CHAPTER 4:

METHOD STUDY

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4. Method Study

- Method study enables the industrial engineer to subject each operation to systematic analysis.
- The main purpose of method study is to eliminate the unnecessary operations and to achieve the best method of performing the operation.
- Method study is also called methods engineering or work design.
- Method engineering is used to describe collection of analysis techniques which focus on improving the effectiveness of men and machines.
- According to British Standards Institution (BS 3138): “Method study is the systematic recording and critical examination or existing and proposed ways or doing work as a means or developing and applying easier and more effective methods and reducing cost.”
- Fundamentally method study involves the breakdown of an operation or procedure into its component elements and their systematic analysis.

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- In carrying out the method study, the right attitude of mind is important.
- The method study man should have:
  1. The desire and determination to produce results.
  2. Ability to achieve results.
  3. An understanding of the human factors involved.
- Method study scope lies in improving work methods through process and operation analysis, such as:
  1. Manufacturing operations and their sequence.
  2. Workmen.
  3. Materials, tools and gauges.
  4. Layout of physical facilities and work station design.
  5. Movement of men and material handling.
  6. Work environment.

4.1. Objectives of Method Study

- Method study is essentially concerned with finding better ways of doing things.
- It adds value and increases the efficiency by eliminating unnecessary operations, avoidable delays and other forms of waste.
- The improvement in efficiency is achieved through:
  1. Improved layout and design of workplace.
  2. Improved and efficient work procedures.
  3. Effective utilization of men, machines and materials.
  4. Improved design or specification of the final product.
  5. Economy in human effort and the reduction of unnecessary fatigue.
  6. The development of a better physical working environment.
- The objectives of method study techniques are:
  1. Present and analyze true facts concerning the situation.
  2. To examine those facts critically.
  3. To develop the best answer possible under given circumstances based on critical examination of facts

4.2. Scope of Method Study

- The scope of method study is not restricted to only manufacturing industries.
- Method study techniques can be applied effectively in service sector as well.
- It can be applied in offices, hospitals, banks and other service organizations.
- The areas to which method study can be applied successfully in manufacturing are:
  1. To improve work methods and procedures.
  2. To determine the best sequence of doing work.
  3. To smoothen material flow with minimum of back tracking and to improve layout.
  4. To improve the working conditions and hence to improve labour efficiency.
  5. To reduce monotony in the work.
  6. To improve plant utilization and material utilization.
  7. Elimination of waste and unproductive operations.
  8. To reduce the manufacturing costs through reducing cycle time of operations.

4.3. Steps or Procedure Involved in Methods Study

The basic approach to method study consists of the following eight steps.

1. **SELECT** the work to be studied and define its boundaries.
2. **RECORD** the relevant facts about the job by direct observation and collect such additional data as may be needed from appropriate sources.
3. **EXAMINE** the way the job is being performed and challenge its purpose, place sequence and method of performance.
4. **DEVELOP** the most practical, economic and effective method, drawing on the contributions of those concerned.
5. **EVALUATE** different alternatives to developing a new improved method comparing the cost-effectiveness of the selected new method with the current method with the current method of performance.
6. **DEFINE** the new method, as a result, in a clear manner and present it to those concerned, *i.e*., management, supervisors and workers.
7. **INSTALL** the new method as a standard practice and train the persons involved in applying it.
8. **MAINTAIN** the new method and introduce control procedures to prevent a drifting back to the previous method of work.

4.3.1. Selection of the Job for Method Study

- Cost is the main criteria for selection of a job, process and department for methods analysis.
- To carry out the method study, a job is selected such that the proposed method achieves one or more of the following results:

  (*a*) Improvement in quality with lesser scrap.

  (*b*) Increased production through better utilization of resources.

  (*c*) Elimination of unnecessary operations and movements.

  (*d*) Improved layout leading to smooth flow of material and a balanced production line.

  (*e*) Improved working conditions.

CONSIDERATIONS FOR SELECTION OF METHOD STUDY

- When considering whether a method study investigation of a particular job should be carried out certain factors should be kept in mind.
- These are

1. Economic aspect.
2. Technical aspect.
3. Human aspect.

Economic Aspects

- The method study involves cost and time.
- Economic considerations will be important at all stages.
- It is obviously a waste of time to start or to continue a long investigation if the economic importance of the job is small, or if it is one which is not expected to run for long.
- The first questions must always be:
- "Will it pay to begin a method study of this job?", and: "Will it pay to continue this study?"
- Thus, the money spent should be justified by the savings from it.
- The following guidelines can be used for selecting a job:

  (*a*) Bottleneck operations which are holding up other production operations.

  (*b*) Operations involving excessive labour.

  (*c*) Operations producing lot of scrap or defectives.

  (*d*) Operations having poor utilization of resources.

  (*e*) Backtracking of materials and excessive movement of materials.

Technical Aspects

- The most important point is to make sure that adequate technical knowledge is available with which to carry out the study
- Example: A machine tool constituting a bottleneck in production is known to be running at a speed below that at which the high-speed cutting tools will operate effectively.
- Can it be speeded up, or is the machine itself not robust enough to take the faster cut? This is a problem for the machine tool expert.
- The method study man should be careful enough to select a job in which he has the technical knowledge and expertise.
- Other factors which favor selection in technical aspect are:
  1. Job having in consistent quality.
  2. Operations generating lot of scraps.
  3. Frequent complaints from workers regarding the job.

Human Considerations

- Method study means a change as it is going to affect the way in which the job is done presently and is not fully accepted by workman and the union.
- Are among the most difficult to foretell, since mental and emotional reactions to investigation and changes of method have to be anticipated.
- Trade union officials, workers' representatives and the operatives themselves should be instructed in the general principles and true objectives of method study.
- If, however, the study of a particular job appears to be leading to unrest or ill-feeling leave it alone, however promising it may be from the economic point of view.
- If other jobs are tackled successfully and can be seen by all to benefit the people working on them opinions will change and it will be possible, in time, to go back to the original choice.
- Human considerations play a vital role in method study.
- These are some of the situations where human aspect should be given due importance:
    1. Workers complaining about unnecessary and tiring work.
    2. More frequency of accidents.
    3. Inconsistent earning.

The Field of Choice

- When selecting a job for method study it will be found helpful to have a standardized list of points to be covered.
- This prevents factors being overlooked and enables the suitability of different jobs to be easily compared.
- A sample list is given below which is fairly full, but lists should be adapted to individual needs.

1. **Product and operation.**
2. **Person who proposes investigation.**
3. **Reason for proposal.**

Suggested limits of investigation.

