A Research Paper on Increasing Productivity of Steel Fabrication Industry

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Abstract— Effective planning and designing of manufacturing processes and equipment helps in achieving optimum productivity through maximum utilization of the resources available leading to least possible industrial wastage thus resulting in low production cost. The aim of this paper is to study the implementation of industrial engineering tools in a steel manufacturing industry. This study started with observing the standard operation procedures and understanding the existing process flow. At the same time, observations at the production line were made to identify problems and areas of possible improvements. Time study, method study and layout study techniques formed an integrated platform to help identify and rectify the time lost in unnecessary movements of labour and tools which resulted in long machine idle time. The packaging method used was conventional and time consuming which was simplified. There were suggestions proposed how redesigning of the process flow and efficient material handling could save idle time for machines, how replacing the old packaging method with use of zip ties would require less manpower and could help mitigate the non-value-added activities, thereby resulting in improved productivity of the industry.

I. INTRODUCTION

A manufacturing company must have an efficient production system to accomplish its operation. The systems consist of people, equipment, and procedure designed for the combination of materials and processes that steer the company's operations. Basically, there are two types of production systems; production facilities and manufacturing support systems. Production facilities refer to the physical equipment and the layout arrangement of equipment in the company. These facilities include the factory, production equipment and material handling equipment. In manufacturing system, facility layout is considered as one of the important criteria which has a significant effect towards manufacturing productivity in terms of cost and time.

The objectives of a layout are to minimize material handling cost, improve flexibility for arrangement and operation, utilize the available area and minimize overall production time. According to there are four types of layout categories based on the type of material handling. Those layouts are single row layout, loop layout, multi-rows layout, and open-field layout. In each phase of the lifecycle many considerations have to be made which include design, evaluation and selection of an effective layout, production planning and scheduling. Moreover, due to the current market demands, the decisions related to the modification in an existing design also need to be thoroughly studied to scope with the requirements. Hence, it is important to have an efficient layout arrangement and material flow path design because material handling requires a large percentage of the product cost. Material handling system (MHS) is an important component of manufacturing system which acts as an inter-connector for facilities and should facilitate the process of delivering the right amount of materials, to the right place, at the right time and at the lowest cost. According to MHS is responsible for transporting materials between workstations efficiently by joining all workstations and workshops in manufacturing systems with minimum obstruction.

According to MHS integrates functions within a manufacturing system and it plays a very important role in the manufacturing system because it accounts for 30-75% of the total cost of a product. An effective MHS should improve the performance of a manufacturing system, especially by reducing work-in process (WIP). Therefore, it is very important to determine the suitable material handling equipment and the tasks of material handling operations to each individual piece of equipment. Ref. categorized the equipment types of MHS in the ‘‘Inter-Departmental Handling of Discrete Parts” into three categories, namely forklift, cranes and manual. Manufacturing support systems, on the other hand, are the procedures used by the company to manage production operation, solve the technical and logistics problems. The systems involve materials ordering, work flow sequence, and ensuring the products meet quality standards. Manufacturing engineering is normally responsible for the company's planning and manufacturing processes.

Furthermore, Production Planning and Control (PPC) department is responsible for solving the logistical problems in manufacturing, which includes material ordering, production scheduling and capacity planning. Both production facilities and manufacturing support systems involve dedicated people that are very important to ensure the company's smooth operation. There are two categories of people involved; the first is factory labor, who is responsible for direct operating the manufacturing equipment. The second is the professional people who are responsible for manufacturing support. In order to face these challenges, manufacturing companies must have strategy and competitive priority in order for them to compete in the dynamic market.”

