Productivity Improvement in Manufacturing Top Dish of Reactor by Time Study and Method Study

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Abstract
Productivity is a quantitative measure of performance. It is the optimized utilization of all available resources to generate output. In manufacturing sector, production time is an important factor in order to compete in the market. In the production of reactor, there are two kinds of time consumptions machining time and travel time which are also known as value added and non-value added time. In production department there is some unwanted work process which takes extra time, extra effort and it increase the cost of production. Plant layout also plays an important role in production time. In this paper a case study to achieve an alternate way to reduce the production time in manufacturing of reactor with the help of method study and time study has been successfully carried out. The study has resulted with outcome of suggestions to modify plant layout and efficiently using 4M: material, man, machine and money indicates improvement in the productivity.

Keywords: *Productivity Improvement, Time Study, Method Study*

INTRODUCTION

Work study which comprises of method study and work measurement. By method study, one can determine the most effective method of performing the job. Work measurement on the other hand determines the time required by an operator to complete the operation of job for the standard method at the defined level of performance [1]. Basic time has been calculated for each element and then analyzed the obtained data for changes to be implemented on machine. To eliminate the observer's errors in collection of time data, one can implement the automation using handheld computers or video recorders [2]. By making simple changes to the process, it can reduce the time taken for each component to improve the flow and speed up the process [3]. Reduction of waste can also improve productivity. Improving quality at the source will not affect any station, but reduces scrap and rework. After collection of data the bottleneck station was identified. Fishbone diagram is used to identify the causes which reduce the production rate and the remedial measures have been noted to reduce the causes [4]. It can de concluded that the process can be improved based on method study, work procedure and proper utilization of machine and material. It will improve the current process by reducing the number of workstations, transportations; combining the operations and reducing the workers fatigue [5]. The origins of productivity measurement can be traced to the manufacturing sector when its need was immediately realized after the industrial engineers and the behavioral scientists proposed methods, tools, industrial engineering practices, the motivation theories to increase the output per unit of input [6]. By implementing work study and method study and establishing new effective process for particular operation can increase productivity. The line balancing is the key point to increase productivity to particular products.

Productivity

Productivity can be defined as human efforts to produce more and more with less and less inputs of resources as a result of which the benefits of production are distributed among maximum number of people. Productivity is the ratio of Output to Input. According to peter Drucker, "Productivity means a balance of all factors of production that will give the maximum output with the smallest effort."The aim should be optimum use of resources so as to provide maximum satisfaction with minimum efforts and expenditure. Productivity analysis and measures indicate the stages and situations where an improvement in the working inputs is possible to increase the output.

Techniques of Work Study:

The amount of work in a given job is referred to as work content. The work study consists of two techniques:
(a) Method Study: Method study is the systematic recording and critical examination of existing and proposed ways of doing work. It is concerned with the reduction of work content of a job or operation.

(b) Work Measurement: Work Measurement is the application of techniques designed to establish the time for a qualified worker to carry out a specified job at defined level of performance. It is concerned with the investigation and reduction of any ineffective time associated with it.

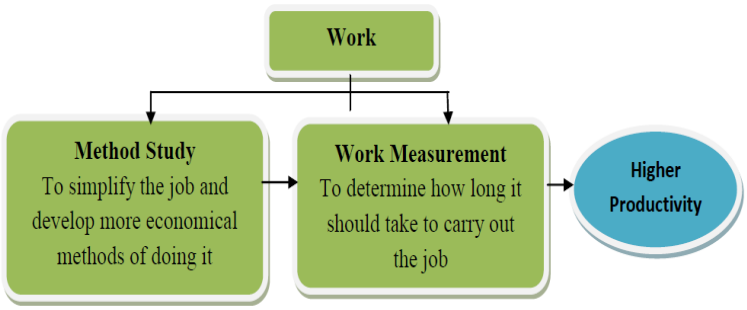

Fig. 1: Relationship between work study and work measurement

SELECTION OF DEPARTMENT

Maximum operation time is require in top dish manufacturing area, thus this area is selected for further improvement.

***Operation required in this area*:**

1. Big press (COC & Manhole cutting)
2. Small press (Nozzle Cut)
3. Top part set up and welding
4. Bevel cutting machine (Cutting)
5. Robot welding operation

} Maxi. Time consume

Based on problems faced in manufacturing of top dish fishbone diagram is diagram

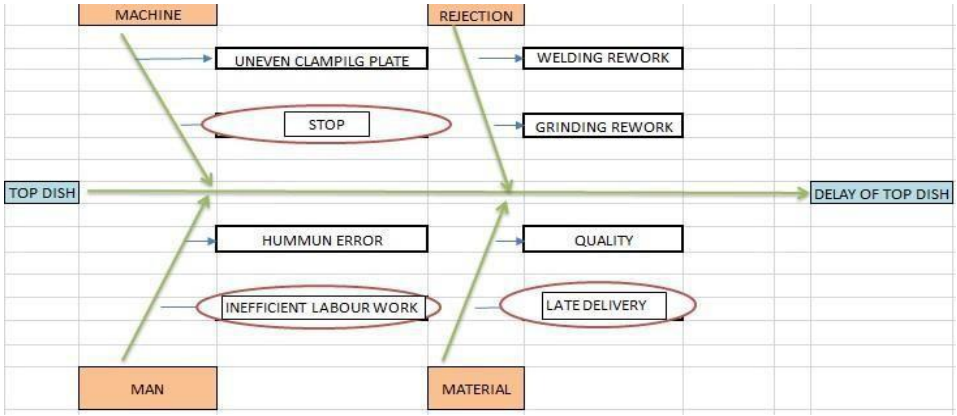

Fig. 2: Fishbone diagram for delay of top dish.

