UNIT – 3

INTRODUCTION TO OPERATIONS MANAGEMENT

Plant location: Plant location is a strategic decision several factors influence this decision. The main objective of any business is to optimize its cost and revenue that is, minimize its costs and maximize its returns.

The degree of significance for the selection of location for any enterprise mainly depends on its size and nature large scale industries requiring huge amount of investment there are many considerations other than the local demand in the selection proper plant location these plants cannot be easily shifted to other place and an error of judgment in the selection of site can be vary expensive to the organization. However, small-scale industry mainly selects the site where in accordance with its capacity; the local market is available for its products. It can easily shift to other place when there is any change in the market.

Factors affecting plant location:

Nearness to Market: If the plant is located close to the market the cost of transportation can be minimized. This also helps the producers to have direct knowledge of the requirements of the customers.

Nearness to supply of raw materials: As far as possible the site selected should be near the source of raw materials, so that the cost of transportation can be minimized and storing cost can be reduced due to shorter lead time.

Availability of labour: Availability of right kind of labour force in required number at reasonable rates is also a deciding factor in selection of site

Transport and communication facilities: Generally, industries have a tendency to locate the industrial units near the railway station, highway or port areas.

Availability of power and fuel: Coal, electricity, oil and natural gas are the important sources of power in the industries.

Ex: Tata iron and steel industry is established near the coalmines of Bihar.

Climatic conditions: Climatic conditions largely affect certain production processes and also the efficiency of the employees.

Ex: Textile mills require moist climate that why these plant located at Mumbai and Ahmedabad.

Availability of water: Water is used in industries for processing as in paper in chemical industries, for generation of power in hydroelectric power, plants and also required for drinking sanitary purpose also.

Ancillary industries: Many industries such as processing and assembly industries are not producing al the parts of their product but purchase some of the parts from ancillary industries producing it.

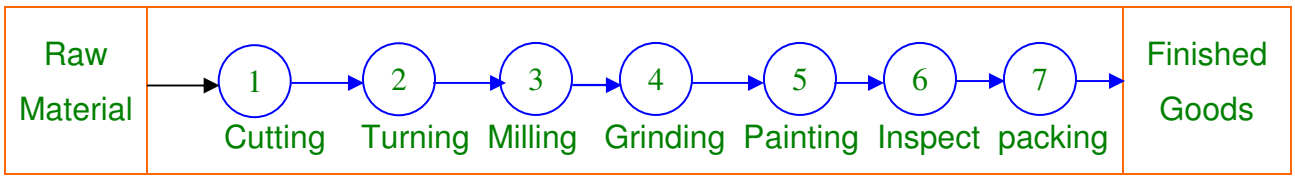
Financial and other aids: For the development of backward regions central as well as state government provide certain incentives and facilities such as cash-subsides, concession financial assistance, land, power and other facilities at cheaper rates, tax concession etc.

Plant Layout: A technique of locating machines, processes and plant services within the factory in order to secure the greatest possible output of high quality at the lowest possible total cost of production

Type of plant layout:

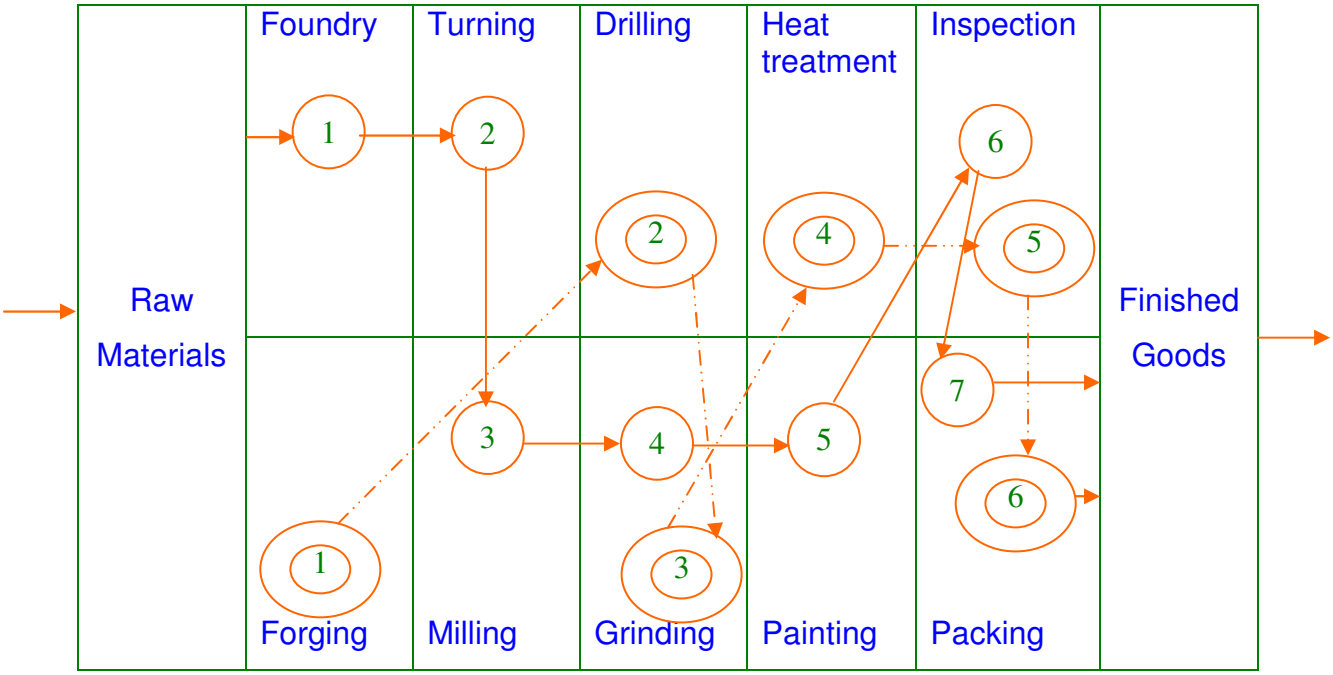
Product or line layout: This type of layout is developed for product-focused systems. In this type of layout only one product, or one type of product, is produced in a given area. In case of product being assembled, this type of layout is popularly known as an assembly line layout.