- It is important to set clearly defined limits to the scope of the investigation.
- Method study investigations so often reveal scope for even greater savings that there is a strong temptation to go beyond the immediate objective.
- This should be resisted, and any jobs shown up as offering scope for big improvements through method study should be noted and tackled separately.

5. Particulars of the job.

A. How much is (many are) produced or handled per week?

B. What percentage (roughly) is this of the total produced or handled in the shop or plant?

C. How long will the job continue?

D. Will more or less be required in future?

E. How many operatives are employed on the job directly? indirectly?

F. How many operatives are there in each grade and on each rate of pay?

G. What is the average output per operative (per team) per day?

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H. What is the daily output compared with the output over a shorter period? (e.g. an hour)

I. How is payment made? (team work, piecework, premium bonus, time rate, etc.)

J. What is the daily out put of the best operator? of the worst operator?

K. When were production standards set?

L. Has the job any specially unpleasant or injurious features?

- Is it unpopular (a) with workers? (b) with supervisors?

6. Equipment.

A. What is the approximate cost of plant and equipment?

B. What is the present machine utilization index?

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7. Layout.

A. Is the existing space allowed for the job enough?

B. Is extra space available?

C. Does the space already occupied need reducing?

8. Product.

A. Are there frequent design changes causing modifications?

B. Can the product be altered for easier manufacture?

C. What quality is demanded?

D. When and how is the product inspected?

9. What savings or increase in productivity may be expected from a method improvement?

A. Through reduction in the "work content" of the product or process.

B. Through better machine utilization.

C. Through better use of labour.

- (Figures may be given in money, man-hours or machine-hours or as a percentage.)

Remember!

- Such a list will prevent the work study man from going first for a small bench job which will entail a detailed study of the worker's movements and yield a saving of a few seconds per operation,
- unless the job is one that is being done by a large number of operatives, so that the total saving will significantly affect the operating costs of the factory.
- It is no use playing around with split seconds and inches of movement when a great waste of time and effort is taking place due to bad shop layout and the handling of heavy materials.
- Finally, remember the adage: "Do not use a spoon when a steam shovel is needed."
- Tackle first the job most likely to have the greatest over-all effect on the productivity of the enterprise as a whole.

4.3.2. RECORD

- The next step in the basic procedure, after selecting the work to be studied, is to record all the facts relating to the existing method.
- The success of the whole procedure depends on the accuracy with which the facts are recorded, because they will provide the basis of both the critical examination and the development of the improved method.
- Records are very much useful to make before and after comparison to assess the effectiveness of the proposed improved method.
- It is therefore essential that the record be clear and concise.
- The usual way of recording facts is to write them down.
- Unfortunately this method is not suited to the recording of the complicated processes which are so common in modern industry.
- To overcome this difficulty other techniques or "tools" of recording have been developed, so that detailed information may be recorded precisely and at the same time in standard form.
- The most commonly used of these recording techniques are charts and diagrams.
- There are several different types of standard charts available, each with its own special purpose

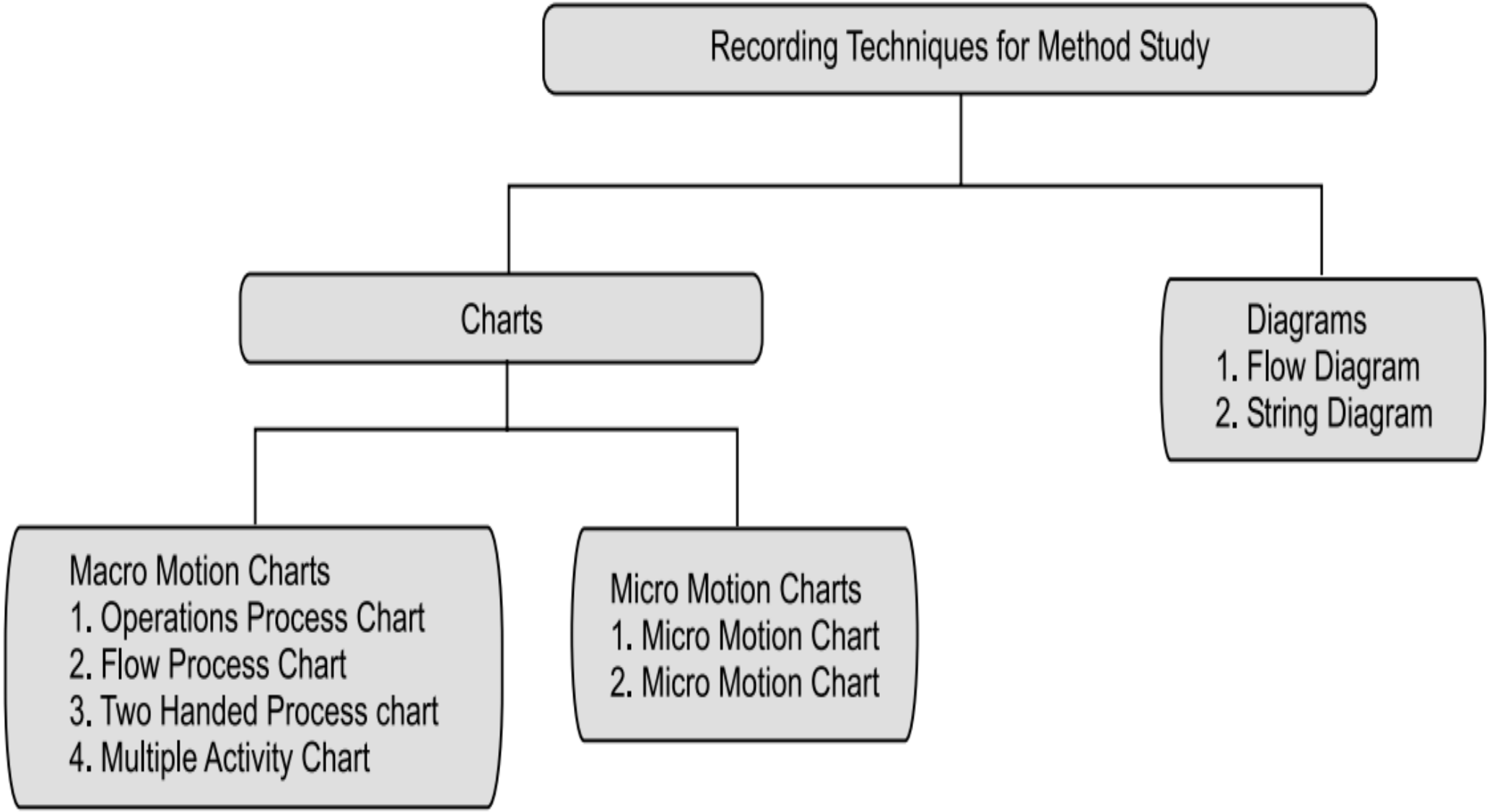


Figure: *Recording techniques for method study*

4.3.2.1. THE MOST COMMONLY USED METHOD STUDY CHARTS AND DIAGRAMS

CHARTS indicating process SEQUENCE

- Outline Process Chart
- Flow Process Chart - Man Type
- Flow Process Chart - Material Type
- Flow Process Chart - Equipment Type
- Two-Handed Process Chart

