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Improvement In Process Industries By Using Work Study Methods

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Abstract— *Work study is the systematic examination of the methods of carrying out activities so as to improve the effective use of resources and to set-up standards of performance for the activities being carried out. It is one of the most powerful tools that management can use to improve productivity. By the application of method study and time study in any organization, we can thus achieve greater output at less cost and of better quality, and hence achieve higher productivity. In this study, the prime objective of this study is to reduced machine idle time, Increase productivity, Reduce worker's fatigue. Establish the standard performance methods and standard cycle time involved, optimally use equipment and manpower, and Eliminate wasteful efforts, as well as useless handling material. The study area includes production lines of Gear manufacturing. This production lines includes 5 machining centers, and 1 CMM machine for inspection. The line production is lagging behind the target due to line imbalance. So time study technique has been decided to measure the work. Present study was done at Shree Gears Pvt Ltd, Indore on application of time and work study technique, because of its high non value added time in an operation. . After implementing the suggested improvement ideas the firm is able to increase its productivity by 27.77%. With the help of recorded observation and discussion with manager of the company, improved flow process chart are suggested.*

Keywords: *Work study, idle time, productivity, worker's fatigue, method study.*

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I. INTRODUCTION

The great deal of effort is required in industry for effective production that includes less production time and higher efficiency. Work study is a generic term for those techniques, particularly method study and work measurement, which are used in the examination of human work in all its contexts, and which lead systematically to the investigation of all the factors which affect the efficiency and economy of the situation being reviewed, in order to effect improvement. Work study is thus especially concerned with productivity. It is most frequently used to increase the amount produced from a given quantity of resources without further capital investment except, perhaps, on a very small scale.

Work study was widely known for years as "time and motion study", but with the development of the technique and its application to a very wide range of activities it was felt by many people that the older title was both too narrow and insufficiently descriptive.

The research and development necessary to develop a new process or a machine of higher performance are usually expensive and take a long time, and there is always the risk that the improvements achieved may not justify the time and money spent. Even to achieve worth-while improvements in existing processes may take considerable time and money. In countries where there is little capital to spare and where the need for increased productivity is urgent this approach to the problem may not even be possible.

Work study is the systematic examination of the methods of carrying out activities so as to improve the effective use of resources and to set-up standards of performance for the activities being carried out. It is one of the most powerful tools that management can use to improve productivity [1]. There are a number work study techniques such as ergonomics, operations research, work study and time-and motion study. Maintenance Management is an orderly and systematic approach to planning, organizing, monitoring and evaluating maintenance activities and their costs. A good maintenance management system coupled with knowledgeable and capable maintenance staff can prevent health and safety problems and environmental damage; yield longer

asset life with fewer breakdowns; and result in lower operating costs and a higher quality of life. The good performance indices of each work study technique should yield improved productivity, improved quality, improved efficiency, reduced downtime, improved employee morale, reduced turnover and absenteeism.

Method study (also sometimes called Work Method Design) is mostly used to improve the method of doing work. It is equally applicable to new jobs. When applied to existing jobs and existing jobs, method study aims to find better methods of doing the jobs that are economical and safe, require less human effort, and need shorter make ready/put-away time. The better method involves the optimum use of best materials and appropriate manpower so that work is performed in well-organized manner leading to increased resource utilization, better quality and lower costs. It can therefore be stated that through method study we have a systematic way of developing human resource effectiveness, providing high machine and equipment utilization, and making economical use of materials.

While they vary considerably, most financial ratios are broadly concerned with the ratio of "sales return on capital employed" or on a ratio of "profit to assets." Such measures are sometimes termed "business efficiency" Many of these ratios resemble output/ input productivity ratios. Consider the following seven ratios for financial control in a decentralized firm:

1. Profit/Capital Employed
2. Profit/Sales
3. Sales/Capital Employed
4. Sales/Fixed Assets
5. Sales/Stocks
6. Sales/Employee
7. Profit/Employee

II. FACTORS OF PRODUCTIVITY IMPROVEMENTS

There are varieties of factors which can affect productivity, both positively and negatively as listed below. Some factors can be controlled and some cannot be controlled due to natural limitations.

