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An Overview of Method Study and Study of Different Recording Techniques

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Abstract: ***Method study is a process in which work is critically and systematically examined in order to develop more efficient and easier ways to accomplish the task. It involves systematic recording and scrutinized inspection of existing and proposed ways of doing work for developing more effective methods and thereby reducing the overall cost. Simplification of work or the working methods to achieve higher productivity is the basic motive of method study. In this paper, we have analyzed the process of method study, and the different techniques used for recording work. We have also examined the various applications of recording techniques based on the type of job and the accuracy required.***

Keywords: Method Study, Process Charts, Micro Motion Analysis, SIMO Charts, Flow Diagrams, Cycle Graphs, Chrono Cycle Graphs

1. Introduction

In any operation, managing people involves actual design decisions about the jobs, methods, different relationships between jobs and machines and systems of control and communication. Work design deals with complex relationships between operative staff, supervisors and specialist people, which are not mere extensions to machines. Even though a worker‟s performance may be better than a machine‟s capability, yet a machine may draw away from the human being for many tasks due to its precision superiority. People can sometimes be impaired physically by various operating environments or sometimes be trapped socially and psychologically by them. As a result, the designing of various operating systems and the jobs and performance relationships within them are of great operational, economic and social importance. Therefore, method study is basically a collection of sundry techniques that are used to inspect work, the way the work is done, and how it is done. As such, there is a systematic analysis of all the factors, resources, elements and the different relationships affecting the efficiency and the effectiveness of the work being studied, and more efficient and effective methods are designed based on these results.

2. Objectives of Method Study

Method study is essentially concerned with finding better ways of doing things, and it contributes to improved efficiency by getting rid of unnecessary work, avoidable delays and other forms of waste. Method study aims at accomplishing the following few objectives:

- Improving the current processes and procedures.
- To add value to the operations under consideration or evaluation by eliminating the excess work content.
- Improving the factory and the work place layout.
- Improving the use of materials, plant and equipment and manpower.
- Reducing the monotony of work and smoothen the material flow with minimum back tracking and thus improving layout.

3. Scope of Method Study

The task of work simplification and compatible work system design concerns the following:

- Layout of shop floor and working areas or work stations.
- Workmen and materials movement with minimum of backtracking.
- Reducing cost through reduction in cycle time of operation.
- Power required and available.
- Material handling equipments and the ways to handle them.
- Working conditions i.e. ergonomics, etc.

4. Procedure for Method Study

Method study aims at eliminating unnecessary operations and achieving the best method to perform the required operation. Procedure for method study involves eight standard steps that are explained below:

- Selection of Process/Job: The first step, once the Method Study idea is conceived, is the orientation and determination of objectives. Appropriate job or process must be selected based on economic and cost effective considerations, technical considerations and human considerations.
- Recording the facts: Adequate facts about the existing system must be collected before the method or procedure is discarded. This is done to confirm that an objective record

of the way the job is carried out is maintained. To avoid any prejudice, this record is based on direct observation by the concerned investigator.

- Critical examination of the facts: This is an important stage of Method Study. The information that is being collected is scrutinized, recorded facts are analysed critically and challenge everything to be done which includes, purpose of activity, place where the following operation is performed, sequence of operations, the concerned person who is doing it, time required for completion of the activity, etc.
- Developing new method: The alternatives selected are further used to recreate and develop the new methods, layouts or procedures. These methods are further tested for their feasibility. The departmental officers are also involved in order to ease the problems of acceptance for the new method in the department. The end result must be a most economic method that takes into account all the circumstances such as contributions of managers, supervisors, workers and other specialists.
- Evaluation of the results: The results attained by using the improved method are then evaluated, compared with the quality of work involved, and the standard time for the work is calculated.
- Definition of the new method: The new method and the related time is defined to all concerned with the work either verbally or in writing using demonstration.
- Installation of the method: Before the new method is installed, certain decisions must be taken on any changes included in the production process, requirement to order any new plants or materials, introduction of new documentation process, setting new quality standards and test procedures, etc. Once the new method is installed, necessary training must be provided to those involved as an agreed practice with the allotted standard time.
- Maintaining the method: New standard practice must be maintained by monitoring the results and comparing them with original targets. When a new method has been installed, it tends to change slowly as a result of minor alterations made by the operators or supervisors. To detect any alterations, a reference standard e.g. a job instruction sheet is needed against which the job can be compared. Similarly, an analogous document for a motive plan, which also contains details of the standard time for each job, called a job specification, is drafted. As such, with this information, changes in method can be identified. If the changes prove to be useful, the instruction sheet can be revised to include them. Whereas, if they are thought undesirable, they can be eliminated through line management.