It is the responsibility of the top management of the company to ensure that there is a coherent manufacturing strategy and policies at all levels designed to support the whole company's mission. According to, manufacturing strategy refers to the competencies that a company practices in its operations in the aim to promote the company's competitive strength.

sr.no	elements	time in min.	distance moved in meters.
1	walk to forklift	1	2
2	insert forklift into the trolley	3	
3	walk to cutting machine	6	4
4	insert the specimen into cutting machine	8	
5	walk to bending machine	12	6
7	insert the specimen into bending machine	14	
9	walk to welding machine	18	10
6	insert the specimen into welding machine	22	
8	walk to drilling machine	30	14
10	insert the specimen into drilling machine	27	
11	components are to be assembled	36	20
12	store the specimen to industry		
13	shipped the specimen to other industry	60	

Fig. 1:

II. RECORDING THE FACTS

Data recording was the most crucial step as the success of the whole procedure depended entirely on the accuracy with which the facts were recorded, the basis of which would provide critical examination and the development of the improved method. Recording was done with the help of Flow Process Chart- Man Type. The chart could be made only after time study had been conducted. The time taken by the operator in doing a specific operation was measured using a stopwatch. (Refer to Fig). A total of 50 elements were identified which were done by the operator.

Time study was done for two processes

1) Inserting the specimen into the bending machine
2) Packaging the steel product.

Time study for the former and latter processes was done to find the time required by the operator to do the operations which involved inserting the specimen into the bending machine to prepare the product, followed by its packaging. The Time required for the former process was 10minutes (5 specimens at a time) and the time required for the latter process was 45minutes. These elements were basically operation, transport, inspection, delay, or storage. The elements were properly classified into transport, operation delay, storage and inspection elements and the researcher found that there were 60 transport elements and 90 operation elements with the present method and with the help of Time Study it came out to be 50 transport elements and 80 operation elements.

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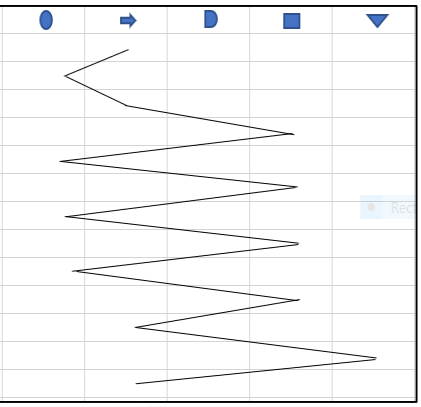
5	walk to bending machine	12	6
7	insert the specimen into bending machine	14	
9	walk to welding machine	18	10
6	insert the specimen into welding machine	22	
8	walk to drilling machine	30	14
10	insert the specimen into drilling machine	27	
11	components are to be assembled	36	20
12	store the specimen in the industry	50	
13	shipped the speciemen to other industry	60	



III. METHODOLOGY

Step by step procedure is the most important for improving productivity through work study method to reduce work content to particular products. Here is given key steps of this case study. We try to develop a conceptual framework for our work. This frame helped to accomplish our research work in systematic way.

In this study, at first we selected a steel fabrication products industry with specific products. After that we selected a specific production line for accomplishing our study. We observed all the particular operations and noted down the time required. After observing all the operations, identified the existing problem by critical questioning technique. After identifying problems, we developed new method or process for particular products. When our proposed method applied to this particular assembly line, the productivity has been improved. Our contributed research objectives are:

1) Analyze the production system with the help of work study technique for productivity improvement
2) Identify the existing problem in a particular production line and develop new system with the help of critical analysis.

A. Solution Methodology

In this research, we used some terminology for research purpose. Here is given that terminology for analyzing data.

B. Observe time

The time taken to perform an operation or combination of Operations obtained by means of direct measurement.

C. Selected time

The time chosen as being representative of a group of times for an Operations or group of work by calculating mean, median or mode.

D. Rating

Rating is the assessment of the worker's performance rate of Working relative to the observer's concept of the rate corresponding to standard pace.

