

Productivity Improvement by Time Study and Motion Study

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Abstract - Productivity plays an important or major role in a company. There are many reasons for which the productivity decreases and there are various methods to improve productivity. But, choosing which method to use according to the situation is a wise decision. For this project work, thermocole manufacturing plant is considered and analysed. After analysing the plant it was found that there was delay between tasks. The delay between the tasks affecting the production and causing low productivity rate. In order to improve productivity time study and motion study were found to be effective. Time study and motion study are the techniques of work study. Work study is known as highly effective productivity improvement method. Time study means to determine the standard time for doing an operation. Motion study means to simplify job and to develop more economical method of doing work. Determination of standard work cycle times is one of the important step used in work study, which provides critical inputs for improvement activities. After analysis and calculation of the time study and method study data it was found that there were no proper standards maintained and followed in the premises, the tasks were not evenly distributed between the workers, the space was not properly utilized, there were lack of safety measures, lack of performance standards, improper communication, unnecessary wastage of time. After successfully analyzing, proper time standards were considered in the industry which increased the production rate by 48 pieces extra per month in one machine.

Key Words: Time Study, Motion Study, Work Study, Flow Process Chart, Time Standards, Productivity.

1. INTRODUCTION

Productivity is ratio of amount of output produced to the amount of input resources. $\text{Productivity} = \frac{\text{Output}}{\text{Input}}$. The European Productivity Agency (EPA) has defined productivity as, Productivity is an attitude of mind. It is mentality of the progress, of the constant improvements of what which exists. It is the certainty of being able to do better today than yesterday and continuously. It is the constant adaption of economic and social life to changing conditions. Economists define productivity as, Ratio of output to input. Accountants define productivity as, financial ratios or budgetary variances. Behavioural scientists define productivity as, labour utilization. Engineers define productivity as, capacity utilization or production per man hour, manpower efficiency. There are various factors that can influence productivity. The factors are divided into two viz. controllable factors and non-controllable factors. Controllable factors are focused in this work. There are various

controllable factors viz. product, plant and equipment, technology, materials, work methods, management, financial, etc. The factors that are concentrated in this work are technology, human factors, work methods. There are diverse methods to increase productivity. But, choosing the proper and appropriate method according to the scenario is very crucial. Choosing the proper method/s is dependent on the problem statement of the project. The problem statement delay in the operation cycle. The problem statement in the work can be controlled by proper method study and time study. Method study or time study are the categories of work study. Work study is known as highly effective productivity improvement method. British Standard Institution defines work study as a generic term for those techniques particularly "Method Study" and "Work Measurement" which are used in the examination of work in all its contexts and which leads systematically to the investigation of all the factors which affect the efficiency and economy of the situation being reviewed in order to incorporate improvements at various levels. 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. Work measurement/Time study is the application of techniques designed to establish the time for a qualified worker to carry out a specified job at a defined level of performance. In this work the time study is done using the stop watch will be used for measurements. The main purpose of method study is to eliminate the unnecessary operations and to achieve the best method of performing the operation. A thermocole manufacturing industry was analysed in this work. The work is concentrated on the mould machines. There are total 7 mould machines and each mould machine manufactures different product. Each mould machine takes different time as the products are different. Some mould machine makes 2 pieces per cycle. After successful analysis of time study and method study, it was seen that there was a proper need of time standards to be followed. The time standards were calculated with the help of motion study and these standards were implemented in the premises causing to increase the production rate.

2. MOTION STUDY

The Fig. 1 shows the process chart in which the raw material to the finished product journey is shown. The raw material enters the pre expander machine where it pre expands to the required density.

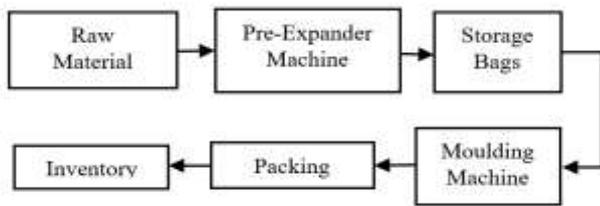


Fig -1: Process Chart

The after proper check of density, the material is transferred and stored in the storage bags through which the machine gets the material. Moulding machine takes material from the storage bags and then the product is manufactured in the moulding machine. Once the product is done in the moulding machine it is transferred to the packaging area, where it gets packed and ready to dispatch. There are total seven moulding machines. The flow process chart is shown for one machine and is approximate to other machines. Then the material is stored in the inventory till dispatch. The detailed process flow chart is shown below with symbols and timing of operation. The flow process chart is approximately calculated. It can change from machine to machine and as well as product to product. Even if the flow process chart is slightly different of each machine the delay of every machine is nearly same.