CHARTS using a TIME SCALE

- Multiple Activity Chart
- Simo Chart

DIAGRAMS indicating movement

- Flow Diagram
- String Diagram
- Cyclegraph / Chronocyclegraph
- Travel Chart

4.3.2.2. Symbols Used in Method Study

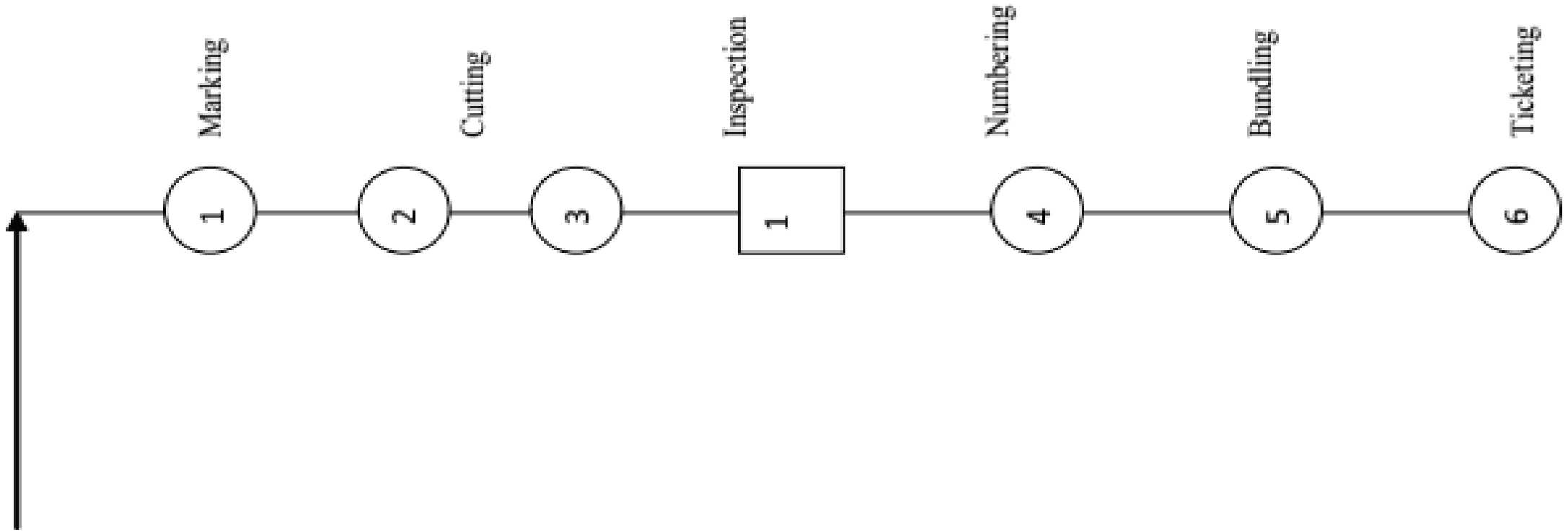
- The recording of the facts about a job or operation on a process chart is greatly facilitated by the use of a set of five standard symbols, which together serve to represent all the different types of activity or event .
- They thus form a very convenient, widely understood type of shorthand, saving a lot of writing and helping to show clearly just what is happening in the sequence being recorded.
- 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.
- There are five basic symbols which are operation, inspection, transport, temporary delay (delay), permanent delay (storage) and combined activities.
- The two principal activities in a process are operation and inspection.

Symbol	Activity	Description
	OPERATION	• Indicates the main steps in a process, method or procedure. • Usually the part, material or product concerned is modified or changed during the operation. • An operation always takes the material, component or service a stage further towards completion
	INSPECTION	• Indicates an inspection for quality and/or a check for quantity. • An inspection does not take the material any nearer to becoming a completed product.
	TRANSPORT	• Indicates the movement of workers, materials or equipment from place to place.
	TEMPORARY STORAGE OR DELAY	• Indicates a delay in the sequence of events: • for example, work waiting between consecutive operations, or any object laid aside temporarily without record until required.
	PERMANENT STORAGE	• Indicates a controlled storage in which material is received into or issued from a stores under some form of authorization; or an item is retained for reference purposes.

1. Operation Process Chart

- It is also called outline process chart.
- An operation process chart gives the bird's eye view of the whole process by recording only the major activities operation and inspections involved in the process.
- In an outline process chart only the principal operations carried out and the inspections made to ensure their effectiveness are recorded.
- Operation process chart uses only two symbols, *i.e.*, operation and inspection.
- Operation, process chart is helpful to:
  (a) Visualize the complete sequence of the operations and inspections in the process.
  (b) Know where the operation selected for detailed study fits into the entire process.
  (c) In operation process chart, the graphic representation of the points at which materials are introduced into the process and what operations and

Figure: outline process chart / operation process chart



2. Flow process chart

- Flow process chart gives the sequence of flow of work of a product or any part of it through the work center or the department recording the events using appropriate symbols.
- It is the amplification of the operation process chart in which operations; inspection, storage, delay and transportation are represented.
- Like operation process chart, flow process chart is constructed by placing symbols one below another as per the occurrence of the activities and are joined by a vertical line.
- A brief description of the activity is written on the right hand side of the activity symbol and time or distance is given on the left hand side.
- Use of flow process chart helps to improve a work method by

(i) Elimination or simplification of operations.

(ii) Elimination or simplification of inspections needed or relocation of inspection points.

(iii) Reduced in movement distance of man or materials in shops.

(iv) Reduction in delay or waiting times.

(v) Reduction in number or elimination of periods of temporary storage of materials between operations. This saves floor space as well as reduces the work-in-process at any given time.

