A Research on Designing the use of Industrial Engineering Tool to Improve Productivity

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Abstract— This project aims to design a combination of various industrial engineering tools to study productivity of a manufacturing and assembly line. The motive is to conduct a study of plant and conclude various parameters affecting the productivity of a product such that improvement in productivity is achieved at the end. As concern of my area of interest in the field of design and industrial Engineering I choose this project offered by company. This type of study project concept is important since the productivity improvement by study project is the hidden benefits of the organization. To improve the ergonomically conditions of the working places, the associate space for movement, the mental condition of associate can improve by such type of study projects. And the results of this type of projects are become a lifelong benefit of the organization. The communication gap between the management and associate can be minimizing by such type of projects.

Keywords: Bolt, Bolted Joints, Vibration, Loosening of bolts, Junker test, Fasteners

I. INTRODUCTION

A. *Tools of Industrial Engineering:*

Industrial engineering is concerned with design, improvement and installation of integrated system of men, material and equipment. It draws upon specialized knowledge and skills in the mathematical, physical sciences together with the principles and methods of engineering analysis and design to specify predict and evaluate the results to be obtained from such systems.

The prime objective of industrial engineering is to increase the productivity by eliminating waste and non-value adding (unproductive) operations and improving the effective utilization of resources.

B. *History and Development of Industrial Engineering:*

History of industrial engineering dates back to industrial revolution and it has passed through various phases to reach the present advanced and developed stage. Though Frederick Taylor is named as father of scientific management and Industrial Engineering, there are many others who

1) Work study:

Work study forms the basis for work system design. The purpose of work design is to identify the most effective means of achieving necessary functions. Historically, this workstudy aims at improving the existing and proposed ways of doing work and establishing standard times for work performance. Work is an activity in which one exerts physical and mental effort to accomplish a given task or perform a duty.

1) Task: An amount of work that is assigned to a worker or for which a worker is responsible.
2) Work Element: A series of work activities that are logically grouped together because they have a unified function in the task

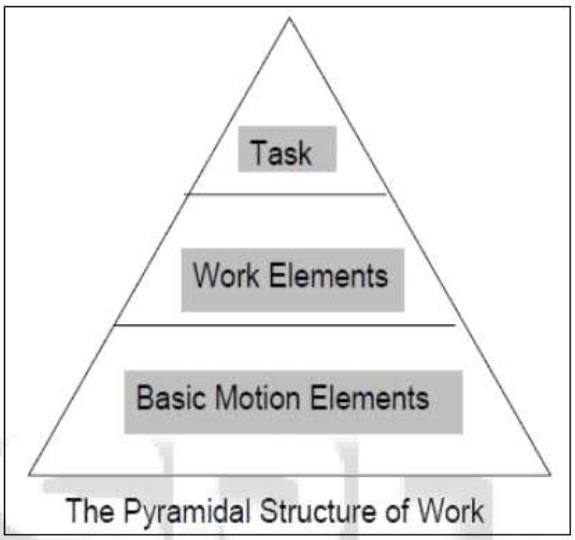


Fig. 1.1: Physical Structure of work

A work element consists of multiple basic motion elements

3) Examples: Reaching for an object, Grasping the object, Moving the object, Walking, Eye movement

2) Method study:

Method-study concerned with "the way in which work is done (i.e., method)". It is used to simplify the way to accomplish a work and to improve the method of production. Method-study results in a more effective use of material, plant, equipment and manpower. Method study is essentially concerned with finding better ways of doing things. It adds value and increase the efficiency by eliminating unnecessary operations, avoidable delays and other forms of waste.

The improvement of efficiency is achieved through:

- Present and analysis true facts concerning the situation.
- To examination those facts critically
- To develop the best answer possible under given circumstances based on critical examination of facts.

3) Work Measurement:

Work measurement is the application of techniques designed to establish the time for a qualified worker to carry out specified jobs at a defined level of performance or at a defined rate of working. A qualified worker is one who has acquired the skill, knowledge and other attributes to carry out the work in hand to satisfactory standards of quantity, quality and safety.

Defined rate of working is the amount of work that can be produced by a qualified worker/employee when working at normal space and effectively utilizing his time and where work is not restricted by process limitation.

4) Time study:

Time study is also called work measurement. It is essential for both planning and control of operations. According to British Standard Institute time study has been defined as "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."

Time study is a direct and continuous observation of a task, using a timekeeping device (e.g., decimal minute stopwatch, computer-assisted electronic stopwatch, and videotape camera) to record the time taken to accomplish a task and it is often used when:

1) There are repetitive work cycles of short to long duration,
2) Wide variety of dissimilar work is performed, or
3) Process control elements constitute a part of the cycle.