There are few steps which are to be followed for doing method study. They are as follows.

1. Selection of the job – It is the first step which involves three considerations namely economic, technological and human. In this work, the focused area is on technological and human aspects.

2. Record the information – For recording step, flow process chart has been done, which gives all the information and the time taken by each operation or activity to complete it.

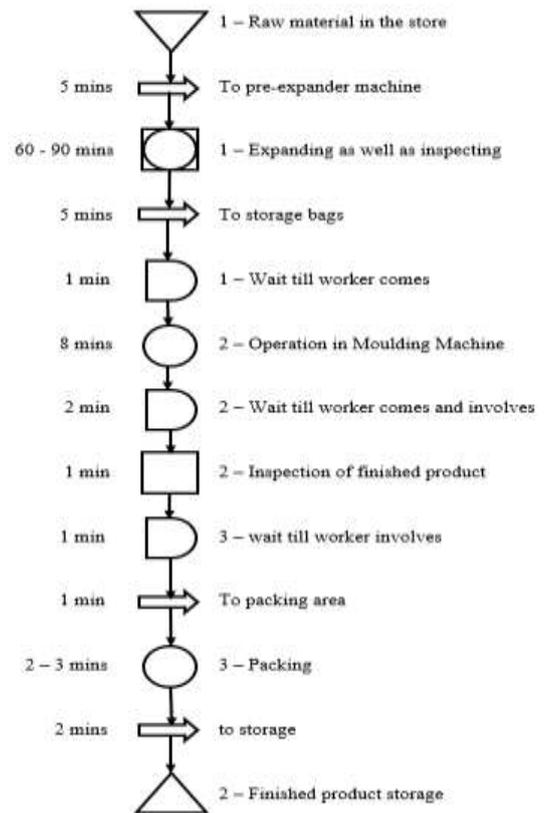


Fig -2: Flow Process Chart

Symbol	Frequency	Time in minutes
○	3	80
→	4	13
□	2	6
D	3	4
△	2	

Table -1: Summary of Flow Process Chart

3. Examine the information – This is very crucial step. In this step the information from the flow process chart is examined critically. From table 1, as there is delay of total 4 minutes equals to 240 seconds. The delay is caused by various reasons which affect directly on the productivity. In this work the delay is seen more in the moulding machine area. So, for analysis and calculation delay during the mould machine operation is considered. The first delay, after storing the material in the storage bags can be neglected and which does not contribute more towards low productivity (Refer Fig -2 and Table 1).

The next two steps will be covered in the calculation and analysis.

3. TIME STUDY

The time study is done with the help of stop watch. Time study is done to calculate the time taken by each task. The time study data is given below for moulding machines from 1 to 7. Each moulding machine has different products, so the time will be different for every task.

Machine Number	Reading Number	Various time considered in seconds						Total Time
		Input	Walking	Operation	Product removal	Inspection	Cleaning	
1	1	38.07	36.24	152.98	15.13	8.12	90.45	340.99
	2	48.48	22.50	152.45	38.35	9.04	-	270.82
	3	39.67	19.78	152.23	28.71	8.67	88.32	337.38
2	1	48.81	25.57	267.12	30.47	8.79	-	380.76
	2	46.74	18.69	267.82	17.78	8.34	76.78	436.15
	3	50.45	21.15	267.06	25.56	9.15	-	373.37
3	1	61.08	21.49	394.72	24.1	8.03	71.34	580.76
	2	49.97	28	390.87	21.59	8.56	67.01	566
	3	42.36	25.04	393.45	17.99	8.29	62.75	549.88
4	1	18.95	16.79	420.93	18.01	9.97	-	484.65
	2	19.98	15.05	412.86	18.48	10.72	-	477.09
	3	17.46	17.62	417.99	19.2	8.38	-	480.65
5	1	19.21	17.78	317.82	17.89	8.95	-	381.65
	2	18.65	17.82	327.44	24.76	8.04	55.71	452.45
	3	22.34	14.56	327.78	19.87	8.16	-	392.71
6	1	38.7	18.61	435.75	27.43	10.37	70.14	601
	2	44.34	24.76	434.68	19.7	9.59	67.71	600.78
	3	42.13	22.49	432.62	19.42	10.74	-	527.4
7	1	37.72	27.10	540.29	29.32	9.68	53.86	697.97
	2	39.55	17.34	555.86	27.10	8.42	-	648.27
	3	45.67	21.02	548.72	24.99	8.10	78.23	726.73