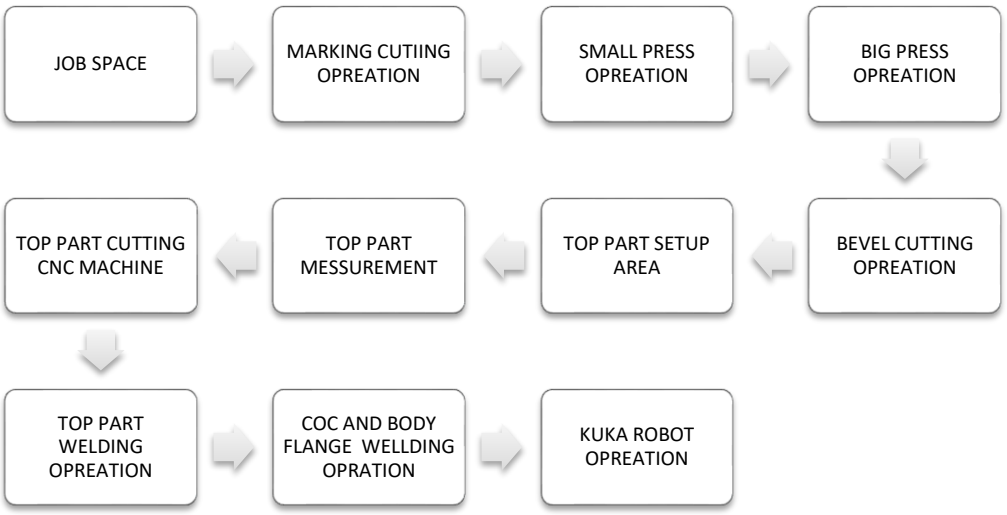

Fig 3: Flow of manufacturing top dish

TIME STUDY

There are 5 main operations to manufacture top dish which are marking, cutting, swaging, bevel cutting, welding. Individual time study table is prepared after taking time measurement of all these operations. Marking and cutting operations is to be done on CNC machine so time study is done on swaging, bevel cutting and welding operations. Time study table for swaging operation on top dish is shown in table no 1

Table 1: *Time study table for swaging on top dish of the reactor*

Time Study table for Swaging operation on Top dish		
Sr. No.	**Description**	**Observed Time(minute)**
1	Loading the job & setting hole	8:35
2	Heating	6:30
3	Press the die	0:30
4	Unloading & setting new hole	4:10
5	Heating	5:31
6	Press the die	0:35
7	Unloading	1:00
8	Break	7:08
9	Loading the new die& setting new hole	3:00
10	Heating	3:21
11	Press the die	0:35
12	Unloading & setting new hole	2:30
13	Heating	3:26
14	Press the die	0:20
15	Unloading & setting new hole	2:22
16	Heating	3:19
17	Press the die	0:22
18	Unloading &setting new hole	4:36
19	Break	6:36
20	Heating	3:32
21	Press the die	0:21
22	Unloading& setting new hole	2:12
23	Heating	3:23
24	Press the die	0:18
Total Time		**80 minutes**

Time study table for bevel cutting operation on top dish is shown in table no 2.

Table 2: *Time study table of bevel cutting*

Time study Table of Bevel cutting		
Sr. No.	**Description**	**observed time (minute)**
1	Path Define	01:34
2	Setting	01:08
3	Bevel cut	05:52
4	Break	10
5	Path Define	03:12
6	Bevel cut	03:00
7	Release & setting new hole	03:00
8	Check alignment	01:00
9	Path Define	02:18
10	Bevel cut	08:35
11	Release & setting new hole	01:15
Total time		**42:16:00**

Time study table for welding operation on top dish is shown in table no 4.

