Prepared by: **Assoc. Prof. Dr. Adham MACKIEH**

OPERATION ANALYSIS

The over-all study of the **process** should result in a reduction in the amount of travel of the operator, materials, and tools, and should bring about orderly and systematic procedures.

The **man and machine chart** often suggests ways of eliminating idle machine time and promotes a better balancing of the work of the operator and the machine.

After such studies have been completed, **it is time to investigate specific operations in order to improve them**.

The **purpose** of **motion study** is to **analyze the motions** used by the worker in performing an operation, in order **to find** the **preferred method**. A systematic attempt is made to eliminate all unnecessary motions and to arrange the remaining necessary motions in the best sequence.

It is when we come to the analysis of specific operations that motion study principles and techniques become most useful.

The extent to which motion study, as well as the other phases of motion and time study, should be carried will depend largely upon the anticipated savings in cost.

Operation Charts (or the left- and right- hand chart)

It is very simple and effective aid for analyzing an operation.

No timing device is needed, and on most kinds of work the analyst is able to construct such a chart from observations of the operator at work.

The **principal purpose** of such a chart is to **assist in finding a better way of performing the task**, **but** this chart also has definite **value in training** operators.

Two symbols are commonly used in making operation charts:
1)- The small circle: indicates a transportation, such as moving the hand to grasp an article, and
2)- The large circle denotes such actions as grasping, positioning, using, or releasing the article.

The first step **in making an operation chart** is to draw a sketch of the work place, indicating the contents of the bins and the location of tools and materials. Then watch the operator and make a mental note of his or her motions, observing one hand at a time.

Record the motions or elements for the left hand on the left-hand side of a sheet of paper, and then in a similar manner record the motions for the right hand on the right-hand side of the sheet.

Because it is seldom possible to get the motions of the two hands in proper relationship on the first draft, it is usually necessary to redraw the chart.

Example: Signing a letter.

98 OPERATION ANALYSIS

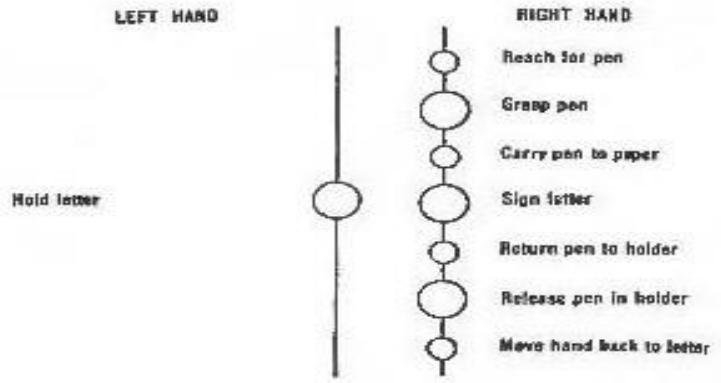


Figure 66 Operation chart showing the movements of the two hands in signing a letter.

Example: Bolt and Washer Assembly.