- Capital investments in production
- Capital investments in technology
- Capital investments in equipment
- Capital investments in facilities
- Economies of scale
- Workforce knowledge and skill resulting from training and experience
- Technological changes
- Work methods
- Procedures
- Systems
- Quality of products
- Quality of processes
- Quality of management
- Legislative and regulatory environment
- Productivity has been defined as the ratio of output to input. An increase in productivity means an increase in output that is proportionally greater than increase in input.
- Productivity may be measured either on an aggregate basis or individual basis. On aggregate basis, output is compared with all inputs taken (added) together. This is called as total productivity. On individual basis, output is compared with any one of the input factor and this is called as partial productivity or factor productivity.

$$\text{Total productivity index} = \frac{\text{Total output}}{\text{Total inputs}} = \frac{\text{Total production of goods and services}}{\text{Labour} + \text{Material} + \text{Capital} + \text{Energy}}$$

Labor productivity: The important function in any production set-up is that the budgeted quantity of work must be achieved over a period of time. Labor productivity depends upon how labors are utilized. Labor productivity can be higher or lower depending on factors like availability of work load, material, working tools, availability of power, work efficiency, level of motivation, level of training, level of working condition (comfortable or poor) etc. Labor productivity can be measured in terms of hours or money.

$$\text{Labour productivity} = \frac{\text{Total output}}{\text{Labour input}}$$

$$\text{Labour productivity (in terms of hours)} = \frac{\text{Total quantity produced}}{\text{Actual man hours required to produce that quatity}}$$

$$\text{Labour productivity (in terms of money)} = \frac{\text{Total cost (or sales value) of output produced}}{\text{Amount in terms of rupees spent on workers}}$$

The productivity of labor can be increased by increasing efficiency of labor and reducing labor time.

Material productivity: Production system converts raw material into finished product with the help of mechanical or chemical processes. Material productivity plays important role in cost of production. Material productivity depends upon how material is effectively utilized in its conversion into finished product. Material productivity depends upon percentage of rejection, creation of scrap, level of spoilage, obsolescence, work wastage etc. Material productivity is expressed as:

$$\text{Material productivity} = \frac{\text{Total output}}{\text{Material input}} \quad or$$

$$\text{Material productivity} = \frac{\text{Number of units produced}}{\text{Total material cost}}$$

Material productivity can be increased by using skilled workers, adequate machine tools, good design of product etc.

Machine Productivity: Production system converts raw material into finished product through mechanical or chemical process with the help of machines and equipments. Machine productivity depends upon availability of raw material, power, skill of workers, machine layout etc.

$$\text{Material productivity} = \frac{\text{Total output}}{\text{Material input}} \quad or$$

$$\text{Material productivity} = \frac{\text{Output in standard hours}}{\text{Actual machine hours}}$$

Capital productivity: For any production set-up, facilities of machines, tools, land etc. are required which are assets of organization. Capital is needed for such assets. As huge capital is locked in assets, their effective utilization is absolutely necessary. Capital productivity depends on how effectively assets are utilized. Therefore decision is necessary to take about replacement of fixed assets. Early replacement of fixed assets brings down maintenance cost but requires capital expenses. On the other hand, late replacement of fixed assets improves ratio of production to capital expenditure, but it increases maintenance cost. Therefore proper balance is necessary. Organization spent large amount (direct expenditure) for assets like direct material, direct wages, land, building, equipment etc. But a production system incurs a lot of direct expenditure like salaries of manpower employed in planning, store keeping, record keeping, inspection etc. Indirect labor is also used for material movement, good housekeeping, cleaning etc. Indirect expenditure is incurred on indirect material like tools, oils, lubricant etc.

III. 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.

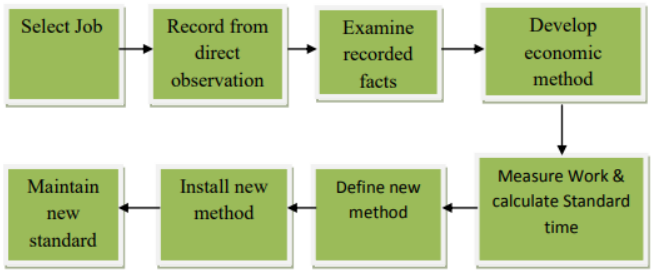


Fig: Work Study Procedure

Basic procedure of Work Measurement

The basic procedure needs to be understood to apply modified technique of work measurement. The basic procedure is divided into 6 steps namely selection, recording, examining, measuring, compiling and precisely defining methods. Full steps need to be performed only when standard time is to be calculated. These steps and the techniques necessary for measuring work are shown in Figure below.