Types Of Flow Process Charts

- **There are three types of flow process charts**

1. Flow process chart – Product Analysis

- This is a graphic representation of different steps involved in performing the work required to convert a product from one stage to another.

2. Flow process chart – Man Analysis

- This is a graphic representation of different steps; a person performs when doing a job and his movement from one place to another in performing that job.

3. Flow process chart – Equipment Analysis

- A flow process chart records how the equipment is used.
- Until, unless clearly mentioned flow process chart refers to that of flow process chart based on product (material) analysis.

Flow process chart

Flow process chart	Man/material/equipment type									
Location of materials warehouse	Product name Men's shirts			Survey date 17/8/2006			Analyst Vivek		Dept cutting	
Activity: transport, spreading, cutting, bundling, storing.	Start point			Taken from material warehouse						
	End point			Stored on shelves in cutting dept						
	Symbols			Time			Distance			
	○ - Operation			3.5 h						
	⇨ - Transport			0.2 h						
	D- Delay			0			27 m			
	□ - Inspection			0						
	▽ - Storage			27 h						
Tasks	Qty	Distance Travelled	Time	○	⇨	D	□	▽	Remarks	
Transport fabric from warehouse to cutting dept	17 rolls	20m	10 min/10 rolls	○	⇨	D	□	▽		
Wait for Spreading	17 rolls		3 h	○	⇨	D	□	▽	Can waiting time reduced	
Spreading	4 rolls	5m	1.2 h	○	⇨	D	□	▽		
Marker drawing	4 rolls		0.5 h	○	⇨	D	□	▽		
Rough cutting Straight knife cutting	4 rolls		0.5 h	○	⇨	D	□	▽		
Band knife cutting	200 garments		1 h	○	⇨	D	□	▽		
Numbering/bundling	200 garments		0.3 h	○	⇨	D	□	▽	Can numbering m/c used	
Transport to shelves at cutting dept	200 garments	2m	0.2 h	○	⇨	D	□	▽		
Waiting for sewing	200 garments		1day	○	⇨	D	□	▽		
Total		**27m**		**5**	**2**	**0**	**0**	**2**		

3. Flow Diagram

- Flow diagram is a drawing or a diagram which is drawn to scale.
- It shows relative position of product machinery, jigs, fixtures, etc., and marks the paths followed by men and materials.
- It is the plan view of a work place to a certain scale and a line diagram indicating the path followed by the object under study.
- This gives an overall view of an existing or proposed process and is used for making improvement.
- It shows the path followed by the material, man or equipment.
- Where more than one floor is involved, an isometric drawing can be used.
- Normally the flow diagram should be accompanying the flow process chart.
- The flow process chart and flow diagrams are very simple and effective tools of method study.
- They are very useful in establishing the overall sequence of operations and in determining the best layout for an economic and effective flow of materials.
- By systematically examining these charts, improvement can be made on the methods of production, sequence of operation and layout, etc.
- Thus, work can be reduced, time can be saved and expenses can be cut.

Steps in drawing a flow diagram:

1. Draw to scale the plan of the work area.
2. Mark the relative positioned of machine tools, benches, stores, racks, inspection booths, etc.
3. From the different observations draw the actual path of the material or the worker on the diagram and indicate the direction of movement.
4. Each movement is serially numbered and indicated by arrow for direction.
5. Different movements can be marked in different colors. Process symbols may also be added on the diagram.