Table 4*: Time study table for welding on whole top dish*

Time Study Table for Welding operation on Top Dish		
Sr. No.	**Operations**	**Observed Time**
1	Loading Top dish to Fixture	15:35
2	Extra time cleaning	02:00
3	Turn the dish to side View	00:54
4	Clean the Area	02:02
5	Surface Finishing set up	02:00
6	Surface Finishing	03:17
7	Break	10:00
8	Waiting for welding m/c	26:25
9	Setup welding m/c	04:50
10	Electrode insert in holder	01:50
11	Welding root run 100mm nozzle 1	08:48
12	100mm Nozzle 2	06:50
13	100mm Nozzle 3	06:20
14	Lunch break	95:00
15	100mm Nozzle 4	06:52
16	100mm Nozzle 5	07:10
17	200mm Nozzle 1	09:48
18	200mm Nozzle 2	08:46
19	Man hole	13:00
20	AE hole	10:08

21	Break	05:00
22	Windup welding m/c	02:00
23	Break	09:00
24	Arc welding 200mm nozzle 1	06:17
25	200mm nozzle 2	06:12
26	Tea Break	12:46
27	100mm Nozzle 1	04:51
28	100mm Nozzle 2	04:07
29	100mm Nozzle 3	04:37
30	100mm Nozzle 4	05:10
31	100mm Nozzle 5	04:18
32	Man hole	17:10
Total time with break		**5:46 hr**
Total time without break		**3:40 hr**

From the time study table data, the analysis is given in below table:

***Table 5**: Productivity Improvement table*

Per Day Work Done			
Sr. No.	**Operation**	**Before**	**Possibility**
1	Swaging on small press machine	3 job	5 job
2	Bevel cutting	3-4 Job	4-5 Job
3	Welding	1 job	1-2 job

Flow process chart has been prepared considering various parameters involved in the manufacturing process and the readings taken which gives the information about the flow of material and time taken in operation, transportation, delay, storage.

***Table 5**: Present Flow process chart of manufacturing of top dish*

DESCRIPTION	QTY	DISTANCE	TIME (MIN)	SYMBOL				
MARKING CUTTING OPREATION			20					
TRANSFER TO SMALL PRESS AREA			3					
SMALL PRESS WATING			10					
SMALL PRESS OPREATION			80					
JOB FOR COOLING			31					
TRANSFER TO BIG PRESS AREA			18					
BIG PRESS OPREATION			35					
JOB FOR COOLING			15					
TRANSFER TO BEVEL CUTTING AREA			28					
BEVEL CUTTING OPREATION			45					
JOB FOR COOLING			18					
MEASSUREMENT OR WELDING AREA			27					
TOP PART LENGTH MESSUREMENT			12					
TOP PART CUTTING			54					
WELDING OPREATON			85					
AND COC WELDING AREA			72					
BODY FLANGE AND COC WELD			345					
TOTAL				740	148	10		

***Table 6**: Proposed Flow process chart*

DESCRIPTION	DISTANCE	TIME (MIN)	SYMBOL				
			○	⇨	D	□	▽
MARKING CUTTING OPREATION		20					
TRANSFER TO SMALL PRESS AREA		3					
SMALL PRESS WATING		0					
SMALL PRESS OPREATION		80					
JOB FOR COOLING		31					
TRANSFER TO BIG PRESS AREA		7					
BIG PRESS OPREATION		35					
JOB FOR COOLING		15					
TRANSFER TO BEVEL CUTTING AREA		12					
BEVEL CUTTING OPREATION+TOP PART		45					
JOB FOR COOLING+TRANSFER TO WELDING AREA		27					
TOP PART CUTTING		40					
TOP DISH AND TOP PART TAG WELDING OPREATON		85					
TRAMSFER TO BODY FLANGE AND COC WELDING AREA		72					
BODY FLANGE AND COC WELD		310					
TOTAL			660	121	0		

***Table 7**: Present vs Proposed*

Present vs Proposed			
ACTIVITY	PRESENT	PROPOSED	SAVING
OPERATION ○	740 MIN	660 MIN	80 MIN
TRANSPORT ⇨	148 MIN	121 MIN	27 MIN
DELAY D	10 MIN	0 MIN	10 MIN
INSPECTION □			
STORAGE ▽			
DISTANCE			
TIME(MIN)	898 MIN	781 MIN	117 MIN

CONCLUSION

According to the problems experience in the manufacturing of the top dish of the reactor Fishbone diagram is drawn and it is analyze that work is to be done on man machine and material. It can be observed by employing Method study and Time study for different operations simultaneously, time is reduced from 898 minutes to 781 minutes. So, total 117 minutes are saved. Bevel Cutting Operation and Top part length measurement are performed separately before when it required 45 and 12 minutes respectively. If we combine this two process and perform them simultaneously then eventually both processes done in 45 minutes, so we can reduce 12 minutes. As like above mentioned, job for cooling and transfer to welding area also required 18 and 27 minutes when we perform them separately; however, combine process performance of this two took only 27 minutes, by which we can reduce 18 minutes at the end Another time can reduce by decrease some unwanted movement. The factors considered for time saving and productivity are unwanted movement of resources (worker and material), reducing wastage, efficiently using the 4M: material, man, machine and money, Proper plant layout and efficient labor work so finally the Productivity improvement table shows swaging operation which was done on 3 jobs based on time study of swaging operation i.e. 80 minute required for 1 job can be done on 5 jobs likewise in Bevel cutting and Welding operations instead of 3-4 jobs it can be done 4-5 jobs and instead of 1 job can be done 2 jobs respectively. In Future further suggestions can be taken as Design welding fixture with swinging chair for top dish and Implementation of automatic swaging machine.

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