E. Basic time

Basic time is the irreducible minimum time theoretically required to produce one unit of output. The time for carrying out an element of Work at standard rating

$$\text{Basic Time} = \frac{\text{Observed time} \times \text{Observed Rating}}{\text{Standard Rating}}$$

F. Standard time

Standard time is the total time in which a job should be completed at standard performance

Standard Time =Basic Time + Allowances

For allowances, we consider 15% relaxation allowances and 3% Contingency allowances.

G. Relaxation allowances

Relaxation allowance is an addition to the basic time intended to improve the worker with the opportunity to recover from the Physiological and psychological effects of carrying out a specified operation and to allow attention to personal needs. The amount of allowance depends on the nature of the work. Generally, Relaxation Allowance is 15% of basic time, has been added to calculate standard Time from basic time.

H. Contingency allowance

Contingency allowance is very small amount of time that may be included in standard time for time study .in this we consider 3% contingency allowance of basic time to calculate standard time

$$\text{Efficiency} = \frac{\textbf{Output}}{\textbf{Input}}$$

High level Problems identified in a nut shell:

1) Improper Layout leading to excessive movements
2) Improper placement of tools
3) Non-productive activities adding no end value
4) Improper Material handling
5) Traditional and time consuming methods of packaging
6) Traditional methods and equipment of manufacturing
7) Poor ergonomics

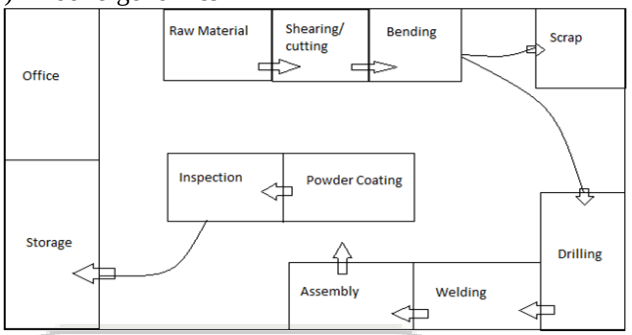


Fig. 1: Original layout

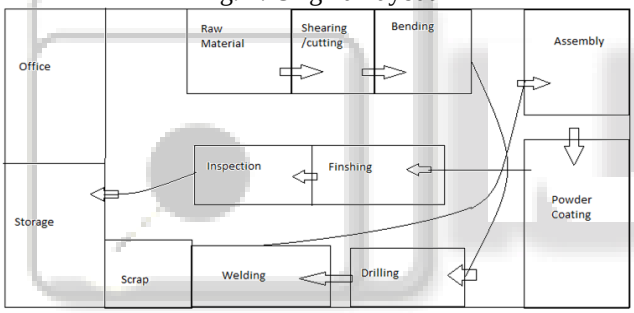


Fig. 2: Corrected Layout

IV. Developing the Improved Method

This stage of method study is about establishing the most practical, economic and effective method by taking into accounts all the circumstances. Categorizing the identified problems, the proposed solution are as follows. The way of arrangement of material and machinery define the layout in that area. A careful analysis of the flow was done before concluding to changes in the present layout since changing the layout is a costly process as it involves movement of heavy duty machineries and stoppage of production.

With the help of flow process chart, we've identified the following problem

1) All workplaces in workshop are misaligned
2) No proper sequence of tasks.
3) There is no space for maintenance

To reduce the worker's fatigue, improve mobility of materials, ameliorate material accessibility, increase free space and improve worker and materials' safety in accordance to convenience, the following suggestions were made

