembly line of an Automotive Industry using Work Study Techniques

Ashish Kalra
Mechanical Engineering Department
Manav Rachna International University
Faridabad, India

Sachin Marwah
Mechanical Engineering Department
Manav Rachna International University
Faridabad, India

Sumit Sharma
Production Department
Escorts Limited
Faridabad, India

Virender Narula
Mechanical Engineering Department
Manav Rachna International University
Faridabad, India

Abstract: **The paper reflects the study conducted at one of the famous automobile assembly plant in which there are two assembly lines before paint assembly line and after paint assembly line. The study was carried out on before paint assembly line with an aim to reduce the cycle time of different work stations to complete the operation at the assembly line in time. Study was done for each bottle neck operation of before paint assembly line and found that the workers had to carry the parts to assembly line from sub assembly station which involves great deal of time, and at many times, the assembly line had to be stopped to complete the operations. This non-futile time of the workers were reduced by 163 seconds by introducing trolley kits on the before paint assembly line.**

Key words: Automobile assembly plant, Assembly line, Cycle time, Non-futile time, Trolley kits.

1. INTRODUCTION.

1.1 Productivity

Productivity is defined as the ratio between output and input. Where output means the amount produced or the number of items produced and the inputs are the various resources are man, machine, material, time, money, etc. Productivity can also be explained as reduction in resources wastage example men, material, time, machine, capital, etc.

Thus we can write general expression for the productivity as under:-

Productivity = (output / input)

Productivity refers to the production system's efficiency.

Productivity is all about how we utilize our resources i.e. (Man, Machine, Time, Money etc.) in an efficient way.

1.2 Objectives

- To identify all bottle neck operations in before paint assembly line and to reduce the cycle time of the bottle neck operations.
- To reduce fatigue level of the workers.

1.3 Study Methodology

- Conduct process mapping and create process chart for before paint assembly line.
- When process mapping is done identify the time required to complete the different operations on the assembly line for a particular product 439 XL for 30 times at each station on before paint assembly line.
- Identify the bottle neck point from the data collected on the assembly line by comparing the standard time with the observed time.
- Formulate the problem to reduce the cycle time of the operations which are causing assembly line to stop.
- Conduct Method study to understand existing method of doing work and to identify the areas where cycle time can be reduced, develop faster method of doing the same work.
- Conduct trial run for 1 week of new method and collect the data of the bottle neck operations by time study technique and compare the results of old method and new method.
- Recommend new method to the concerns.

1.4 Productivity improvement techniques

The techniques used to increase the productivity on before paint assembly line are work study techniques which include

a) Method study b) Work measurement

Work study

Work study is as an generic term which is particularly used for techniques like Method study and Work measurement which are basically used in examination of the human work in all its context and which lead to investigation of all the factors systematically which affects the efficiency of the situation being reviewed in order to further seek improvements.

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1.4 (a) Method study

Method study aims at finding the best way of doing the work. Method study basically involves systematic investigation, which involves recording and critical investigation of the existing method of doing the job so that easy, fast and which causes less fatigue to the workers, safe, economical way of doing the work can be developed and installed at low cost. This is basically achieved by eliminating the unnecessary motions which are involved in a procedure of doing the work and also the same can also be achieved by changing the sequence of operations or process itself.

1.4 (b) Work Measurement

Work measurement or time study is used to determine the time required to complete the operations by skilled workers by using stop watch.

2. STUDIES AT COMPANY

2.1 Case study:

The company is one of the large scale manufacturer of the automotive tractors and it is desirable that 110 tractors to be assembled daily in a shift of 8 hours but many times around 90% tractors are assembled in a single day. Thus the main goal of the study is to improve the productivity of the shop floor by utilising the concept of work study so that the production target could be met on daily basis.

The work was carried out on before paint assembly line, In this study the concept of work study was used. Cycle time of the different operations were determined without implementing new concept and after implementing new method the motion of the workers were reduced and cycle time was reduced while performing the operations.