5) Motion study:

Motion study is a technique of analyzing the body motions employed in doing a task in order to eliminate or reduce ineffective movements and facilitates effective movements. By using motion study and the principles of motion economy the task is redesigned to be more effective and less time consuming. Objective of motion study is job simplification so that it is less fatiguing and less time consuming. Lillian Gilbreth used motion picture to study worker motions – developed 17 motions called "therbligs" that describe all possible work. Traditionally, the data from micro motion studies are recorded on a Simultaneous Motion (simo) Chart while that from macro motion studies are recorded on a Right Hand – Left Hand Process Chart.

6) Plant layout and materials handling:

Plant Layout and Materials Handling offer very good scope for improvements and cost reduction. While developing improved methods it is necessary to give a. careful consideration to the layout and handling aspects. A poor layout involving' excessive movement of materials and men and improper utilization of space can considerably increase the manufacturing costs besides being unsafe. Some of the advantages of an improved layout and a handling system are:

1) Increased production
2) Savings in time and cost
3) Reduced materials inventory
4) Economy in space
5) Better working conditions, increased safety and greater job satisfaction
6) Improvement in quality and reduced damages tomaterials

7) Motion Economy and Workplace Layout:

There are a set of principles developed in order to achieve economy in movements and reduction in fatigue on the part of the operator. These are known as the "principles of motion economy". These principles are particularly applicable and useful for developing improved methods at the workplace. An understanding of these principles helps in the design of equipment, jigs, tools and fixtures, layout of workplaces and development of better methods and forms a basis for improving the utilization and reducing the fatigue. Classification of Movementsm The movements of the· Human Body have been classified under five groups, based on the pivots under which the body members move. The lowest classification of movement results in maximum economy and least fatigue. Thus the workplace layout should, as far as possible, be arranged in such a way that the movements involved conform to lower classifications. The principles of motion economy may be classified under three headings:

1) 1)Use of the human body
2) Arrangement of the workplace
3) Design of tools and equipment

II. LITERATURE REVIEW

Productivity can be defined as a ratio between output and input. Productivity improvement is a critical success factor and the foundation of profitability [1]. Productivity measurement is a long-term measurement. Any changes in dynamic potential show a growth or reduction of figures over a long period [2]. Industrial Engineering in the other hand concerned with the design, improvement, and installation of the integrated system of men, materials, and equipment. It draws upon specialized knowledge and skills in the mathematical, physical, and social sciences, together with the principles and methods of engineering analysis and design, to specify, predict and evaluate the result to be obtained from such a system [3]. Today, quality plays an important role as it leads to increasing number of product sold and also increment of company profit. Productivity, quality, and cost of operation relatively depended to each other. By improving the productivity, the quality also must be improved and hence lower the reject rates or defects [4].

Engineer needs to know what the main problem is, the causes of the problem before they proposed any solutions. However, logical and systematic method should be applied to make the job easier by locating and eliminating the root cause of the problem. There are many techniques [5] available in problem solving, ranging from simple and easy to use methods to relatively complicate and advance statistical tools

[6]. The Seven QC Tools are easier to apply and understand and yet proven scientific management tools. It can be used in all process phases, starting from the beginning of a product development up to management of a process, on day to day basis and in systematic manner [7]. They form the fundamental foundation for all problem solving and quality control activities. Generally, the Seven QC tools are check sheet, Pareto chart, flowchart, cause and effect diagram, histogram, scatter diagram and control chart [8] and [9]. These tools are also known as Total Quality Management (TQM) tools [10]. Many researches have been done using seven quality control tools. Pierchala and JyotiSurti [11] and Winco [6] used Statistical Process Control to solve problems their case study. Jafri and Chan [4] presents a case study in plastic injection molding company deployed check sheets, pareto chart, cause and effect diagram and control chart to improve the monthly defect quality from 13.49% to 7.4%. Naser [12] used histogram, scatter plot and pie chart to investigate their case study. DMAIC is an abbreviation of the five improvement steps comprising of Define, Measure, Analyze, Improve and Control. This method is often described as an approach to problem solving. DMAIC is applicable to empirical problems ranging from wellstructured to semi-structured, but not to ill-structured problems or

pluralistic messes of subjective problems. The advantage of such methods is that they are very versatile [13].