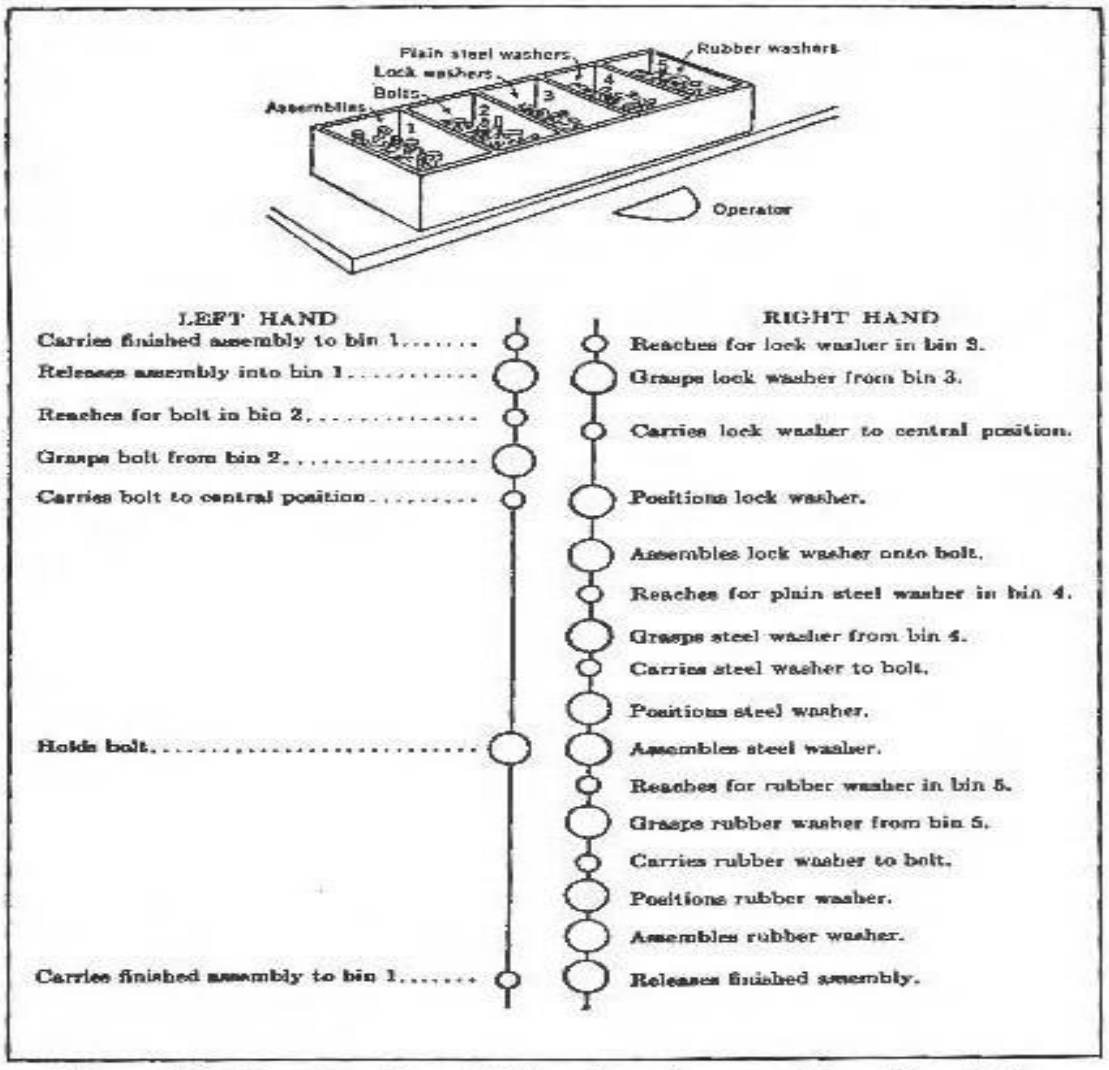
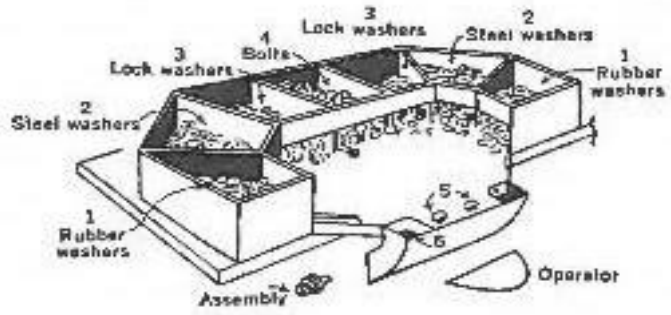


Figure 67 Operation chart of bolt and washer assembly—old method.

Example: Bolt and Washer Assembly (Improved Method).



LEFT HAND	RIGHT HAND
Reaches for rubber washer in bin 1.....	Reaches for rubber washer in bin 1.
Grasps rubber washer from bin 1.....	Grasps rubber washer from bin 1.
Slides rubber washer to countersunk hole	Slides rubber washer to countersunk hole.
Positions rubber washer in countersunk hole 5.....	Positions rubber washer in countersunk hole 5.
Reaches for plain steel washer in bin 2..	Reaches for plain steel washer in bin 2.
Grasps steel washer from bin 2.....	Grasps steel washer from bin 2.
Slides steel washer to countersunk hole..	Slides steel washer to countersunk hole.
Positions steel washer in countersunk hole 5.....	Positions steel washer in countersunk hole 5.
Reaches for lock washer in bin 3.....	Reaches for lock washer in bin 3.
Grasps lock washer from bin 3.....	Grasps lock washer from bin 3.
Slides lock washer to countersunk hole..	Slides lock washer to countersunk hole.
Positions lock washer in countersunk hole 5.....	Positions lock washer in countersunk hole 5.
Reaches for bolt in bin 4.....	Reaches for bolt in bin 4.
Grasps bolt from bin 4.....	Grasps bolt from bin 4.
Carries bolt to washers at 5.....	Carries bolt to washers at 5.
Positions bolt preparatory to inserting it into washers at 5.....	Positions bolt preparatory to inserting it into washers at 5.
Assembles bolt and washers.....	Assembles bolt and washers
Lifts bolt and washers, carries to left and releases into top of chute 6.....	Lifts bolt and washers, carries to RIGHT and releases into top of chute 6.