2.2 Method study implication:

Problem statement: Assembly line stops at different work stations which reduce the production level form 110 tractors to around 90% of production level of tractors.

Step 1: Determine the sequence of operations create outline process chart of before paint assembly line.

Step 2: Determine the assembly stations in the assembly line which are causing assembly line to stop by comparing the standard time allotted by the organization with the observed time. It was found that 10 stations are responsible for assembly line to stop as these work station takes more time than the allotted time. The 10 stations are listed below in table 1.

Sr. No	Work Stations
1	Tie rod fitment and guide support
2	Fitment of shell support
3	Fitment of water separator bracket
4	Fitment of fuel tank
5	Fitment of Foot rest
6	Fitment of Parking brake
7	Fitment of Brake paddle
8	Fitment of clutch paddle
9	Fitment of footrest LH
10	Fitment of hydraulic lift linkage

Table 1

Step 3: Collect all necessary data about the existing method by critical examination of existing method where assembly line stops or bottle neck situation arises. Outcome from critical examination of the existing method is that movement of material from the sub assembly station and from storage area takes around 20 seconds on an average to the main assembly line where these components will be fitted for single tractor.

Step 4: Now new method of material handling was developed by using kitting trolley in which all the 10 components of the work stations which are causing the assembly line to stop are available on the kitting trolley on the assembly line, which reduces the motion of the workers.

Step 5: New material handling system has been developed and installed into the assembly line and also work forces have been trained and then trial was done for 1 week.

Step 6: Analysed weather new material handling method is followed correctly by workforce and found that in trial of 1 week period performance of work force was enhanced.

Step 7: Time study was done of all the 10 work stations and it was found that by implementation of the new material handling system time required to bring the material from kitting trolley to workstation was reduced by 163 seconds approximately per day per product for assembling 10 parts of the tractors to single.

Daily 163 seconds saved means 2:43 minutes saved for single tractor between the 10 stations which were causing the bottle neck situation.

As daily 15 tractors of such model to be assembled then we save in a day 2445 seconds approximately daily.

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2.3 Time description sheet

After implementing the concept of kitting trolley it carry's item of 10 operations on the before paint shop assembly line before uploading of the chassis and time comparison of before and after implementation of the concept is shown in the time description sheet below in table 2.

Sr.no	Operations	Average time for 30 samples before implementation of concept (in sec)	Average time for 30 samples after implementation of concept (in sec)
1	Tie rod fitment and guide support	115	90
2	Fitment of shell support	45	33
3	Fitment of water separator bracket	47	36
4	Fitment of fuel tank	182	165
5	Fitment of Foot rest	104	80
6	Fitment of Parking brake	80	50
7	Fitment of Brake paddle	55	45
8	Fitment of clutch paddle	140	128
9	Fitment of footrest LH	181	170
10	Fitment of hydraulic lift linkage	124	113
	Summation	1073	910

Table 2

2.4 Distance movement sheet

Table below shows comparison of distance moved by the worker before implementation of the concept and after implementation of the concept on the bottle neck operations.

See table -3

Sr.no	Study Factors	Before	After
1	Motion reduction	29.33 meter	15.63 meter
2	Time reduction	1073 seconds	910 seconds
3	Fatigue reduction	High fatigue due to greater movement	Fatigue reduced due to reduction in movement