5. Recording Techniques

Method study uses formal techniques to record the sequence of activities, the time relationship between different activities, the movement of materials and the movement of staff. The recording techniques must be critically drafted, as the triumph of method study largely depends upon this particular step. The recording techniques should be designed with a view to simplify the work and standardize the recording process.

For recording the time relationship between parts, the chief techniques used are: Multiple activity charts and Simo Charts.

For recording the movements, the chief techniques used are: Memo-motion analysis, Micro-motion analysis and Flow diagrams. However, the most commonly used technique used for recording is by using flow charts. These are classified into three different types, viz. Outline Process Charts, Flow Process Charts and Two Handed Process Chart.

6. Method Study Symbols For Recording The Facts

Graphical method of recording was originated by Gilberth, in order to make the presentation of the facts clearly without any ambiguity and to enable to grasp them quickly and clearly. It is useful to use symbols instead of written description. The table shows a list of different symbols used for recording the facts:

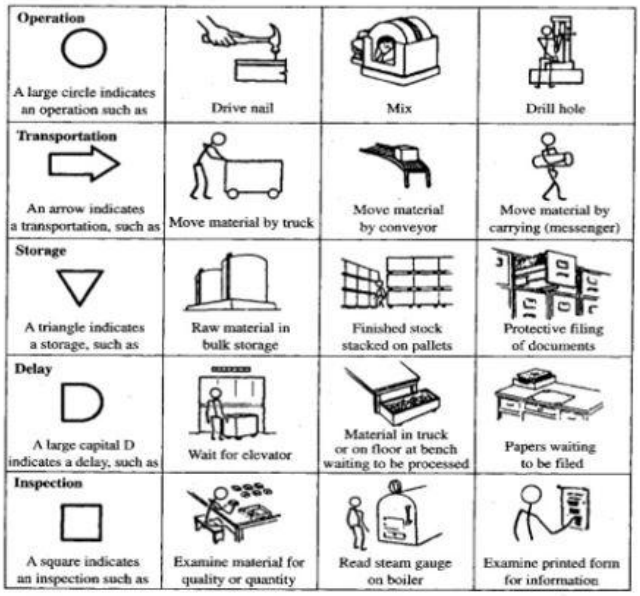

Figure 1: Method Study Symbols For Recording The Facts

The five basic method study symbols include:

O OPERATION
□ INSPECTION
→ TRANSPORTATION
D DELAY
∇ STORAGE

Operation: When an object is intentionally changed in one or more of its physical or chemical characteristics operation occurs. It includes the main steps involved in a process, method or procedure. An operation always takes the object one stage ahead towards completion.
Some examples of operation are:

- Turning, drilling, milling, etc.
- A chemical reaction.
- Welding, brazing and riveting.
- Lifting, loading, unloading.
- Getting instructions from supervisor, etc.

Inspection: When an object is critically examined and compared with the standard for quality and quantity, an inspection occurs.
Some examples of inspection are:
- Visual observations for finish.
- Count of quantity of incoming material.
- Checking the dimensions.

Transportation: When there is a movement of workers, materials or equipment from one place to another, it is termed as transportation. Some examples of transportation are:
- Movement of materials from one work station to another.
- Workers travelling to bring tools.

Delay: When the immediate performance of the next planned thing/process does not take place, a delay occurs. Some example of delay are:
- Work waiting between consecutive operations.
- Workers waiting at tool cribs.
- Operators waiting for instructions from supervisor.