The work centers are organized in the sequence of appearance. The raw material centre at one end of the line and goes from one operation to another rapidly with minimum of work-in-process storage and material handling

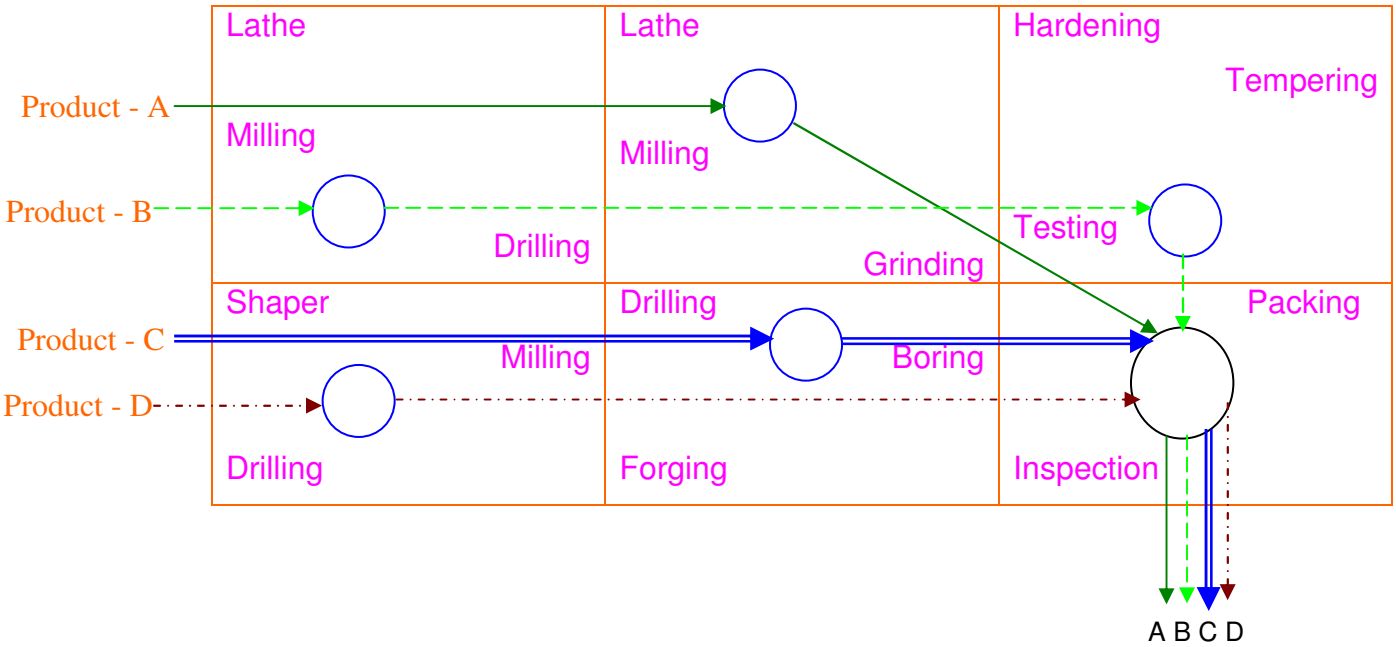


Process or Functional layout: This type of layout is developed for process focused systems. The processing units are organized by functions into departments on the assumption that certain skills and facilities are available in each department similar equipments and operations are grouped together, e.g., milling, foundry, drilling, plating, heat treatment etc.

The use of process-focused systems is very wide in both manufacture and other service facilities such as hospitals, large offices, municipal services, etc.