Table 4

Sr.no	Work Stations	Steps before	Single step distance	Distance before applying new method	After steps	Single step distance	Distance after material handling technique
1	Tie rod fitment and guide support	14 steps	10 inch	3.55 meter	4 steps	10 inch	1.01 meter
2	Fitment of shell support	12 steps	9.5 inch	2.9 meter	7 steps	9.5 inch	1.68 meter
3	Fitment of water separator bracket	9 steps	10.2 inch	2.33 meter	6 steps	10.2 inch	1.55 meter
4	Fitment of fuel tank	12 steps	12 inch	3.65 meter	5 steps	12 inch	1.52 meter
5	Fitment of Foot rest	13 steps	9.8 inch	3.23 meter	7 steps	9.8 inch	1.74 meter
6	Fitment of Parking brake	6 steps	10 inch	1.52 meter	4 steps	10 inch	1.01 meter
7	Fitment of Brake paddle	15 steps	10.5 inch	4 meter	9 steps	10.5 inch	2.4 meter
8	Fitment of clutch paddle	8 steps	9.5 inch	1.93 meter	5 steps	9.5 inch	1.20 meter
9	Fitment of footrest LH	9 steps	11 inch	2.51 meter	6 steps	11 inch	1.67 meter
10	Fitment of hydraulic lift linkage	12 steps	12.2 inch	3.71 meter	6 steps	12.2 inch	1.85 meter

Table 3

Before

After

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3. RESULT AND CONCLUSION

3.1 Result

Daily 163 seconds saved= 2:43 minutes saved for single tractor between the 10 stations which were causing the bottle neck situation.

And daily 15 tractors of such models are assembled 163*15= 2445 seconds approximately daily.

Percentage decrease in time by above study is
= (1073-910)/1073 x 100 = 15.19%
Percentage decrease in motion of worker
= (29.33 15.63)/29.33 x 100 = 46.70%

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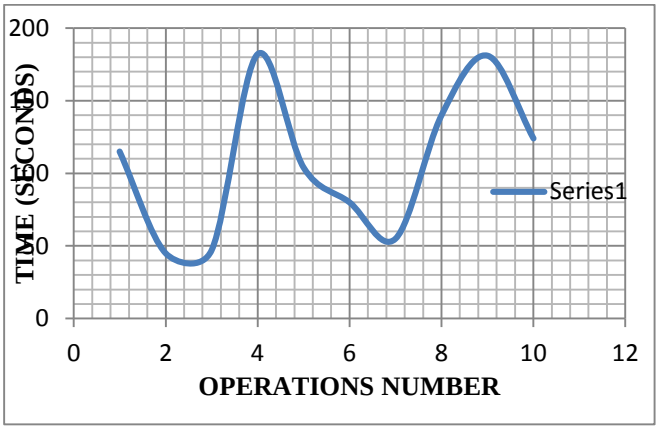
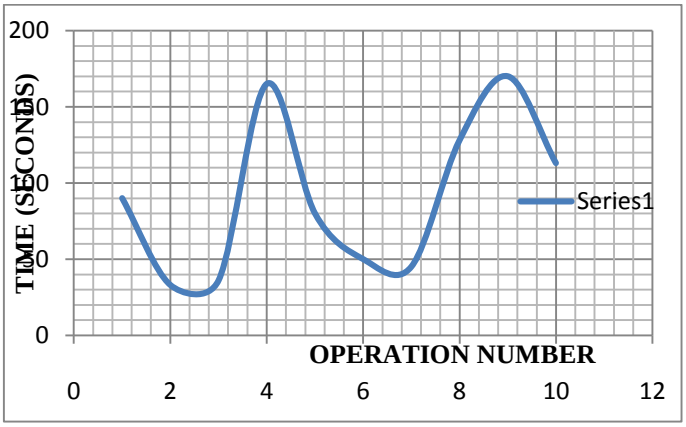


a) Before method average time plot in sec.



b) New method average time plot in sec.

In this study by implementing this concept of kitting trolley we can reduce the cycle time of 10 operations by 2:43 minutes on single tractor and daily around 15 tractors of same model are assembled which means around 2445 seconds approximately saved in a day.

3.2 CONCLUSION

The main objective of this paper is to present ideas to improve productivity which can be used by automobile industry to reduce the cycle time of the bottle neck operations, by utilizing the concept of method study and time study i.e. by work study techniques.

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