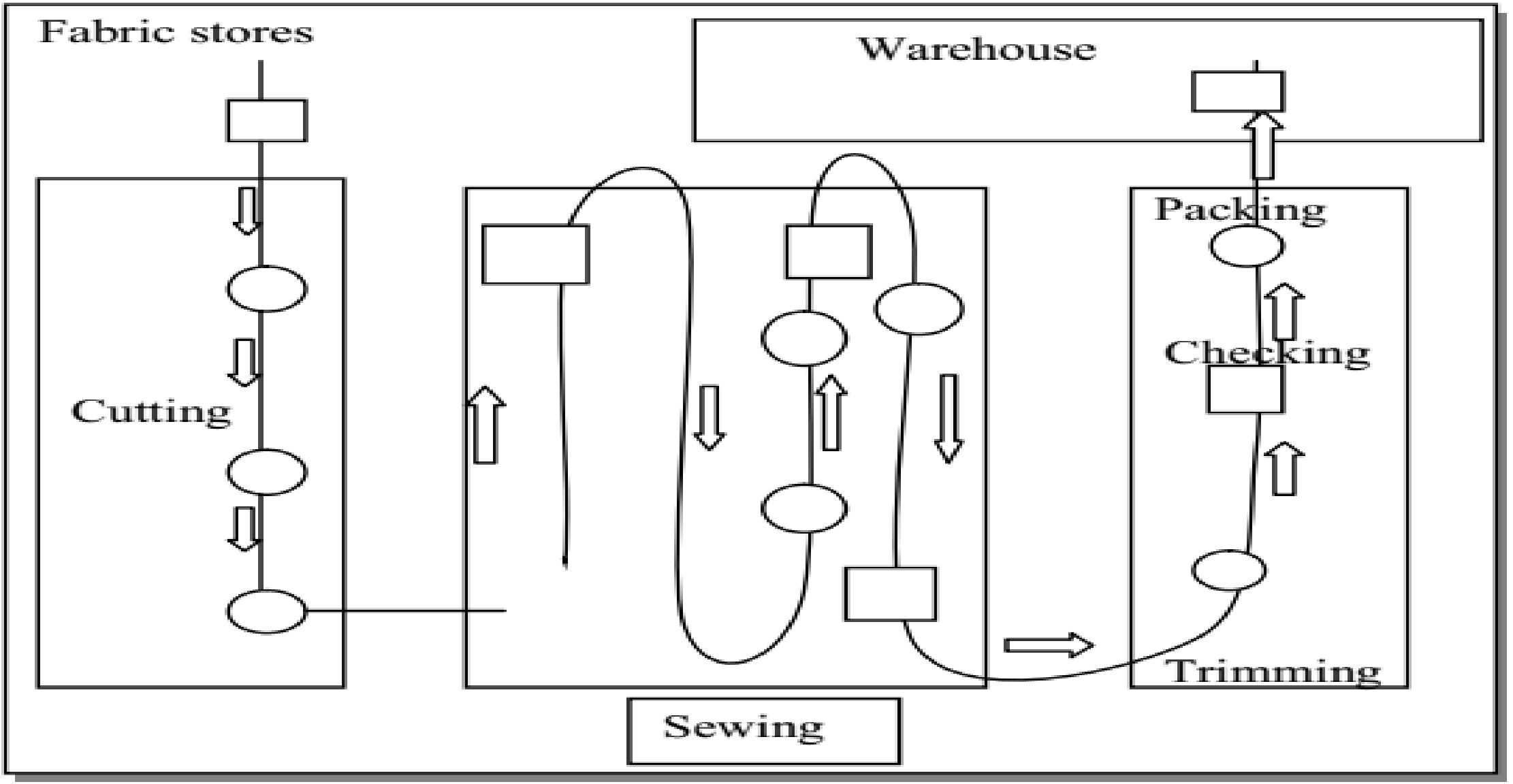


Figure: Flow diagram

4.String Diagram

- The string diagram is a scale layout drawing on which, length of a string is used to record the extent as well as the pattern of movement of a worker working within a limited area during a certain period of time.
- When the paths are many and repetitive, a flow diagram becomes congested and is neither easy to trace it nor to understand. Under such conditions a string diagram is preferred.
- It is a special type of flow diagram, generally prepared when the movements involved (of men, material or equipment) are large and cannot be comprehensively recorded by flow diagram.
- One of the most valuable features of the string diagram is the actual distance travelled during the period of study to be calculated by relating the length of the thread used to the scale of drawing.
- Thus, it helps to make a very effective comparison between different layouts or methods of doing job in terms of the travelling involved.
- The main advantages of string diagram compared to flow diagram is that respective movements between work stations which are difficult to be traced on the flow diagram can be conveniently shown on string diagram.

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➢CONSTRUCTION

1. Draw the scale layout of the shop area mark various features, such as machinery, work stations, store, etc.
2. Mount this scaled drawing on a soft board and strike pins or pegs at all the places which form the path of the workers and materials.
   - More pegs may be struck in between the facilities as to trace more or less, the actual path of men and materials.
3. A continuous colored un stretchable string, taken from the first to the last peg, is wound to mark the path followed by workers or materials.

✓USES

- ➢It is very useful in dealing with complex movements and plant layout and design problem.
- ➢Indicates clearly, back tracking, congestion bottlenecks and over- and under-used paths on the shop floor
- ➢Measures the distances involved and points out whether a work station is suitably located.
- ➢Traces modifications in existing path.

❑Drawbacks

- If the workers or materials move in some irregular or curvilinear path, it is not possible to trace exactly the same on the string diagram.