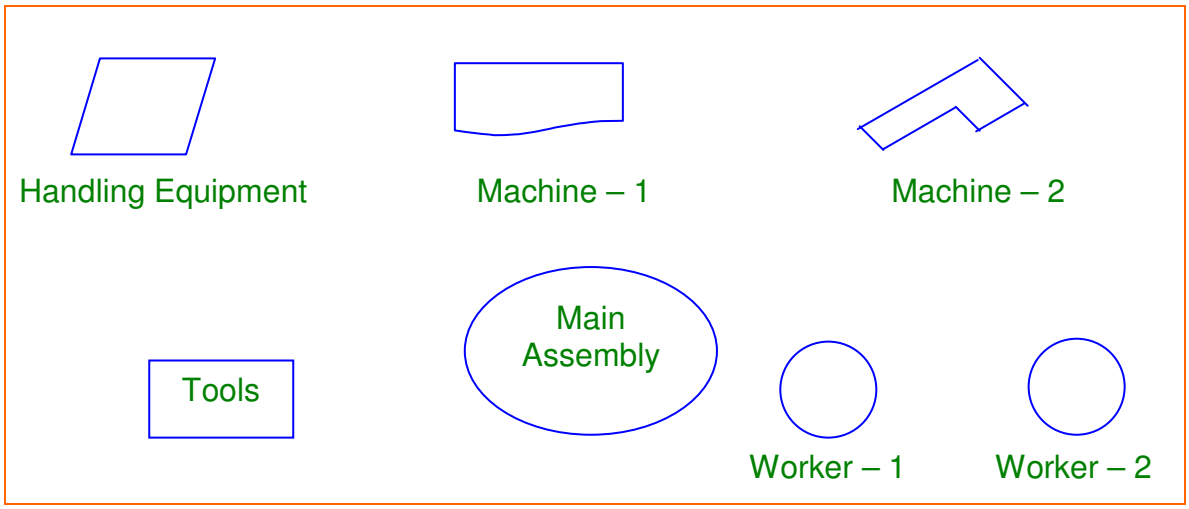


Cellular or group layout: It is special type of functional layout in which the facilities are clubbed together into cells. This is suitable for systems designed to use the concepts, principles and approaches of 'group technology'. Such a layout offers the advantages of mass production with high degree of automation even if the numbers of products are more with flexible requirement. In such a system the facilities are group in to cells which are able to perform similar type of functions for a group of products.



Job Shop Layout: It is a layout for a very general flexible system that is processing job production, The preparation of such a layout is dependent on the analysis of the possible populations of orders and is a relatively, complex affair.

Project or Fixed position Layout: This is the layout for project type systems in which the major component is kept at a fixed position and all other materials, components, tools machines, work etc. are brought and assembly or fabrication is carried out. This type of layout is now not used very commonly as the machines required for manufacturing work are big and complicated. The fixed position layout is used only when it is difficult to move the major component and fabrication is to be carried out. Ex: production of ships.



Factors influencing plant layout:

Management policy: Management has to decide on many matters e.g. nature and quality of products, size of the plant, integration of production process, plans for expansion, amount of inventory in stock, employee facilities

Manufacturing process: The type of manufacturing process e.g. synthetic/analytical, continuous/intermittent and repetitive/non-repetitive, will govern the type of plant layout.

Nature of product: Small and light products can be moved easily to the machines, whereas for heavy and bulky products the machines may have to be moved.

Type of equipment: The use of single purpose and multi-purpose machine substantially affects the plant layout. Similarly, noisy and vibrating machines require special attention in the plant layout decision.

Types of buildings: The plant layout in a single storey building will be different from that in a multi storey building. The covered areas, the number of storey's, elevators and stairs, parking and storage area all affect the layout.

Availability of total floor area: The allocation of space for machines, work-benches, sub-store aisles etc., is made on the basis of the available floor area use of overhead space is made in case of shortage of space.

Arrangement of materials handing equipment: Provide sufficient aisles for free movement of material handling equipment such as hand truck, fork truck etc.

Service facilities: The layout of factory must include proper service facilities required for the comfort and welfare of workers. These include canteen, lockers, drinking water, first aid etc.

Possibility of future expansion: Plant layout is made in the light of future requirement and installations of additional activities.

Principles of plant layout:

Principle of integration: The best layout is one which integrates the men, materials, machinery, supporting activities and any other such a factors that results in the best compromise.

Principle of minimum movement: The number of movement of workers and materials and the distance moved should be minimized. The materials should be transported in bulk rather than in small amounts.

Principle of smooth and continue flow: It states that bottlenecks, congestion points and bulk tracking should be removed by proper line balancing techniques.

Principle of cubic space: Space of a room, it the ceiling height is also utilized, more materials can be accommodated in the same space.

Principle of satisfaction of safety: Working places-safe, well-ventilated and free from dust, noise fumes, odors and other hazardous conditions, help to increase the efficiency of the workers and improve their morale.

Principle of flexibility: It means the best layout in one which can be adopted and re-arranged at a minimum cost with least inconvenience.

Productivity:

Definition: Productivity is defined as the rate at which the goods and services are produced.

It refers to the relationship between the inputs and the output. It is calculated as a ratio between the amount produced and the amount of resources (land, labour, capital, technology etc.) used in the course of production in other words

$$\text{Pr}\,oductivity = \frac{Output}{Input}$$

And also defined productivity as human efforts to produce more and more with less and less inputs of resources as a result of which the benefits of production are distributed among maximum number of people.

Method of Production:

Job production: In this system, goods are produced according to the orders with this method, individual requirements of the consumers can be met. Each job order stands alone and is not likely to be repeated. This type of production has a lot of flexibility of operation and hence general purpose machines are required. Factories adopting this type of production, are generally small in size.

Advantages:

1. It is the only method, which can meet the individual requirement.
2. There is no managerial problem, because of very less number of workers, and small size of concern.
3. Such type of production requires less money and is easy to start.