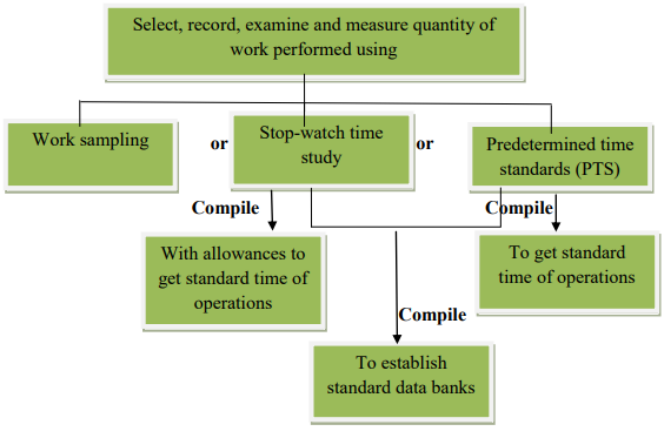


Fig: Basic Procedure of Work Measurement

Techniques of Work Measurement

The work measurement is carried out by using following principle techniques as shown in Figure

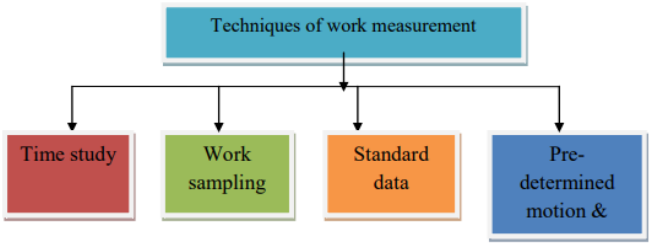


Fig: Techniques of Work Measurement

Time study: Time study is the technique of work measurement to establish time for a qualified worker to carry out specified task under specified conditions and at defined level of performance. Basic time study equipment consists of – a stop-watch, a study- board and time study forms. The time study procedure consist of steps such as (i) Selection of Job (ii) Standardization of Method (iii) Select the operator for study (iv) Recording of details (v) Measure the duration of each element (vi) Calculating representative time of each element (vii) Convert observed time into normal time (viii) Calculate relaxation and other allowances (ix) Calculate Standard time. Time study can be performed depending on the accuracy of stopwatch method, time recording machine and motion picture camera.

Work Sampling: Work sampling was pioneered by L.H.C. Tippet in a British Textile Mill. It is defined as "A technique in which a statistically competent number of instantaneous observations are taken, over a period of time, of a group of machines, process or workers. Each observation records what is seen to happen and the percentage of observations recorded for a particular activity or delay is a measure of percentage of time

observed by the occurrence". It is a method of finding the percentage occurrence of certain activity by statistical sampling and random observations.

Standard Data: Large numbers of operations in a plant have several common elements. When similar elements and jobs are present throughout a plant, the standard data system of work measurement can be used. Standard data consist of tables, curves and charts built up from various basic job constituents called as elements. These elements along with the time are used to set output standards for new jobs for organization. Standard data elements must first be measured by any of the three work measurement systems: Time Study, PMTS or work sampling.

Predetermined Motion Time Study (PMTS): These systems utilized the time study and micro motion techniques of the earlier techniques to determine and assign times to specified basic motions. It is a work measurement technique whereby time established for basic human motions are used to build up the time for a job at a defined level of performance. PMTS is also called as Predetermined Time Standards (PTS). The motions and associated times were catalogued. Work measurement then became a matter of establishing the best basic motion pattern to perform a certain task and, from the catalog or data card, assigning the appropriate predetermined time for each basic motion in that pattern. Since times for all motions are predetermined, it is possible to accurately predict future task times. The catalogs of predetermined times leveled to 100% of performance time.

IV. TECHNIQUES OF WORK STUDY AND THEIR RELATIONSHIP WITH PRODUCTIVITY IMPROVEMENT

Method study and work measurement are closely linked to each other as both are associated with work study. Method study reduces the content of job and work measurement investigates and reduces ineffective time associated with job with establishment of standard time. This results into efficient working operations leading to increase in productivity of that process.