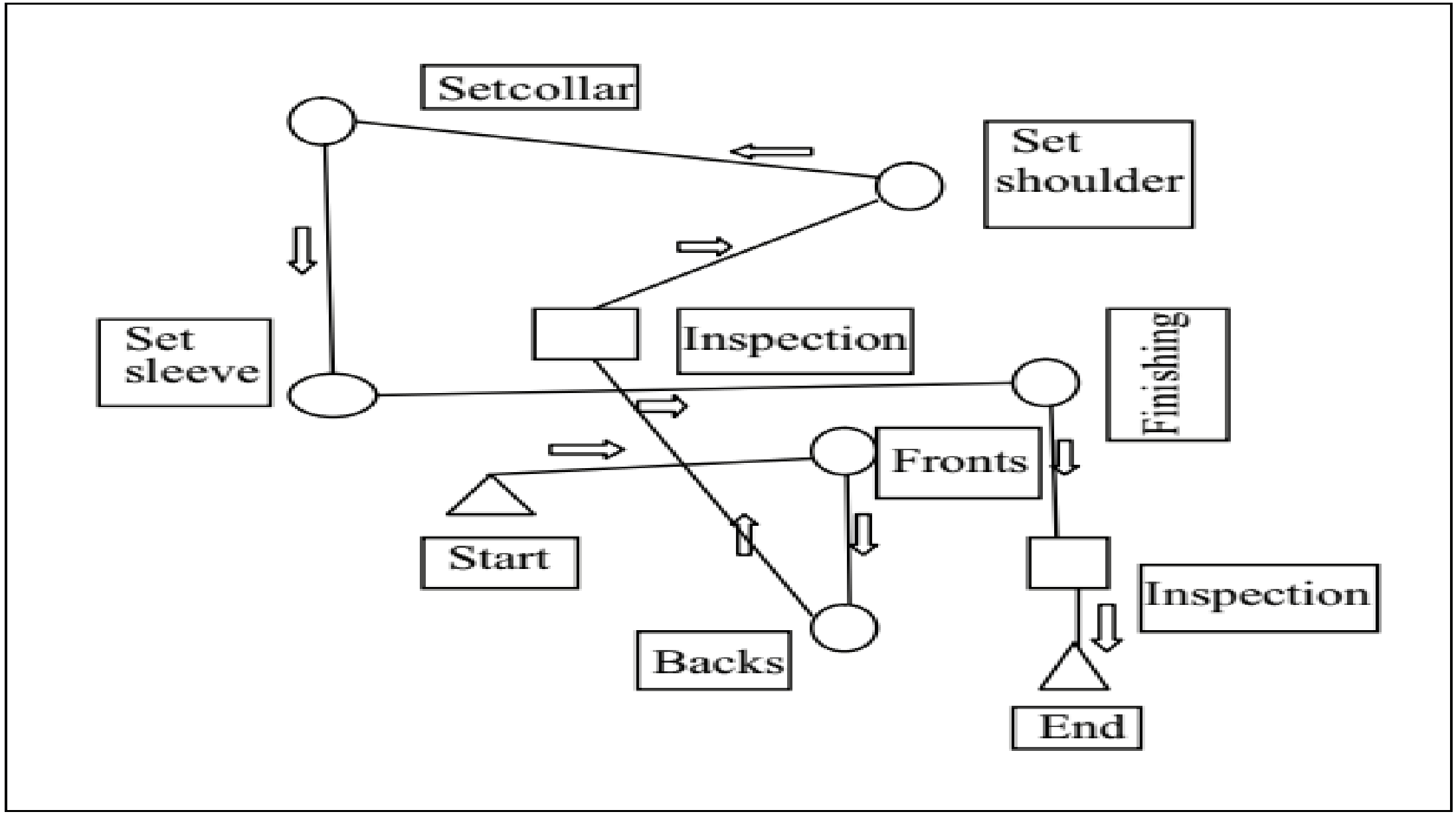


Figure: String diagram

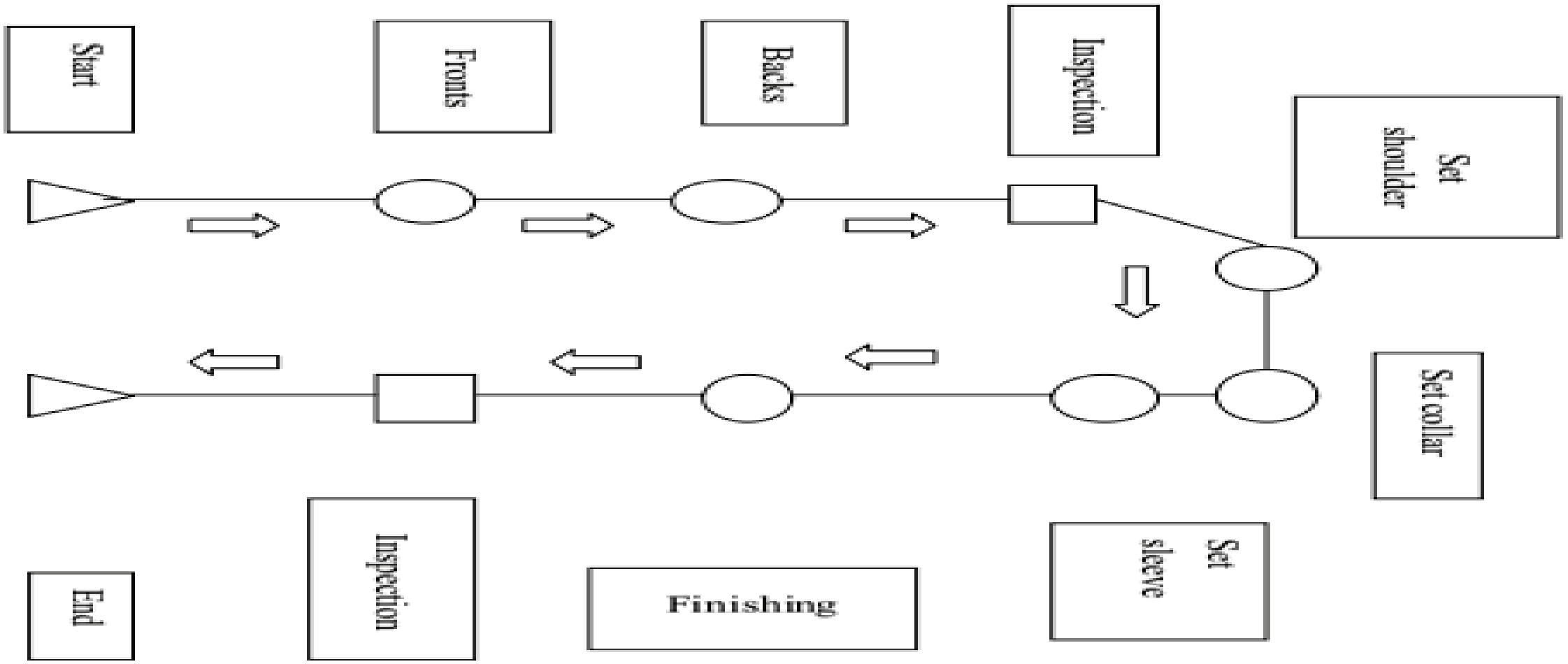
5. Travel chart (From – To chart)

- The chart which gives an estimate about the amount of material handling between various work stations is known as travel chart.
- The amount of travel depends upon the frequency of movements between sections of departments.
- A travel chart helps improving the existing plant layout.
- A travel chart is advantageous because it brings out the relative importance of having different parts of departments close to each other.
- It is a two-way matrix table which provides quantitative data regarding the origin and destination of the movement of any worker (or material or equipment) during a given period.
- Travel chart is, therefore, a very useful aid to examine the arrangement of machine or departments for reducing or eliminating the movement (Khanna, 2003).
- The following example explains a travel chart:
  Existing plant layout showing the locations of various departments (A to F)

Uses of travel chart

- A travel chart is advantageous because it brings out relative importance of having different pairs of departments close to each other.
  - o To analyze material handling and plan department locations.
  - o To compare layouts and to determine their efficiency.
  - o To plan materials handling procedure and routes.
  - o To shorten manufacturing cycles.
  - o To reduce work in progress.
  - o To reduce labor costs.
  - o To assist improving materials handling procedure.
  - o To determine relative self-sufficiency of various areas.
  - o To determine inventory control difficulties.
  - o To make economical use of available areas.

Example: string diagram revised layout



Step 1:

A - Fabric Section	B - Stores Section	C - Sewing Section
D - Finishing Section	E - Cutting Section	F - Packing Section

Step: 2

- Movements
- A to B are 10; B to A =20;
- B to C = 15; C to B = 15;
- A to E = 40; E to A = 20;
- C to D = 50; D to C = 30;
- D to F = 40; F to D = 10,
- E to F = 5; F to E = 5;
- B to D = 10; B to E = 10; B to F = 10

Step: 3

A square grid is drawn and the various movements are marked.

From / To	A	B	C	D	E	F
A		20			20	
B	10		15			
C		15		30		
D		10	50			10
E	40	10				5
F		10		40	5	

Step: 4

- Step 3 is simplified by combining movements like A to B (20) and B to A (10 which involve some distance and therefore total movements B‹=›A = 20 + 10 = 30).
- The simplified travel chart shows movements as:-
  A‹=›B = 30 B‹=›C = 30
  C‹=›D = 80 E‹=›F = 5
  D‹=›F = 40 F(=)D = 10
- According to these figures, maximum number of movements is between department C-sewing room and D-finishing section; hence in the plant layout there two departments should be side by side.
- The next lesser number of movements is between D-finishing section and F-packing section, hence D and F should also lie closer to each other and so on.

6. Multiple activity chart (or) man–machine chart

- This chart describes graphically the activity of a man and machine he is attending against a time scale.
- Where a number of workers work in a group or an individual operator handles two or more machine, their activities have to be coordinated for achieving proper results.
- A man–machine chart (multiple activity charts) records simultaneously the activities of all the workers and
  machines on a common time scale and thus shows inter relations between them. (Khanna, 2003).
- Purpose
  (i) To detect idle times being enforced on machines and workers.
  (ii) To optimize work distribution between workers and machines.
  (iii) To detect number of workers in a group.
  (iv) Ultimately to develop an improved method of accomplishing a task and to have an effective labor lost control.

Construction

(a) A separate vertical bar or column is there to represent each subject (machines or operator).
(b) A common time scale is provided for all the subjects.
(c) Activities of each subject in relation to those of the others are marked in the respective columns.
(d) Previously conducted time studies provide the time values for each activity.
(e) A brief description of each activity is marked on the chart.
(f) Working and idle times are marked differently on the chart.
For example, a worker is doing an operation on collar turning machine.