Disadvantages:

1. There is no scope for continuous production and demand
2. As the purchase of raw materials is less, hence cost of raw materials per unit will be slightly more.
3. For handling different type of jobs, only skilled and intelligent workers are needed, thus labour cost increases.

Batch production: This type of production is generally adopted in medium size enterprise. Batch production is in between job production and mass production. Batch production is bigger in scale than the job production. While it is smaller than that of mass production, batch production requires more machines than job production and fewer machines that the of mass production.

Advantages:

1. While comparing with mass production it requires less capital
2. Comparing with job production, it is more advantageous commercially.
3. If demand for one product decrease then production, for another product may be increased, thus the risk of loss is very less.

Disadvantages:

1. Comparing with mass production cost of scales and advertisement per unit is more

2. Raw materials to be purchased are in less quantity than that in mass production; therefore it is slightly costlier than that of mass production because less quantity discount is available.

Mass production: This method of production is used by concerns where manufacturing is carried on continuously in anticipation of demand though demand of the product may not be uniform through the year.

In mass production, simplification and standardization of products are made with the help of specialized (one purpose) machine, articles of standardized nature can easily and economically be produced on a large scale.

There is a small difference between mass production and continuous production. This is mainly in the kind of product and its relation to the plant. In mass production plant and equipment are flexible enough to deal with other products, involving same production process. Where as in continuous or process production only standardized product in a sequence produced. In this method layout and requirement of additional tools and equipment

Advantages:

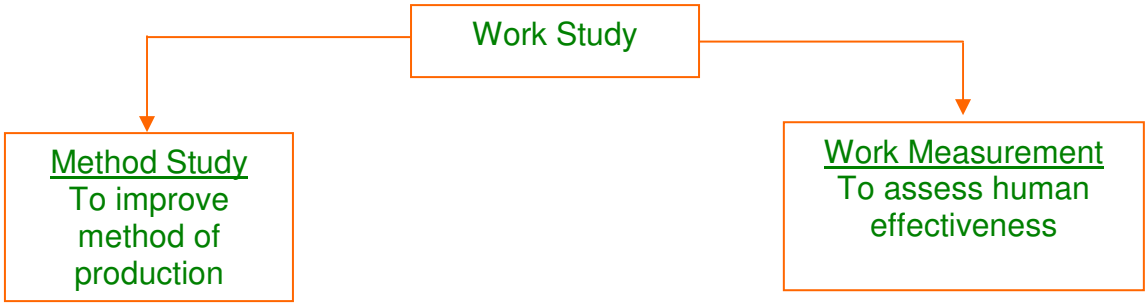
1. A smooth flow of materials from one work station to the next in logical order.
2. Since the work from one process is fed directly into the next, small in process inventories result
3. Total production time per unit short
4. Simple production planning control system are possible
5. Little skill is usually required by operations at the production line, hence training is simple, short and inexpensive.

Disadvantages:

1. A breakdown of one machine may lead to a complete stoppage of the line that follows the machine. Hence maintenance and repair is challenging job.
2. Since the product dictates the layout, changes in product design may require major changes in the layout.
3. Generally high investment are required owing to the specialized nature of the machines and their possible duplication in the line

Work Study: Work study is one of the most important management techniques which is employed to improve the activities in the production. The main objective of work study is to assist the management in the optimum use of the human and material resources.

Definition: Work study refers to the method study and work measurement, which are used to examine human work in all its contexts by systematically investigating into all factors affecting its efficiency and economy to bring forth the desired improvement.



Method Study:

Definition: The systematic recording and critical examination of existing and proposed ways of doing work, as a means of developing and applying easier and more effective methods and reducing cost it is also called motion study.

Work Measurement:

Definition: Work measurement is the application of techniques designed to establish time for a qualified worker to carry out a specified job at a defined level of performance.

Work study has two parts, Method Study and Work Measurement. Method study deals with the techniques of analyzing the way to do a given job better, Work Measurement seeks to measure the time required to perform the job.

Basic procedure for Method Study:

Select: The work to be studied

Record: All the relevant facts of the present or proposed method study by observation

Examine: The recorded facts critically every thing that is done, considering in turn, the purpose of the activity, the place where it is performed, the sequence in which it is done, the person who is doing it and the means by which it is done.

Develop: The most practical, economical and effective method considering all the circumstances.

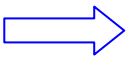
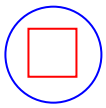
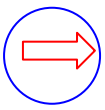
Define: The new method so that it can always be identified.

Install: The method as standard practice

Maintain: That standard practice by regular routine checks.

Recording: The current process of doing the job has to be recorded, while doing so every detail however small it may be, has to be identified.

Where the process is too long, involving many stages of production, inspection or transportation, the present process of doing the job is recorded sufficiently together with all the relevant information, using the process chart symbols.

Symbol	Meanings
	Operation: Operation involving changes in the condition of a product Ex: Assembly of spare parts
	Transport: Something from the location to another Ex: Assemble PC is moved to inspection section
	Storage: (permanent) To store the materials, goods etc. Ex: When PC is put into the store after inspection
	Delay: (Temporary storage) Arises when the product waits for next stage in the process Ex: Machinery breakdown etc.
	Inspection: To check whether the quality and quantity of the product is satisfactory or not
	Operation – cum – Inspection: Inspection is taken place during the production process
	Operation – cum – Transportation: Assemble is taking place while the belt conveyer transports the spares.