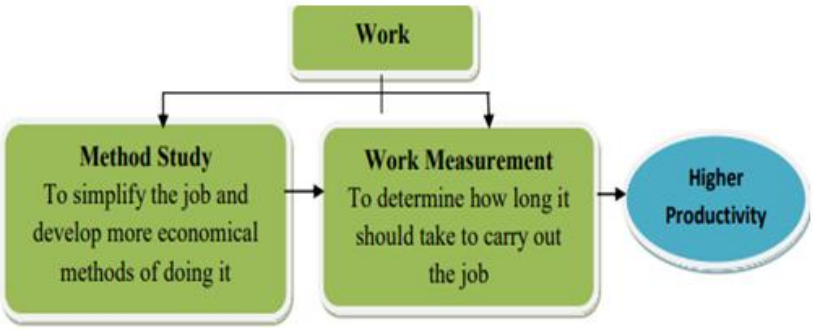


Fig: Relationship between Method Study and Work Study

V. PROBLEM FORMULATION

The study area includes production lines of Gear manufacturing. This production line includes 5 machining centers, and 1 CMM machine for inspection. The line production is lagging behind the target due to line imbalance. So time study technique has been decided to measure the work. Cycle times of all machines measured with element and their breakpoints wise. This work illustrates one such example of eliminating non value added time in an operation. It shows the flow of counterstriking the problem and suggests the productive way to be carried out for work measurement.

Present study was done on application of time and work study technique, because of its high non value added time in an operation.

Fig: Spur gear manufacturing

THE PRESENT COMPANY IS FACING A HIGH NON VALUE ADDED TIME, AFTER OBSERVING DATA OF THE COMPANY MOST FREQUENTLY NON-VALUE ADDED ACTIVITY WAS IDENTIFIED.

This work is aimed at improving productivity of mixed model production system of a medium scale manufacturing industry through work measurement approaches. The work measurement of various elements of the work cycle has been made on the basis of recommendations of ILO. The work cycles were divided into small measurable work elements. These elements were recorded on the observation sheet. Observations have been recorded for different trails to analyze the operation effectively for identification of value-added and non-value added element.

The production department was identified to have certain work processes that could be made reluctant, as these steps consumed extra time and extra effort, in addition to increasing the cost of its product. Moreover, these processes resulted in worker's fatigue, which proved as a damper to improvement of productivity

VI. OBJECTIVE

In today's challenging market, every organization is looking to achieve higher quality and productivity. Productivity improvement is an everlasting continuous activity in manufacturing. Industries need to develop capability of coping up with customer demands to deliver quality products on time. Continuous improvement is the need of the hours which can be achieved by incorporating flexibility in layout, design and processes The objectives are as follows:-

Reduced machine idle time
Increase productivity.
Reduce worker's fatigue.
Establish the standard performance methods and standard cycle time involved
Optimally use equipment and manpower.
Eliminate wasteful efforts, as well as useless handling material.

VII. METHODOLOGY

The study illustrated in this work does measure the work content and cycle times but also helps in analyzing the different elements consuming non value aided time in the whole operation. Initially the whole production line is studied for machine wise cycle times. Then the bottleneck stations were treated under elemental study using time study technique. Then the work cycles were broken into operations and operations were divided into measurable elements. For each elements cycle time has been noted down on observation sheets. These times were analyzed and non-value added elements were eliminated to conclude for productivity improvement.

For the above explained operation, the elements and breakpoints were listed at the time of work measurement was undertaken, and were then noted on study sheet prepared for the time study.

Fig: Flow chart of study

EXISTING PROCESS

The process flow of existing process for the Gear Cutter product is mentioned as follows:

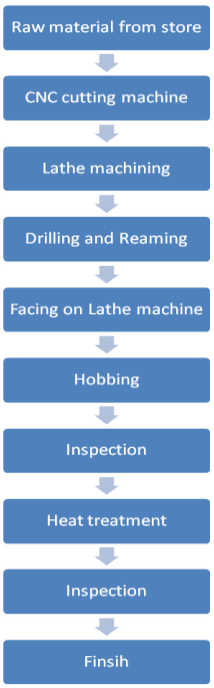


Fig: Process flow of Gear Manufacturing (existing process)

As per the existing process flow, the product gear need standard processes and 25.5 min to produce complete component, which is in actual a time consuming process. To find out actual standard time of existing process, need to calculate it in details

DATA ANALYSIS OF EXISTING PROCESS

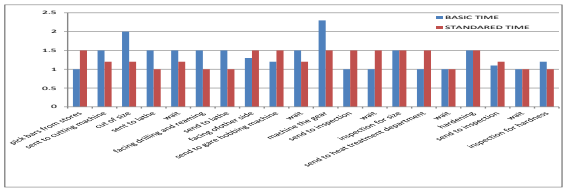


fig:- Data analysis of existing process

VIII. RESULT AND DISCUSION

The operational analysis involve measurers aspect involve estimation and assessment and prominent outstanding performance. It meant it was first understood time is managed by The activity performed at each station timed randomly at any time and it was always kept in mind that the average is derived from of the timings and worker and a relatively inexperienced worked. To affect these readings were scattered in all the three or two working time to different labors