Storage: Indicates a controlled storage in which a material is issued or received from the store under some form of authorization, or an item is retained for reference purposes.
Some examples of storage are:
- Raw material in bulk storage.
- Finished stock stacked on pallets.
- Protective filing of documents.

7. Process Charts

Process charts are one of the finest recording techniques that are used in work study. The various types of process charts are as follows:

Operation Process Chart (Outline Process Chart):
An operation process chart / outline process chart is a process chart which gives an overall view of a process by recording only the main operations and sequences in proper order. As such, such a chart requires only the symbols for „Operations" and „inspection". In this chart, a brief note of the nature of each inspection and operations is written beside the symbol. The allowed time if known is added as well. The following example shows the operation process chart for the assembly of two plates with rivets:

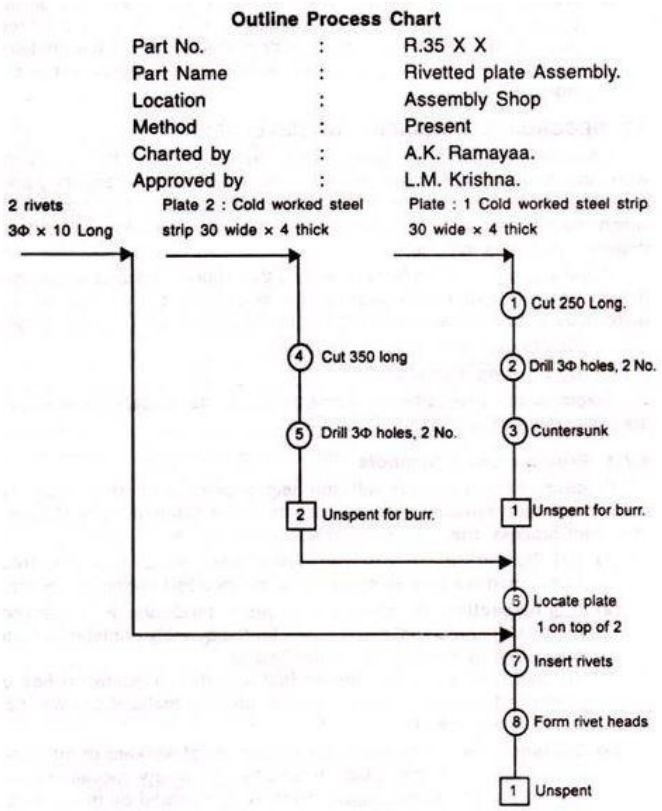

Figure 2: Operation Process Chart For The Assembly Of Two Plates With Rivets

An operation process chart holds the following advantages:
Improved plant layout.
- For specifying the basic manufacturing system.
- For determining the sequence of assembly.
- To introduce manufacturing system to new technical personnel.

Flow Process Chart:
Flow process chart is a graphical representation of the sequence of steps or tasks (workflow) constituting a process, right from raw materials to the final finished product. It serves as an important tool for examining the process in detail and to identify areas of possible improvements. It is also called a process map. It is basically an extension of operation process chart in which operations, inspection, storage, delay and transportation are represented. Flow process chart can be of three types:

- Man type flow process chart – This type of flow process chart record the activities by man.
- Material type flow process chart – This type of flow process chart deals with the events of materials, and records what happens to the material.
- Equipment type – This type of flow process chart records the events of equipment used in all stages of product development.

The following process chart represents a basic example of a Man and a Material type flow process chart for the Inspection of a Turned shaft:

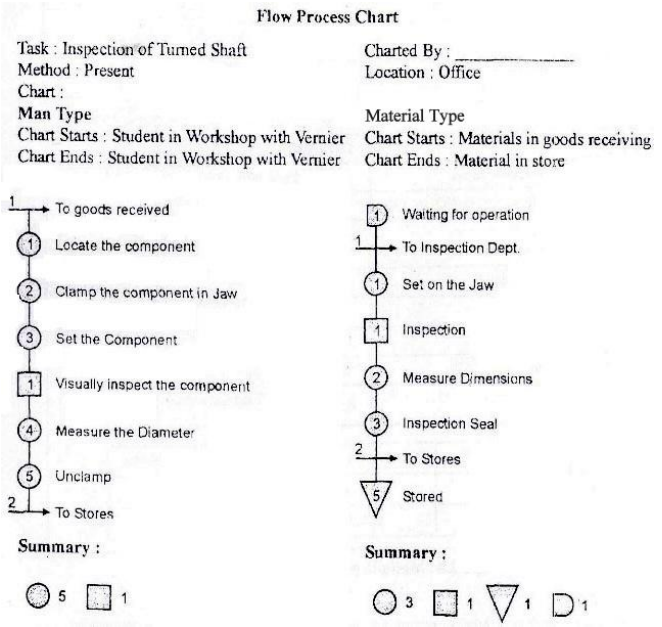

Figure 3: Flow Process Chart (Man & Material Type) For The Inspection of A Turned Shaft

The following process chart represents a basic example of an Equipment type flow process chart that is used to record the inspection of a turned shaft:

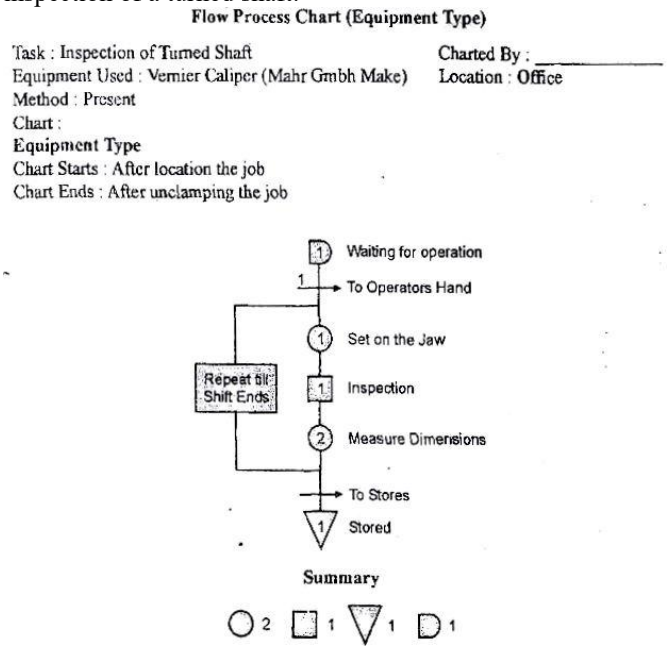

Figure 4: Flow Process Chart (Equipment Type) For The Inspection Of A Turned Shaft

Flow process charts are very useful to avoid long waiting time and insignificant delays, to reduce the cycle time of operation, to fix up the sequence of operations, to reciprocate the inspection stages and to minimize the distance travelled by men or materials and optimize the utilization of equipment during the working hours.

Two Handed Process Chart:

A Two-Handed Process Chart individually shows the movement of each hand in a manual process. It is typically used when analyzing a manual assembly process, to help make it easier to perform. Many a times, due to work involvement, the operator is unaware of the fact about what the other hand is doing and sometimes, this may lead to injuries to the operator. As a result, with the help of two handed process chart, the motion between both the hands can be precisely synchronized and avoid safety issues. Following is an example of a two handed process chart that shows the assembly of two washers and nut to bolt:

Left Hand Description	*Symbol (L.H.)*	*Symbol (R.H.)*	*Right Hand Description*
1 Move to bolt	⇒	⇒	Move to first washer.
2. Grasp the bolt	O	O	Pickup/grasp the washer.
3. Move to position	⇒	⇒	To position
4. Hold	∇	O	Assembled to bolt.
5.		⇒	Move to second washer.
6.		O	Pickup/grasp the washer.
7.		⇒	To position
8.		O	Assembled to bolt.
9.		⇒	Move to nut.
10.		O	Pick up the nut.
11. Move to box	⇒	⇒	To position.
12. Aside to box	O	O	Assembled to bolt

Figure 5: Two Handed Process Chart For The Assembly Of Two Washers And Nut To Bolt

As a result, with the help of two-hand process charts, a detailed knowledge can be attained regarding the job. Further, the relationships between two different activities can be attained. Therefore, different charts are made and then compared and then considering the principles of motion economy, the best method is found out.