Recording Techniques: The recording techniques are of three types

a) Process chart b) Diagrams c) Motion and film analysis d) Models

A) Process Charts:

1) Out line process chart: This chart outlines the main events sequence wise considering only operations and inspections in the given job

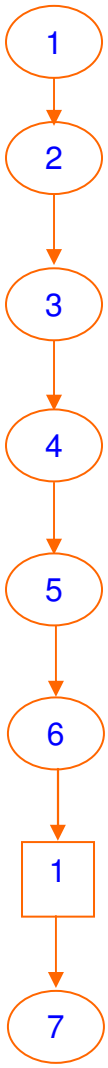
Ex: TASK : Changing refill of a Ball Point pen

Chart begins : Unscrew the cap

Chart ends : Screw the cap

Chart by : ----------

Chart Ends : ----------



Unscrew cap

Unscrew neck

Remove the old refill

Assemble the spring on new refill

Place the refill in the barrel

Screw the neck

Check if the ball pen writes

Screw the cap

No. of operations	7
No. of inspections	1
Total No. of activities	8

2) Flow process chart: These are scale drawings of the work place, which indicate where each activity takes place. This chart is capable of reflecting undue delays in transferring work between workstations duplication of work, and unfair work assignment, which may delay the completion process. It classified into three types

Man Type : It records what the worker does

Materials Type : It records what happens to the materials

Equipment Type : It records how the equipment used.

a) Man Type

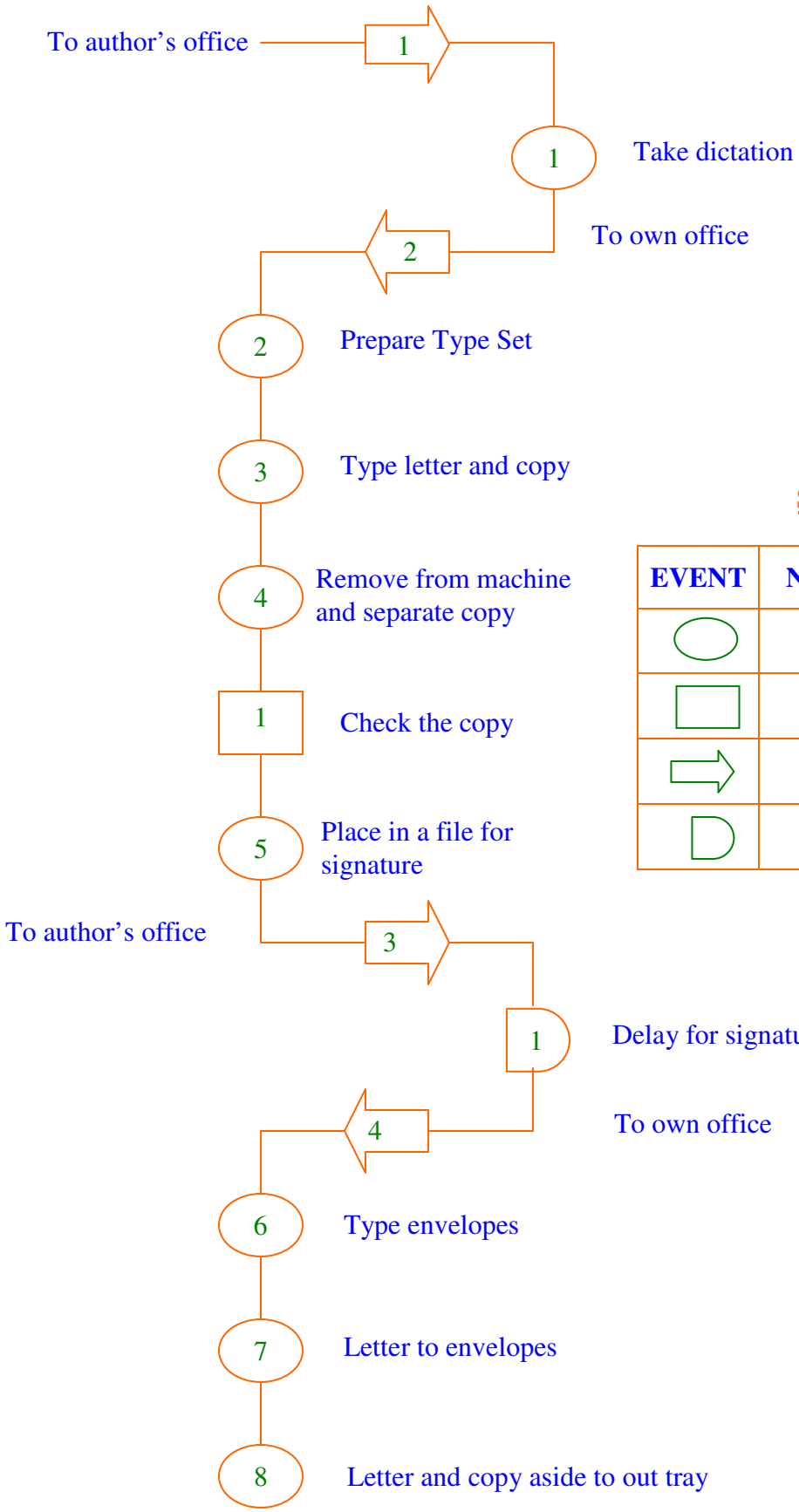
Ex:

Job : Writing a letter using short hand typist

Chart begins : Typist in own office-awaiting dictation

Chart ends : Typist puts letter and copy in out tray

Typist office : 6 meters manager's office



Summary

EVENT	NO	TIME	DISTANCE
⬭	8		
▭	1		
⇨	4		24 meters
D	1		

b) Material Type:

Ex: Job : Making the casting ready for machining

Chart begins : Casting lying in foundry

Chart ends : Casting ready for machining

Activity	Operations	Distance moved mts	Time	Remarks
Costing laying in foundry store		-	-	-
Moved to gas cutting machine		10	3	By Trolley
Wait, cutting machine being set		-	5	-
Rises cut		-	20	-
Wait for trolley		-	10	-
Moved to inspection department		6	2	-
Inspection before machining		-	15	By Trolley
Move to machine shop		10	3	-

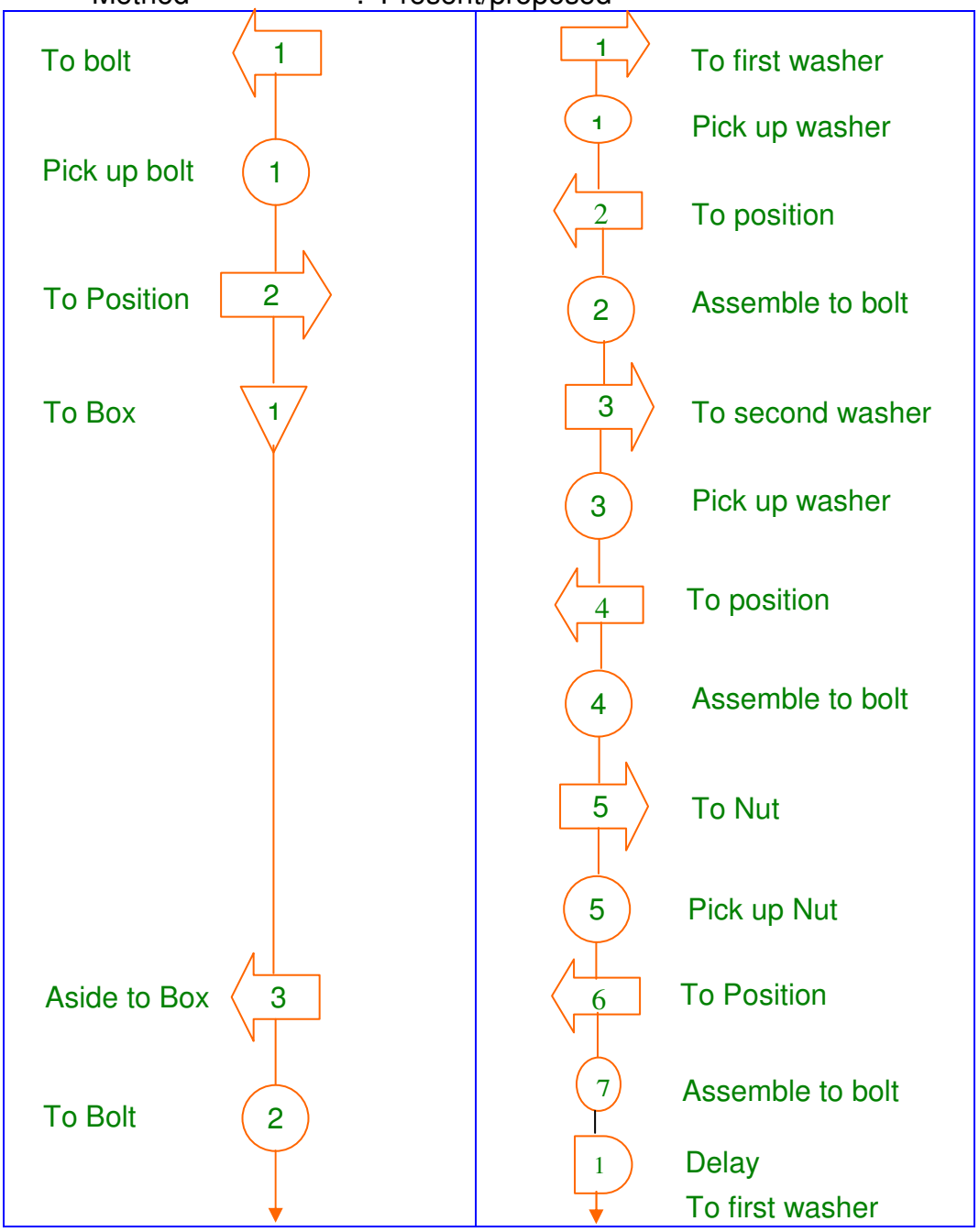
Summary

Event	No.	Time	Distance
○	1	20	-
▭	1	15	-
△	1	-	-
D	2	15 (5+10)	-
⇨	3	8	26

3) Two handed process chart: The two hand process chart is a chart is which the activities of a workers hand are recorded, in their relationship to one another. It is commonly used for repetitive and short operations.