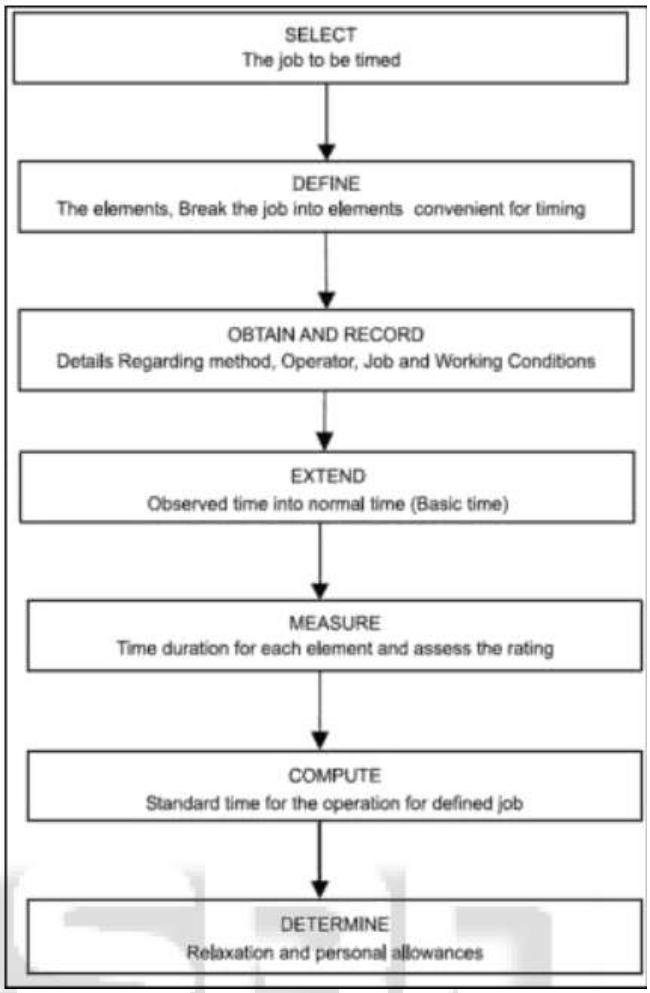
III. STEPS IN MAKING TIME STUDY

Stop watch time is the basic technique for determining accurate time standards. They are economical for repetitive type of work. Steps in taking the time study are:

1) Select the work to be studied.
2) Obtain and record all the information available about the job, the operator and the working conditions likely to affect the time study work.
3) Breakdown the operation into elements. An element is a instinct part of a specified activity composed of one or more fundamental motions selected for convenience of observation and timing.
4) Measure the time by means of a stop watch taken by the operator to perform each element of the operation. Either continuous method or snap back method of timing could be used.
5) At the same time, assess the operators effective speed of work relative to the observer's concept of 'normal' speed. This is called performance rating.
6) Adjust the observed time by rating factor to obtain normal time for each element

$$\text{Normal} = \frac{\text{Observed time} \times \text{Rating}}{100}$$

7) Add the suitable allowances to compensate for fatigue, personal needs, and contingencies. etc. to give standard time for each element.
8) Compute allowed time for the entire job by adding elemental standard times considering frequency of occurrence of each element.
9) Make a detailed job description describing the method for which the standard time is established.
10) Test and review standards wherever necessary. The basic steps in time study are represented by a block diagram in Fig.



IV. PRINCIPLES OF MOTION ECONOMY AND WORKPLACE

A. Layout:

There are a set of principles developed in order to achieve economy in movements and reduction in fatigue on the part of the operator. These are known as the "principles of motion economy". These principles are particularly applicable and useful for developing improved methods at the workplace. An understanding of these principles helps in the design of equipment, jigs, tools and fixtures, layout of workplaces and development of better methods and forms a basis for improving the utilization and reducing the fatigue. Classification of Movements.

The movements of the· Human Body have been classified under five groups, based on the pivots under which the body members move. The lowest classification of movement results in maximum economy and least fatigue. Thus the workplace layout should, as far as possible, be arranged in such a way that the movements involved conform to lower classifications.

The principles of motion economy may be classified under three headings:

1) Use of the human body
2) Arrangement of the workplace
3) Design of tools and equipment

1) Use of the Human Body

1) The two hands should' begin as well as complete their motion at same time.
2) Arrangement of the workplace
3) Design of tools and equipment

2) Use of the Human Body

1) The two hands should' begin as well as complete their motion at same time.
2) The two hands should not be idle at the same time except during rest periods.
3) Motions of the arms should be made in opposite and symmetrical directions, and should be made simultaneously.
4) Hand motions should be confined to the lowest classification with which it is possible to perform the work satisfactorily.
5) Momentum should be employed to assist the worker wherever possible, and it should be reduced to a minimum if it must be overcome by muscular effort.
6) Smooth continuous motions of the hand are preferable to zig zag motions or straight line motion involving sudden and sharp changes in direction.
7) Ballistic movements are faster, easier, and more accurate than restricted (fixation) or 'controlled' movements.
8) Rhythm is essential to the smooth and automatic performance of an operation and the work should be arranged to permit easy and natural rhythm wherever possible.
9) Work should be arranged so that eye movements are confined to a comfortable area, without the need for frequent changes of Focus.