Multiple Activity Chart:

The process charts using a time scale are basically termed as Multiple Activity Charts. It is generally used when a man studying work study wants to record the activities of a particular subject with respect to other on a single chart. The subject may be the worker, machine or equipment.

Now, depending upon the job, Multiple Activity Charts can be of the following types:

a) Man-Machine Activity Chart – When a single operator is working on a machine.
b) Multi-man Activity Chart – When a group of workers are working on a machine.
c) Man- Multi machine activity chart – When a single operator is working on a multiple machines.
d) Multi man- Machine chart – When a group of operators are working on a common central machine.

The chart below shows a man-machine activity chart showcasing the process of reading a deck of cards in card reader:

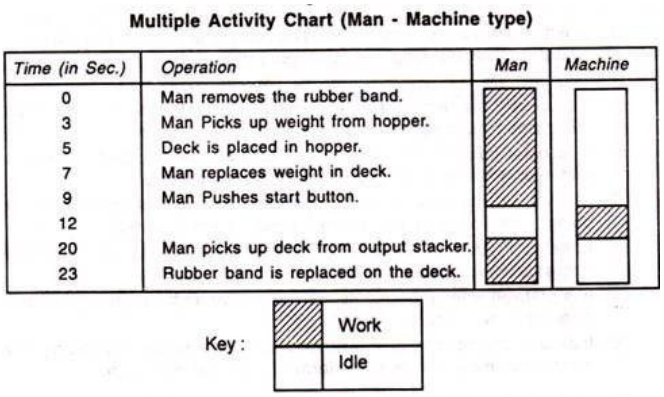

Figure 6: Man-Machine Multiple Activity Chart For Reading A Deck Of Cards In A Card Reader

Such a type of chart is generally used for enabling maintenance and the similar work to be organized so that the time expensive equipment out of commission can be reduced to minimum. The complex processes however can be recorded in a simpler manner. Such charts prove very useful in planning team work and construction jobs as well.

Travel Charts:
A chart that represents the quantitative data regarding the movement of workers, materials or equipment between different stations in a tabular form during a given period of time is called a travel chart. It can be used instead of string diagrams, as it‟s much easier to construct and takes less time as compared. It becomes very easy to record complex movements with the help of travel charts.

Travel chart usually consist of a square, which further consists a number of smaller squares. Each small sequence in the square represents a work station. A diagonal line is drawn from top left to bottom right.

The chart below shows a travel chart of the movement of workers in a workplace or a workshop that consists of 10 workstations:

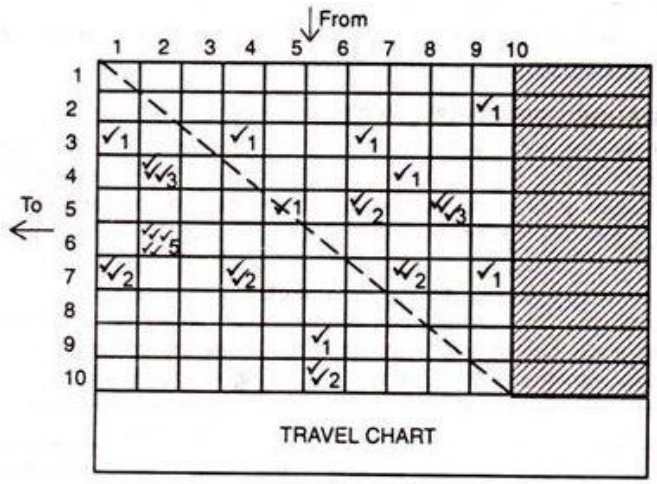

Figure 7: Travel Chart Of The Movement Of Workers In A Workplace

In the chart above, a big square in drawn and it is sub-divided into 10×10 smaller squares. Each smaller square represents a work station. The movement of the worker from any station to other stations in shown in the travel chart by a tick mark. Two tick marks indicate that the worker has moved between stations two times. All the movements and journeys are recorded in the same way.