Ex:

Job	:	Assemble to washers and nut to bolt
Chart begins	:	Hand empty material in boxes
Part No.	:	----------
Chart ends	:	Completed assembly aside to box
Operation No.	:	----------
Method	:	Present/proposed



4) Multiple activity chart: A multiple activity chart is a chart in which the activities of more than one item (worker, machine or equipment) are recorded on a common time scale to show their inter relationship.

By using separate vertical columns to represent the activities of different operators or machines on a common time scale, the chart shows very clearly the period of idleness on the part of any items during the process.

Ex:

Chart No.---------- Sheet No. ---------- Department ----------

Material : B201 casting Job : Making a slot on the casing

Machine : Slotted Operation : XYZ

Charted by : ---------- Date : ----------

Time (min.)	Man			Machine	Time (min.)
0.2	Removes finished casting cleans with compressed air			Idle	0.2
0.4	Gauges depth of slot on surface plate			Idle	0.4
0.6	Breaks sharp edges with file cleans with compressed air			Idle	0.6
0.8	Place in a box obtains new casting			Idle	0.8
1.0	Cleans machine with compressed air			Idle	1.0
1.2	Locates casting in fixture, starts machine and automatic fee			Idle	1.2
1.4	Idle			Cutting slot	1.4
1.6	Idle			Cutting slot	1.6
1.8	Idle			Cutting slot	1.8
2.0	Idle			Cutting slot	2.0

Summary:

Cycle time : 2 min.

Working Time:

a) Man : 1.2 min.

b) Machine : 0.8 min.

Idle time:

a) Man : 0.8 min.

b) Machine : 1.2 min.

Utilization:

a) Man : 60%

b) Machine : 40%

B) Diagrams:

1) Flow diagrams: Flow process chart only shows the sequence of various activities necessary for performing the specified work. It does not show clearly the path of movement of men and materials from one location to another.

Definition: It is a diagrams, drawn to scale, intended to show the relative position of the production machinery and marks the route followed by the machines, materials and men.

2) String diagrams: The workers are moving at irregular intervals between a number of points in a working area with or without materials in many industrial activities.

Definition: The string diagram is a scale plan or model on which a tread its used to trace and measure the path of workers, materials or equipment during a specified sequence of events.

3) Cycle graph: In this method a small electric bulb is attached to each part of the body, which makes the movement for carrying out an operation. The path of movement is photographed by high-speed camera.

4) Chronocycle graph: This is a photographic record, which traces the path of movement onto a photographic place. In principle, it is similar to the string diagram, and is most effective when recording short, rapid movements.

C) Micro motion Study and film analysis: Micro motion study is a set of techniques intended to divide human activity into groups of movements or micro motions (therbiligs) and the study of such movements help to find for an operator one best pattern of movements that consumes less time and requires less effort to accomplish the task.

Film analysis: Once the activity has been filmed and the film processed, a projector runs the film very slowly and the film can be stopped or reversed whenever required.

1) SIMO Chart (simultaneous motion cycle chart): A SIMO chart is based on film analysis, it is a graphic representation of the coordinated activities of an operators body embers. The activities are described in terms of basic or fundamental motions. The time required for completion of these motions is also recorded on the chart.

D) Models: Sometimes the picture of the existing conditions is not clear by the use of flow process chart or flow diagram. In such cases instead of the scales plans of the shop facilities models are used to provide visual representation of the proposed layout before proceeding with actual rearrangement of the work place.

Work Measurement: Work measurement is the application of technique to establish the time for a qualified worker to carry out a specified job at a defined level of performance.

Procedure for Work Measurement:

1) Sect: The work to be studied and determine the objectives of the study

2) Record: All the relevant data relating to circumstances in which the work is being done, the methods to be used breakdown the job into its elements

3) Examine: The recorded data and the detailed breakdown critically to ensure the most effective method and motions are being used and that unproductive elements are separated from productive elements.

4) Measure: The time required to complete each element using the appropriate work measurement techniques and calculate the time required to compete the work cycle which is known as basic time.

5) Compile: The standard time for the operation or work place, in case of stop watch time study the various allowances to cover relation, personal needs etc. are added to the basic time to estimate the standard time.

Techniques of work measurement:

1. Time study
2. Synthesis from standard data
3. Predetermined Motion Time System (PMTS)
4. Analytical estimating
5. Work Sampling

1) Time study: It is defined as the art of observing and recording the time required to do each detailed element of all industrial operation.

Time study equipment: Time study equipment can be broadly grouped two categories

A) Time measuring device B) Time study boards and time study chart

A) Time measuring devices:

a) Stop Watch b) Motion picture camera c) Time recording machine

d) Electronic timer.

a) Stop Watch:

i) Decimal minute stop watch: In this type of watch the movements is started and stopped by moving the slide "A", forward and backward respectively are complete revolution of large hand represents 1 minute and since the dial is divided into 100 parts reading to with in 0.01 minutes can be obtained. Every time the large hand make one revolution the small hand will register 1 minute and is able to register up to 30 minutes.

ii) Decimal hour stop watch: The dial in this watch is divided into 100 parts. The needle completes 10 revolutions in one hour. The least count in this watch is 0.001 hours. The small dial of this watch is divided into 30 equl spaces (representing 0.01 hour) and the small needle makes 31/3 revolutions in one hour.

b) Motion picture camera: Every element of the operation involving motion of the workers is made into film through motion picture camera when this film is run at a slow speed through a projector; the time of each element is recorded using a stopwatch.

c) Time recording machine: A moving tape is run is this machine at a uniform velocity of 10 inches/minutes with the help of electric motor. The machine has two keys: one key, when pressed, indicates starting of an operation, and the other key used to take a print on the scaled tape at the end of elements.

d) Electronic timer: The timing of starting and ending of an operation of an element is automatically recorded through electronic timers.