Table -2: Time Study Data

Various time taken by different mould machines are shown in the table. As seen the data taken is of 7 moulding machines. For each moulding machine 3 readings are shown. As seen in the table considering machine number 4 and machine number 5 take less time in every task, which means the worker assigned to these machines are working efficiently without wasting any time. Cleaning does not occur after every cycle of machine. As seen in the table there are various time given such as input, walking, operation, product removal, inspection, cleaning. These times varies from person to person. Proper time standards were not followed due to which the task that require less time to be completed takes long time. The mould machine 1, 2, 3, 6, 7 makes 2 pieces of product per cycle.

4. CALCULATIONS AND ANALYSIS

By the data of motion study the following points came further.

1. There were no proper standards maintained and followed in the premises by the workers.

3. The tasks were not evenly distributed between the workers.

4. There were lack of safety measures.

5. Lack of performance standards.

6. Improper time standards

7. Unnecessary wastage of time

For analysis of time study any two machines are considered from the table. And from each machine one reading will be considered for analysis. Considering machine number 6 and 7. From machine number 6 considering reading number 1 and from machine number 7 considering reading number 3. Machine number 6 and 7 makes 2 pieces. Allowing only one worker to work between these two machines.

The following time is calculated with the help of motion study standards and considering allowances as 15%. The time are constant for all machines except the operation time will differ.

1. Time for input to the machine – 40 seconds

2. Time for walking between machines – 20 seconds

3. Time for product removal – 22 seconds

4. Time for inspection of product – 10 seconds

5. Time for cleaning the die – 60 seconds

6. Time for Operation at Machine number 6 – 436 seconds approximately

7. Time for Operation at Machine number 7 – 556 seconds approximately

According to the process adding standard time required for each task and adding actual operation time for machine number 6 and 7 to get the standard time for the cycle.

Cycle time for machine number 6 = Input time + Operation time + Product Removal Time + Inspection Time + cleaning time + Walking time
= 40+436+22+10+60+20
= 588 seconds

Standard Cycle time for machine number 6 = 588 seconds
Actual Cycle time for machine number 6 = 601 seconds
Difference = 13 seconds per cycle

In one hour there are 5.99 cycles of machine number 6
Time saved per hour = 77.87 seconds

Considering one shift (7 hours) = 545.09 seconds
Cycle time for machine number 7 = Input time + Operation time + Product Removal Time + Inspection Time + cleaning time + Walking time
= 40+549+22+10+60+20
= 701 seconds

Standard Cycle time for machine number 7 = 701 seconds
Actual Cycle time for machine number 7 = 726.73 seconds
Difference = 25 seconds per cycle
In one hour there are 4.95 cycles of machine number 6
Time saved per hour = 123.84 seconds
Considering one shift (7 hours) = 866 seconds

Similarly,
For all the machines.

5. RESULTS

After analyzing and calculation of the data of time study and motion study, the following are the results.

After giving input to two machines the worker is free till the operation of the machine is done. During this free time the worker cleaned the steam pipes, keeping the previously manufactured products in the finished product section and utilize the free time perfectly. Proper standards were followed like each worker were assigned two machine, safety measures were taken like wearing gloves and mask, proper maintaining the time schedule, following proper allowances.

Previous Productivity (weekly) = Number of pieces manufactured in one machine in a week/ Number of days in a week.

= 42+47+32+41+43+52 / 6
= 257 / 6

= 42.83 pieces per day approximately

After implementation of proper standards = adding 2 pieces extra per day

= 44+49+34+43+45+54 / 6
= 269 / 6

= 44.83 pieces per day approximately

In a month = 12 pieces x 4 weeks = 48 pieces extra were manufactured per machine.

6. CONCLUSION

In the working premises the standards were not followed proper through which there was delay in production causing low productivity rate. Increasing motivation levels of workers, keeping the tool box which is needed during the machine breakdown or for cleaning purpose, proper safety measures, calculation of standard times and following those time standards and allowances helped in increase the production causing the productivity to increase. Time study and motion study contributed to achieve high productivity rate. By following these time standards scheduling of the required quantity of product was done and was found to be precise. After successful standardization proper routine timetable for every worker was made which included the time standards with allowances.

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