8. Diagrams

The movement of material and men from one location to the other is involved in every business activity of manufacturing and service. Of these movements, some are unavoidable while others are unnecessary. As a result to overcome the unnecessary movements, the rearrangement of the facilities within the department or by applying changes in the sequence of activities is necessary. Process charts indicate the sequence of different events, but does not indicate the details about the movements. For this reason, diagrams are useful. Diagrams indicate the unnecessary long travel, obstacles, etc. with ease, and also proves to be very useful to study different plant layouts and interrelationships between different sections of organizations.

Diagrams can be broadly classified into the following four types:

- Flow Diagrams
- String Diagrams
- Cycle graphs
- Chrono cycle graphs

Flow Diagrams: Flow diagram is a scale plan on which movements of an object are presented by lines showing position of various machine tools, inspection, storage and other facilities on a scaled diagram. The various positions are connected by the different paths used by workers and material for movement. The relative positions of all the facilities are also shown in flow diagrams.

The figure below shows an example of a Flow Diagram used to represent the manufacturing of a Bi-Cycle pedal axle:

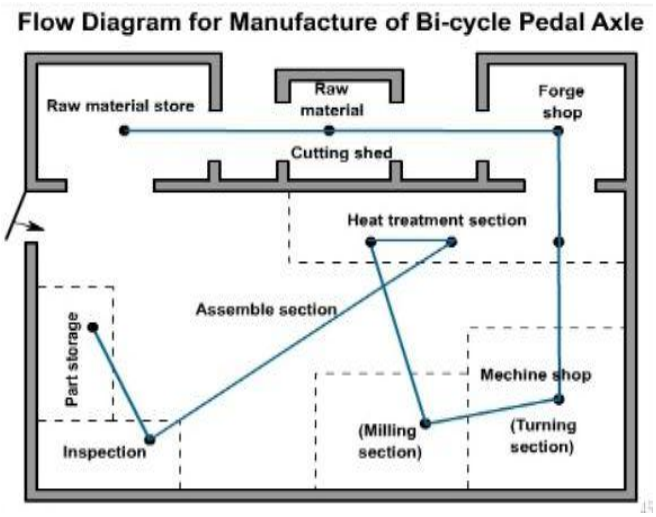

Figure 8: Flow Diagram Of The Manufacturing Of A Bicycle Pedal Axle

String diagram: It is scale plan or model on which a string or a thread is used to trace and measure the path of workers, material or equipment during a specified sequence of events. Usually, the repetitive movements are difficult to trace on flow diagrams, and therefore string diagrams are used in such cases. String is very useful to deal with complex movements, plant layout and design problems. It proves to be very useful in testing relative values of different layouts. The string is threaded around different locations with the help of a peg. A peg is a location around which string can be threaded to show the movements. As such, the thread when measured gives the approximate distance travelled by the worker or the material for which the string diagram is plotted.

The figure below shows a string diagram of a metal worker during the manufacturing of a metal box:

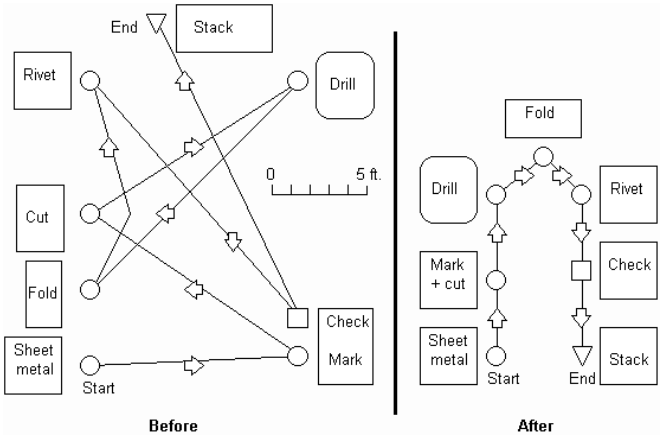

Figure 9: String Diagram Of A Metal Worker During The Manufacturing Of A Metal Box

The initial diagram on the left shows the path of motion of the metal worker that involves several unnecessary movements. Considering the string diagram, a more efficient and movement economical path for the worker is developed in order to avoid unnecessary movements and to ease accessibility.