Figure 68 Operation chart of bolt and washer assembly—improved method.

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Check Sheet for Operation Analysis

One approach to the problem of finding a better way of doing the work is to subject the operation to specific and detailed questions. If several persons interested in the job consider these questions together, a more satisfactory solution is likely to result.

In addition to studying the motions used in performing an operation, it is also desirable to give consideration to materials, tools, jigs, fixtures, handling equipment, working conditions, and other factors affecting the job.

Finding the best way is not always easy, and considerable **imagination**, **ingenuity**, and **inventive ability** are required. Therefore, the cooperation of the supervisor, the tool designer, and the operator is of decided value to the analyst.

After recording all that is known about the job, the various phases of the operations should be considered:

I. Materials
1. Can cheaper material be substituted?
2. Is the material uniform and in proper condition when brought to the operator?
3. Is the material of proper size, weight, and finish for most economical use?
4. Is the material utilized to the fullest extent?
5. Can some use be found for scrap and rejected parts?
6. Can the number of storages of material and of parts in process be reduced?

II. Materials handling
1. Can the number of times the material is handled be reduced?
2. Can the distance moved be shortened?
3. Is the material received, moved, and stored in suitable containers? Are the containers kept clean?
4. Are there delays in the delivery of material to the operator?
5. Can the operator be relieved of handling materials by the use of conveyors?
6. Can backtracking be reduced or eliminated?
7. Will a rearrangement of the layout or combining of operations make it unnecessary, to move the material?

III. Tools, Jigs, and Fixtures
1. Are the tools the best kind for this work?
2. Are the tools in good condition?

3. If metal-cutting tools, are the cutting angles of the tools correct, and are they ground in a centralized tool-grinding department?
4. Can tools or fixtures be changed so that less skill is required to perform the operation?
5. Are both hands occupied by productive work in using the tools or fixtures?
6. Can slide feeds, ejectors, holding devices, etc., be used?
7. Can an engineering change be made to simplify the design?

IV. Machine

A. Setup

1. Should the operator set up his or her own machine?
2. Can the number of setups be reduced by proper lot sizes?
3. Are drawings, tools, and gauges obtained without delay?
4. Are there delays in making inspection of first pieces produced?

B. Operation

1. Can the operation be eliminated?
2. Can the work be done in multiple?
3. Can the machine speed or feed be increased?
4. Can an automatic feed be used?
5. Can the operation be divided into two or more short operations?
6. Can two or more operations be combined into one? Consider the effect of combinations on the training period.
7. Can the sequence of the operation be changed?
8. Can the amount of scrap and spoiled work be reduced?
9. Can the part be pre-positioned for the next operation?
10. Can interruptions be reduced or eliminated?
11. Can an inspection be combined with an operation?
12. Is the machine in good working condition?
13. Can structural adhesives be used?

V. Operator

1. Is the operator qualified to perform this operation?
2. Can unnecessary fatigue be eliminated by a change in tools, fixtures, layout, or working conditions?
3. Is supervision satisfactory?
4. Can the operator's performance be improved by further instruction?

VI. Working Conditions

1. Are the light, heat, and ventilation satisfactory on the job?
2. Are washrooms, lockers, restrooms, and dressing facilities adequate?
3. Are there any unnecessary hazards involved in the operation?

4. Is provision made for the operator to work in either a sitting or a standing position? Do they meet the needs of the employees?
5. Are the lengths of the working day and the rest periods set for maximum economy?
6. Is good housekeeping maintained throughout the plant?

This **list of questions**, although **by no means complete**, shows some of the **elements** that enter into a **thorough consideration** of the problem of finding the best way of doing work.
This **list** is **typical** of a **check sheet** that can be prepared for use in a specific plant.
Another approach to the problem is to **divide the job into** the **three phases**: **(1) get ready; (2) do the work (or use); and (3) put away or clean up**.
The second phase is the primary object of the work. Often the get-ready and the cleanup can be shortened and simplified without impairing the do or use phase of the operation.