B) Time study boards and time study charts:

Time study board: These are simple and handy hard wood boards equipped with stopwatch holders and clamps for holding the observation sheets and time study forms. These boards help to see and record the observation and time at the same instant.

Observations forms: Printed or cyclostyled forms are used for recording the observation during that time study. It ensures that time study are made in a

standard manner and that no essential data are omitted. These forms are attached to the study board by means of clip provided

2) Synthesis from standard data: This one technique of work measurement to obtained synthetic times that are synthesis from element times previously obtained from direct time studies. The analysis and measurement stage are thus conducted prior to the actual study.

3) Predetermine motion time system (PMTS): Every element of work is composed of some combination of basic human motions. Apart from mental activity all works can broken down into elements that usually a fundamental movement of the body or body members. After this analysis stage the basic motions that have been isolated have a time allotted to them on the basis of predetermine motion times.

4) Analytical estimation: Analytical estimating serves as best for measuring work. In the analysis stage we find the usually these basic elements or much larger as compared to the elements in PMTS or time study. For measuring stages the time, which will be occupied by the element at a specific speed of working is estimated.

5) Work Sampling: It is work measurement technique which large number of instantaneous observation are made random interval over a specified period of time of a group of workers, machine and processes. Each observation records what is happening at that instantant and the present observations recorded for a particular activity or delay is a measure of the percentage of time during which that activity or delay occurs.

It can also defined as a method of finding the percentage occurrence of a certain activity by statistical sampling and random observations.

Procedure for conducting time study: For conducting time study average workers and average machines are selected. This study id conducted by the time study expert, who should be familiar with all the information related to the job and the conditions in which it is being done.

Time study is performed in the following stages.

A) Analysis of work B) Standardization of methods

C) Making time study

A) Analysis of work: It includes all the tasks performed by the workers, not just the effective work. In the end, time required for job preparation, cleaning of machine, etc. should also be included.

B) Standardization of methods: Related to materials, equipment, tools, working conditions to ensure an acceptable method which is easy, safe and the fastest.

C) Making time study: Time study is done on a printed time study record sheet, which is fixed on a board known as time study board. On one corner, a stopwatch is placed.

Different time readings of element are recorded in the corresponding column of the record sheet. Several sets of reading are taken to arrive at an accurate result after noting all these readings, average tome is calculated, neglecting abnormal values, if any.

Standard time: it is the time, which is taken by a normal worker for a specific task or job, working under moderate conditions and including other allowances. Such as fatigue setting of tool and job, repairing of tool and checking of job etc

Standard time is the basis for the calculation of wages and incentives.

Standard time= Average time* Rating factor+ other allowances

Rating factor: the study engineer multiplies actual time with a factor known as Rating factor or leveling factor to set the average time which a normal worker would take. This is expressed as a percentage of the effacing of representative operator, which is in comparison to some of his average fellow workers.

Performance rating: performance rating is that process, during which the time study engineer compares the performance of the operator of normal performance.

$$\text{Performance rating} = \frac{\text{Observed persormance}}{\text{Normal performance}} \times 100$$

The rating can be

a) Standard rating: A qualified worker will naturally work if he is motivated to apply himself to his work at the average rate of pace.

b) Normal rating: It is the average rate or pace at which a qualified worker will naturally work even if he has no specific motivation to apply himself to this work.

Rating techniques:

1) Speed rating : Speed rating consists of determining the speed of the operator's movements in relation to a normal pace as a factor and applying it to each element so as to get the normal time for the element.

$$\text{Normal or basic time} = \frac{\text{Obsered time} \times \text{Rating}}{\text{Standard rating}}$$

Rating = Worker's speed

Standard rating = Speed expected from the worker

2) Westing-house system of rating: It is based upon four factors- system comprising skill, effort, conditions and consistency and arrives at cumulative rating.

3) Synthetic rating: It is the ratio of the standard tome for the element to that of observed time.

4) Objective rating; It is determined in two stages- first the speed rating and second the adjustment for job difficulties.

5) Psychological evaluation of performance level: In this rating we consider the amount of oxygen consumed, change of heart rate etc to determine rating factor.

Types of allowances in time study:

1) Process allowances: Process allowances to compensate for enforced idleness due to no work power failure, faulty material or tools and equipment.

2) Personal allowances: It comprises personal needs and fatigue. Fatigue allowance contains, in turn, a constant portion and a variable portion.

3) Interference allowances: When a worker is attending more than one machine

4) Contingency allowances: These allowances are to meet legitimate but irregular or infrequent items of work or delays.

5) Special allowances: Special allowances decided as a policy matter, covering activities that are essential for satisfactory performance of work but may not be part of the job, like start up, shut down, change over, cleaning, set up, tool changing etc.