Cycle graph and Chrono Cycle Graph: Both these techniques were developed by Gilbreth. Both these techniques are used to record the motion path of an operator. These techniques require filming equipment, as the movement of the operator are to be filmed in these methods. Rapid movements which are very difficult for the human eye to trace are traced by these techniques. In drafting a cycle graph, a small electric bulb or any small light source is attached to the hand, finger or any other part of body whose motion is to be analysed. The path of the light from the bulb would therefore be the same as that of the body member. As the bulb moves through space for a complete cycle, the path of the bulb is photographed by various filming equipment. The figure below shows an example of a cycle graph of an operator performing change of tools:

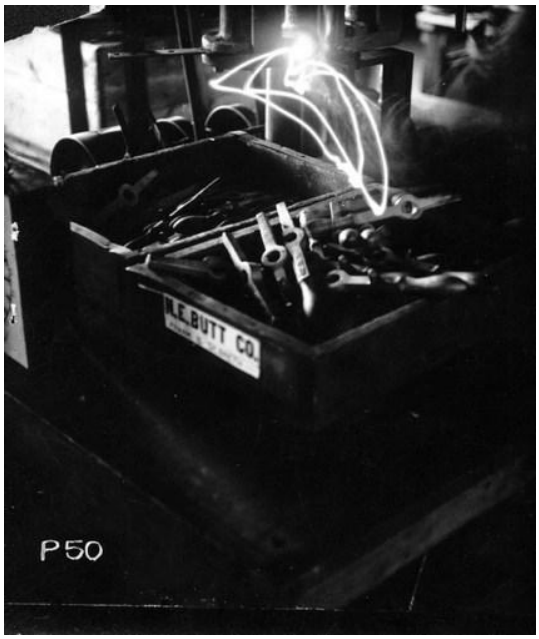

Figure 10: Cycle Graph Of An Operator Performing Change Of Tools

The direction of the operator however cannot be traced out in cycle graphs, as it shows a continuous line of light of the path through which the operator moves. For this purpose, a Chrono Cycle Graph is used. Chrono Cycle Graph also indicates the direction of the body movements of the operator. It incorporates a system of interrupting the light source from about 10 to 30 times per second. As such, instead of getting a continuous line of path, a path consisting of numerous pear shaped spots is attained on the photographic plate. The sharp end of the pear shaped path shows the direction of movement and the shape of the pear indicates the shape. Higher speed would correspond to more elongated spots with longer gaps between them and vice versa for lower speeds.

The figure below shows an example of a Chrono Cycle Graph of an operator performing diamond variations:

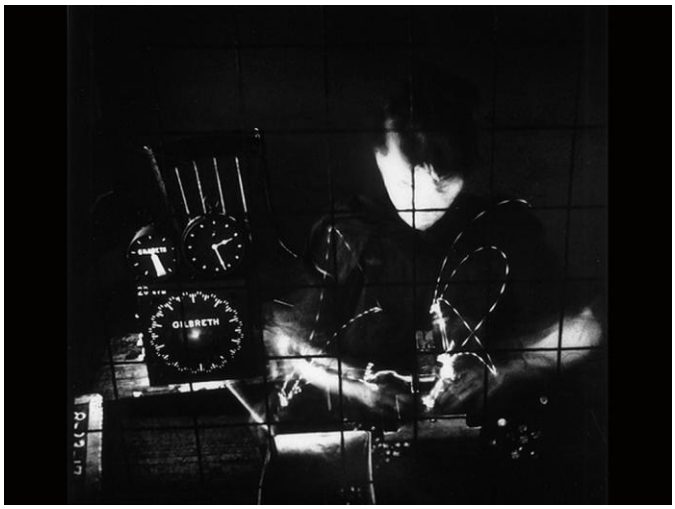

Figure 11: Chrono Cycle Graph Of An Operator Performing Diamond Variations

9. Micro Motion Analysis By SIMO Chart

Micro motion study is a technique that is most desirable for those operations or activities that are of short duration and which are repeated several number of times. These include the operations or motions needing very small time and as such, it becomes difficult to measure time for these motions accurately, and the time required by these motions cannot be neglected due to repetitive operations. As a result, to analyse such movements, a much precise and detailed method is essential. Thus, micro motion study is the technique of recording and analysing the time of basic elements of an operation with the aim of achieving the optimum method of performing the operation.