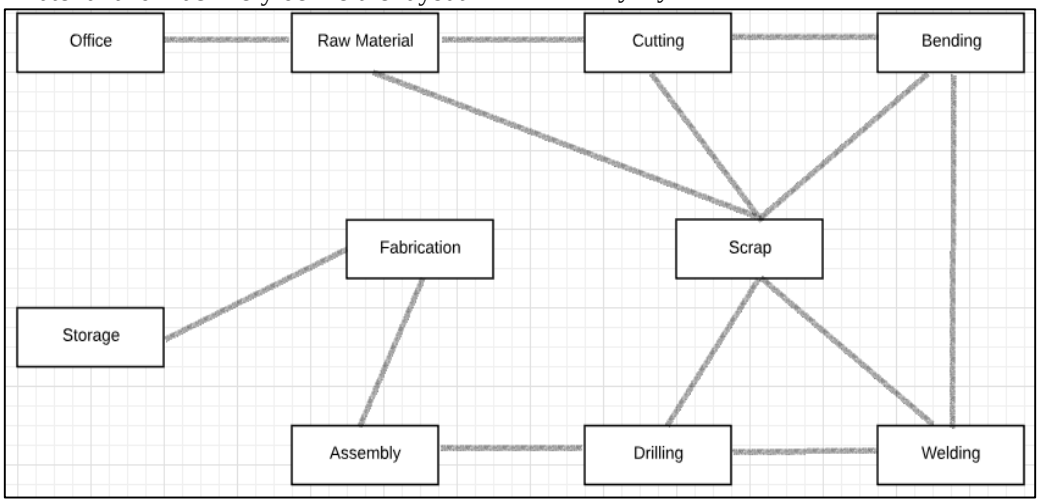
4) Relocating the Machineries and workplaces
5) Maintaining proper sequence of task
6) Addition of machines and workers for better feasibility.
7) Allocation of free space for maintenance
8) Allocation of free space near containers for easier accessibility.
9) Reallocation of machines step by step to reduce time wastage.
10) Reallocation of packaged good near the lift area for easier accessibility.

V. Limitation

1) Workers feel quite apprehensive about the fact of losing their respective jobs when they adopt the methods such as time study and method study, which will put their jobs in jeopardy.
2) There is a case where certain workers possess information that are detrimental to the image of the organization.
3) Most of the low cadre employees were not well versed in English, so they preferred their local language in collecting the data.
4) Since the time was limited, not all employees could be included in the survey. A sample of 65 employees was selected for the purpose of conducting the survey and collecting relevant data.

VI. Observations

The figure given below shows the string diagram of the industry layout



Sr. No	Manufacturing with	Insertion time (5 units)	Setting all the commands	Packaging	Total Time (hrs)	Total time (minutes)	Total time saved
1	Present method	10	5min	60min	1hr 25 min	75	
2	Proposed Method	8	5 min	50min	1hr 3min	63	12 min

1) Time saved after improvement in layout=1.94 min
2) Time saved after improvement in material handling=1.3min
3) Time saved after improvement in packaging =16min

Therefore, total time saved in 1 batch= 19.24 min.

1) Shift Timings 9:30am to 5:30am including break of 30 minutes.
2) Total Available time = 450 minutes
3) Number of steel plates produced and packed per batch= 50
4) Number of working days in a month= 25

The Other observations include

5) Improper placement of tools.
6) Improper Material handling.
7) Poor ergonomics

VII. CALCULATION

A. With present method

1) Number of batches that can be performed is

450/75 = 6 batches

2) Number of steel plates that can be produced and packed in 6 batches are

6*50=300 steel plates

3) Number of steel plates that can be produced per month are

300*25=7500 steel plates

B. With proposed method

1) Number of batches that can be performed

450/63=7.14 batches

2) Number of steel plates that can be produced and packed in 7.14 batches

7.14*52=371.428 steel plates

3) Number of steel plates that can be produced per month are

371.428*25=9286steel plates

4) Increment in production of steel plates is

9286-7500=1786 steel plates

5) Therefore, increment in productivity in productivity is

(1786/7500)*100=23.81%

VIII. CONCLUSION

Every industry like steel being one looks to their workers as beings who can give the gain that the industry is expecting from them, here the main thing that differentiates profit from loss is the key word Productivity or Productivity growth which depends on the input and output. Time study plays a prominent rule in enhancing productivity and we applied it for calculating the productivity, which was a success

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