- Suppose that the time to set up a machine is 0.50 minutes and machining time is 0.75 minutes.

Time	*Operator*	*Machine 1 Washer*	*Machine 2 Dryer*
	Load clothes and detergent in to Machine 1	Being loaded	Idle
	Idle	Run	Idle
	Remove clothes from Machine 1	Being unloaded	Idle
Repeat	Load clothes into Machine 2	Idle	Being loaded
Cycle	Load clothes and detergent into Machine 1	Being loaded	Run
	Idle	Run	Run
	Remove clothes from Machine 2	Idle	Being unloaded
	Hang clothes	Idle	Idle

Figure: Multiple activity chart

7. The Two-Handed Process Chart

- Study of the work of an operator at the bench starts, as does method study over the wider field, with a process chart.
- In this case it is the fifth of the charts indicating process sequence that known as the two-handed process chart.
- The two-handed process chart is a process chart in which the activities of a worker's hands(or limbs) are recorded in their relationship to one another.
- The two-handed process chart is a specialized form of process chart because it shows the two hands (and sometimes the feet) of the operator moving or static in relation to one another, usually in relation to a time scale.
- One advantage of a time scale on the chart form is that it brings the symbols for what the two hands are doing at any given moment opposite to one another.
- The two-handed process chart is generally used for repetitive operations, when one complete cycle of the work will be recorded.
- Recording is carried out in more detail than is normally used on flow process charts.
- What may be shown as a single operation on a flow process chart may be broken down into a number of elemental activities which together make up the operation.
- The two-handed process chart generally employs the same symbols as the other process charts but because of the greater detail covered the symbols are accorded slightly different meanings

8. SIMO CHART

- THE SIMO CHART Only one recording technique of micromotion study will be described here, namely the simultaneous motion cycle chart, known as the SIMO chart for short.
- A SIMO chart is a chart, often based on film analysis, used to record simultaneously on a common time scale the therbligs or groups of therbligs performed by different parts of the body of one or more workers.
- The SIMO chart is the micromotion form of the man type flow process chart.
- Because SIMO charts are used primarily for operations of short duration, often performed with extreme rapidity, it is generally necessary to compile them from films made of the operation which can be stopped at any point or projected in slow motion.
- The movements are recorded against time measured in "winks" (1 wink = 1/2000 minute).
- These are recorded by a "wink counter" placed in such a position that it can be seen rotating during the filming.
- Some SIMO charts are drawn up listing the fingers used, wrist, lower and upper arms.
- The hatching in the various columns represents the therblig colours associated with the movements, the letters refer to the therblig symbols.

9. Other Recording Techniques

- The **cyclegraph** is a record of a path of movement, usually traced by a continuous source of light on a photograph, preferably stereoscopic.
- The path of movement of a hand, for instance, may be recorded on a photograph in this way if the worker is asked to wear a ring carrying a small light which will make the trace on the photograph.
- Or such a light may be attached to a worker's helmet if the purpose is to obtain a record of the path over which he moves during the performance of a task.
- The **chronocyclegraph** is a special form of cyclegraph in which the light source is suitably interrupted so that the path appears as a series of pear-shaped dots, the pointed end indicating the direction of movement and the spacing indicating the speed of movement.
- The application for these recording techniques is limited compared with those for the charts and diagrams illustrated in this book, but there are occasions on which photographic traces of this sort can be useful.

4.4. Principles Of Motion Economy

- A motion is an act of moving body part. Fewer motions decrease the time and energy required to complete an operation (Glock and Kunz, 2009).
- The best method of performing a job is not only with minimum expenditure but certain other rules or principles should be observed for increasing the speed to achieve more economy in production.
- Although all the principles are not applied to every operation, but they form basis or a code for improving the efficiency and reducing fatigue in manual work.

A. Principles related to the use of the “human body”.
B. Principles related to the “arrangement of the work place”.
C. Principles related to the “design of tools and equipment”.
D. Rules concerning “time conservation”.

4.4.1. Principles Related To The Use Of The “Human Body”

1. Both hands should start as well as complete their motions at the same time.
2. Both hands should not be idle at the same time except during rest periods.
3. Use both hands simultaneously and use best motion sequence.
4. Hand motions should be confined to the lowest possible classification in order to reduce fatigue.

- These are listed in the order of giving least fatigue and maximum economy (Khanna, 2003).

Class	Pivot	Body Part(s) Move
1	Knuckle	Finger motion
2	Wrist	Finger and wrist motions
3	Elbow	Finger, wrist and lower arm motions
4	Shoulder	Finger, wrist, lower arm and upper arm motions
5	Trunk	Finger, wrist, lower arm, upper arm and body motions

Conti…

5. Utilize momentum to assist the worker, wherever possible.

6. Smooth continuous motions produce less fatigue in comparison to zigzag or straight line motions involving sudden and sharp change in direction.

7. Ballistic movements are faster, easier and more accurate than controlled movements.

8. Sequence of motions should be arranged to build rhythm and automatically into the operation.

9. Hands should be relieved of all work that can be done by feet or other parts of the body.

4.4.2. Principles Related To The Arrangement Of The Work Place

1. All tools and materials should be placed at a definite and fixed place with easy reach.
2. All tools materials and actuating devices should be placed in front of the operator at a distance as near as possible.
3. Provide gravity feed bins and use power or gravity conveyors to transport materials.
4. Wherever possible use drop deliveries.
   - Drop delivery means dropping the article into a chute or on a conveyor as near to the point of assembly as possible so that gravity assists rather than the hands to reach the part to its required place.
5. Tools and materials should be located in such a way to achieve the best sequence of motions.
6. Illuminate the work places properly for adequate seeing and visual perception.
7. Provide proper working tables, stools and chairs, etc., because to work in standing or sitting position on floor consumers more time and energy.
8. The height of the work place and chair, etc., should be such that worker can either sit or stand comfortably.
9. Chairs provided should make good posture possible.
10. Keep the shops in good order, neat and clean (Khanna, 2003).

4.4.3. Principles Related To The Design Of Tools And Equipment

1. The hands should not be used for work that can be done more advantageously with the help of devices.

- Therefore, following devices should be used to reduce manual work and to free both the hands as far as possible:
  (a) Use power operated tools and equipment,
  (b) Use vices, jigs and fixtures, etc.,
  (c) Use stops, guides, etc.,
  (d) Use foot pedals.