SIMO Chart: SIMO is an abbreviation for Simultaneous Motion Chart. It is a micro motion study devised by Gilbreth and it presents graphically the separable steps of each pertinent limb of the operator under study. It is an extended version of the two hand process chart. It gives an extremely detailed left and right hand operation chart. It records simultaneously the different therbligs performed by different parts of the body of one more operators on a common time scale.

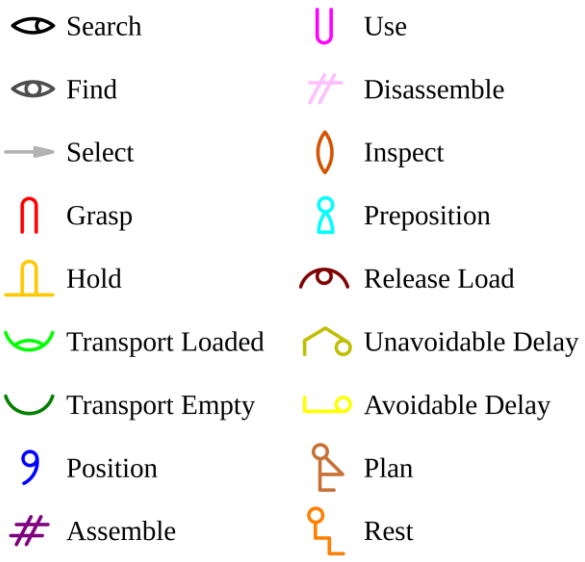

Figure 12: Therbligs Used In Industrial Engineering

Therbligs are diagrammatic representation of movements such as search, select, hold, position, assemble, etc. having specific colours, symbols and alphabets for recording purpose. 18 standard therbligs drafted by Gilberth and the American Society of Mechanical Engineers are shown above. The movements are recorded against time which is measured in "Winks" (1 wink= 1/2000 minute). The recording is done by a "Wink Counter" positioned in such a location that it can be seen rotating during filming process. The figure below shows SIMO chart of an operator performing finish hand filing of a copper work piece:

S.No.	Left hand description	Therblig	Time	Therblig	Right hand
1.	Searching and lifting	SH,H	0.2		
2.			0.4	U	Opening the vice
3.	Clamping workpiece	PP	0.8	PP	clamping work piece in the vice piece in the vice.
4.			1.0	TL	Take the file
5.	Do the hand filling operation.	U	2.0	U	Do the hand filing Operation.
6.			2.2	TL	Taking the micrometer
7.	Check the dimension	I	3.0	I	Check the dimension
8.			3.2	U	Open the vice
9.	Remove the work piece	TL		3.4	

Figure 13: SIMO Chart Of An Operator Performing Finish Hand Filing Of A Copper Work Piece

A SIMO chart is beneficial since it allows very precise and detailed analysis of the operation. The work cycle from the film can be easily and calmly studied away from the disturbing surroundings of the actual work station. SIMO chart is examined with scrutiny in order to attain a picture of complete cycle in complete detail and aid in drafting out better combination of the desired motions.

10. Conclusion

Therefore, the following paper explains and illustrates some of the more common methods of improving productivity through the saving of wasted efforts and time, and by reducing the work content of the process. The various recording techniques that can be used for recording the work and motion data have also been studied. The applications of each technique based the type of job and the level of accuracy and detail required is also illustrated under this paper. Furthermore, good method studies will do more than this as they will draw attention to waste of material and waste of capital invested in the equipment.

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