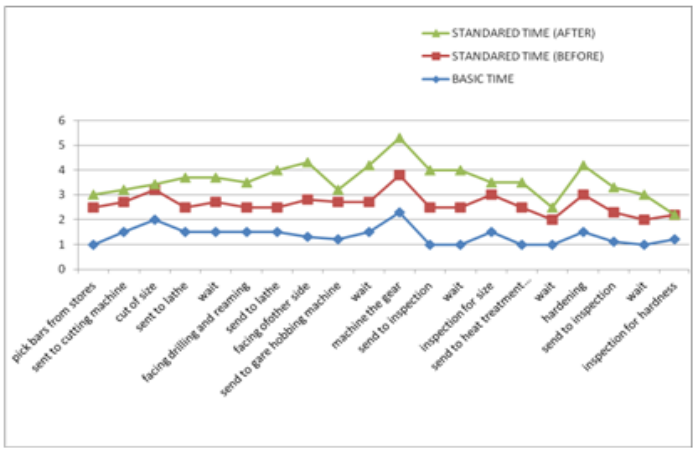
The main reason for the study being started was the continuing drive in the factory to achieve higher production levels. In starting due to the low volume of production the company was more aimed to establishing the brands in the market. Once the market potential was know the company went about improving production by reducing the know waste and losses.

One of the main areas of concern in this production drive was the effective use of the available capacity to be included the labor required. The focus of the study in the assembly line rotates around reducing the ineffective time avoidable activities.

The other relevant reason was the accurate estimation of the work content in the entire line in time units, so as to find the required time for assembly of the studied model. It helps in finding approximate the maximum output that can be drawn.

S.no.	Process	Basic time (min)	Allowance (min)	Std Time (min) (Before)	Std Time (min) (After)
1	Pick bars from stores	1	0.5	1.5	0.5
2	Sent to cutting machine	1.5	0.7	1.2	0.5
3	Cut to size	2.0	0.5	1.2	0.23
4	Sent to Lathe	1.5	0.5	1	1.2
5	Wait	1.5	0.3	1.2	1
6	Facing drilling and reaming	1.5	0.5	1	1
7	Send to Lathe	1.5	0.5	1	1.5
8	Facing of other side	1.3	1.5	1.5	1.5
9	Send to Gear hobbing machine	1.2	0.3	1.5	0.5
10	Wait	1.5	0.7	1.2	1.5
11	Machine the gear	2.3	2.2	1.5	1.5
12	Send to inspection	1	0.5	1.5	1.5
13	Wait	1	0.5	1.5	1.5
14	Inspection for size	1.5	1.0	1.5	0.5
15	Send to heat treatment dept.	1.0	0.5	1.5	1
16	Wait	1.0	1.0	1	0.5
17	Hardening	1.5	1.0	1.5	1.2
18	Send to inspection	1.1	1.1	1.2	1
19	Wait	1.0	0.5	1	1
20	Inspection for hardness	1.2	1.3	1	0.5
	TOTAL			**25.5**	**20.63**

Graphical Analysis



IX. CONCLUSION

Work measurement includes time study and motion study as well. Work measurement should be carried out by conducting both time and motion study in order to achieve reasonable results. Before conducting time study, it is very much necessary to consider the motion study also. Hence motion study can be considered as a basis for time study. As discussed earlier, time study measures the required time to perform the operation as per the specified process flow. Authors studied the time study on bottleneck stations to eliminate the unnecessary time to improve the production quantity on machine. Basic time has been calculated for each element and then analyzed the obtained data for changes to be implemented on machine.

During the study of the process of the gear manufacturing plant, existing processes are examined critically with method study & layout technique.

From the above discussion it can be concluded that the process can be improved based on method study, work procedure and proper utilization of machine. It will improve the current process by reducing the process, time and the worker's fatigue. After implementing the suggested improvement ideas the firm is able to increase its productivity by 27.77%.

With the help of recorded observation and discussion with manager of the company, improved flow process chart are suggested.

X. FUTURE SCOPE

The study is limited to few departments only, the other issues leading to the availability, performance and quality loss which ultimately leads to a loss in productivity. In this project, the study is done and suggestions are given which is implemented, resulting in an exact increase in production and Efficiency of

workers and Operators. Since it is a continuous running industry the work is limited to the particular departments and the calculations to the other departments are not made. Observations for individual machines and operators for other department scan be studied and overall plant cost reduction can be perform in future research work.