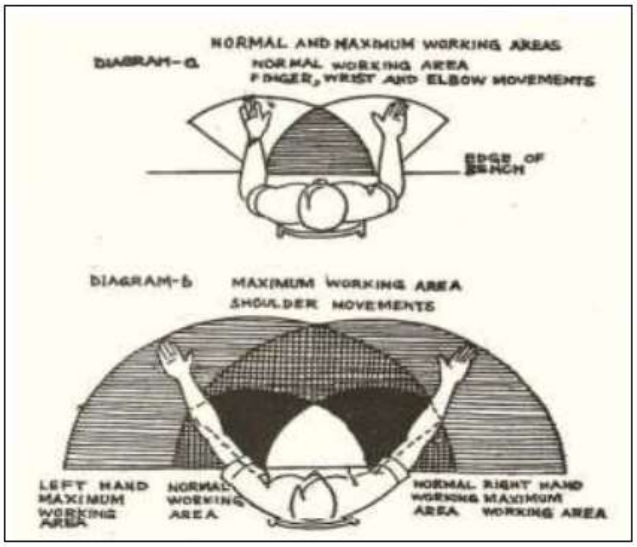
3) Arrangement of the Workplace

1) There should be a definite and fixed place for all tools and materials to permit habit formation.
2) Tools, materials, and controls should be located close in and directly in front of the operator within the maximum working area.
3) Gravity feed bins and containers should be used to deliver material close to the point of use.
4) "Drop deliveries" should be used wherever possible.
5) Materials and tools should be located to permit the vest sequence of motion.
6) Provisions should be made for adequate conditions for seeing. Good illumination is the first requirement for satisfactory visual perception.

B. Working Areas

The working areas of an operator can be classified into normal and maximum working areas. The normal working area is the area covered by an arc made by the fingers with the elbow as the pivot. The maximum working area is the semi-circular area covered by the hand when it is fully stretched with shoulder as the pivot. Anything beyond the maximum working area will involve the class 5 movement, i.e., movement of the trunk. There is a normal and a maximum working area for each of the two hands. Figure 20 shows the working areas for the two hands. The immediate area right in front of the operator is the most accessible involving least movements.

A knowledge of these working areas will be helpful in arranging the workplace.



C. Notes on Workplace Layout

A few general notes on laying out the workplace may be useful.

- If a similar work is being done by each hand there should be a supply of the same materials or parts for each hand.
- If the eyes are used to select material the latter should be kept as far as possible in an area where the eyes can locate them without turning the head.
- The nature and the shape of the material' influence its position in the layout
- Hand tools should be picked up with the least possible disturbance to the rhythm and symmetry of movements. As far as possible the operator should be able to pick up or put down a tool as the hand moves from one part of the work to the next, without making a special journey. Natural movements are curved, not straight; tools should be placed on the arc of movements, but clear of the path of movement of any material which has to be slid along the surface of the bench.
- Finished work should be
  1) dropped down a hole or a chute;
  2) dropped through a chute when the hand is straight the first motion of the next cycle;
  3) put in a container placed so that hand movements are kept to a minimum;
  4) If the operation is an intermediate one, the finished work should be placed, in a container in such a way that the next operator can pick it up easily.
- Always look into the possibility of using pedals for operating locking or indexing devices on fixtures or devices for disposing of finished work.

V. RESULTS

It is expected that the work will provide the effective combination of industrial engineering tools such that production efficiency could be improved. So we studied this operation cycle and discussed with management of KFIL for this operation station. They discussed about extra man power

utilization for material handling and told to do study on, how to minimize this man power?

Operation	Machine	Total Cycle time In min	No. of Components per month	Operators Per shift	Machining cost per unit	Machining cost per month
1	OLD SPM	17.11	2103	3	20	1, 01,880
2	NEW SPM	5.5	6792	1	15	42,060

Justification of new SPM locus clearance milling

VI. CONCLUSION

This project aims to design a combination of various industrial engineering tools to study productivity of a manufacturing and assembly line. The motive is to conduct a study of plant and conclude various parameters affecting the productivity of a product such that improvement in productivity is achieved at the end. Here we think about the effort minimization of associates in material handling and number punching. We search the solution for number punching automation and we found the one company who is only gives the solution of punching technology.

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