2. Reduced noise increases the speed or work and requires less energy.

3. Wherever practicable, tools and materials should be propositioned to reduce search, find and the select operations.

4. Wherever possible two or more tools should be combined.

5. Handles on tools and cranks should be designed to permit maximum contact with the hands, particularly where force is applied, such as in a screw driver, pliers, scrappers, etc.

6. When each finger performs some specific movement, such as in type writing, the load should be distributed in accordance with the inherent capacities of the fingers.

7. The location of levers, cross bars and hand wheels, etc, should be so decided that the operation can operate with the least change in body position and with greatest mechanical advantage.

Rules concerning “time conservation”

1. Even temporary ceasing of work by a man or machine should not be encouraged.

2. Machine should not run idle.

3. Two or more jobs should be worked upon at the same time or two or more operations should be carried out on a job simultaneously.

- Number of motions involved in completing a job should be minimized.

4.5. Micro Motion Study

- Some motions require very small time and it is difficult to measure time for these motions accurately. But the time required by these motions cannot be neglected because they are repeated hundreds of time.
- Therefore, the motions are taken on picture films with the help of picture camera.
- Very small time up to 0.0005 minutes can be measured by this system. When picture camera is used, the procedure is known as “micro motion study” (Kanawaty, 1992).
- The method gives very accurate analysis of the product, but being a costly one it is used when products are likely to continue for a long time.
- Micro motion study has the following important advantages:

(a) It provides permanent record of motion study with the help of film.

(b) A large number of workers can see the procedure at any time even after the completion of motion study.

(c) Differences in the old and new methods can be demonstrated, if both are filmed.

(d) Films can be demonstrated at any desired speed.

(e) It gives very accurate time for each motion or operation than that noted by the stop watch.

4.5.1. Therbligs

- Frank Gilbreth developed a set of 17 elementary motions commonly found in manual operations and called them “Therbligs”, reverse spelling of his name.
- We know that motion study is used for deciding the best way of doing work for which present and proposed methods are observed by experts by recording on charts.
- For the purpose of recording the motions, he splitted up different motions of process into 17 fundamental elements made by various members of human body and each event was allotted a symbol and letter abbreviation.
- To maximize the utility of charts sometimes color codes are also used.
- These symbols, abbreviations and color codes are used for preparing motion study charts.

S. no.	Therblig	Explanation	Abbreviation
1	Search	Attempt to locate an object	S
2	Hold	Keep an object stationary	H
3	Select	Choose one object from among a group	SE
4	Grasp	Gain control or a hold on an object	G
5	Release load	Relinquish hold	RL
6	Transport loaded	Move object with body member	TL
7	Transport empty	Reach for an object	TE
8	Position	Orient an object for use at its present location	P
9	Preposition	Orient an object for easy use at some later times and usually in a different location	PP
10	Assemble	Put two or more parts together	A
11	Disassemble	Separate two or more parts	DA
12	Use	Apply object or tool	U
13	Inspect	Examine object	I
14	Avoidable delay	A delay which operator could prevent	D
15	Unavoidable delay	A delay which operator could not prevent	UD
16	Rest to overcome fatigue	An attempt to recover from physical or mental work	R
17	Plan	Mentally chart for future action	PN

4.6. Study of method recorded

4.6.1 Examination of the existing method

- Critical examination of every activity of the process is carried out by means of two sets of detailed questions;
- the primary questions to indicate the facts or the necessity of carrying out the activity and the secondary questions to indicate the alternative methods of doing the activity and then the selection of an alternative to be used later as a standard practice.
- Primary questions

1. ***Purpose*** – The need of carrying out the activity is challenged by the questions: what is achieved? Is it necessary? Why?

- The answers to these questions determine whether the particular activity will also be included in the proposals of new method for the process.

2. ***Means*** – The means of carrying out the activity are challenged by the questions: how is it done? and why that way?

3. ***Place*** – The location of carrying out the activity is challenged by the questions: where is it done? and why there?

4. ***Sequence*** – The time of carrying out the activity is challenged by the questions: when is it done? and why then?

5. ***Person*** – The level of skill and experience of the person performing the activity is challenged by the questions: who does it? and why that person?

4.6.2 Develop The Improved Method

- After considering the above primary and secondary questions, a new better method is developed.
- Apart from the above considerations, before finishing the new method, the following facts should also be thought over during the motion study.
- **Elimination** – Every operation or detail of the job should be thought that whether it can be eliminated without any harm.
- **Combining** – In this aspect, it is to be observed that whether two or more operations can be combined without any adverse effect to save operation time.
- **Rearrangement** – If rearrangement in the sequence of operations help in simplification or in any other aspect then it should be done.
- **Simplification** – In simplification, it is found that if the operation is possible with any other easy, safe and economical method then that should be adopted.
- The work can also be simplified by:
  (a) Placing the materials, tools and equipment at proper working area.
  (b) Using gravity feed hoppers and other material handling equipment.
  (c) Taking useful work by both hands.
  (d) Using special jigs and fixtures.

4.6.3. Defining The Improved Method

- Once a decision has been taken on the changes in method to be adopted, it is important that the new method should be strictly defined.
- For all jobs it is desirable to prepare a written standard practice also known as a “method documentation sheet”.
- This serves several purposes as mentioned below:

  1. It records the improved method for future reference.
  2. It can be used to explain the new method to management, supervisors and operators.
  3. It is an aid to training or retraining operators and can be used by them for reference until they are fully conversant with the new method.
  4. It forms the basis on which time studies may be taken for setting standards.

4.6.4 Installing The Improved Method

- After having developed the method, it is required to install.
- The new method must first be got approved from the supervisors, workers and management.
- Then the workers must be trained to work according to this new method and their habits must be developed to follow the correct way.
- For some times, close contacts must be maintained with progress of the job until it runs satisfactorily.
- It is at this point that active support is required from management and trade unions alike. Installation can be divided into five stages, namely:

1. Gaining acceptance of the change by management.
2. Gaining acceptance of the change by the departmental supervision.
3. Gaining acceptance of the change by the workers and their representatives.
4. Preparing to make the changes.
5. Controlling the change-over.

Teaching a new method

- There are five essential steps in the teaching of a new method:

1. The mind of the operator must be focused upon what is to be learned.

2. The method must be demonstrated and explained.

3. The operator must be allowed to practice.

4. Constant correction of fault.

5. Operator must persevere.

- *Training and re-training of operatives* In the training or re-training of operatives, the important thing is to develop the habit of doing the job in the correct way.

4.6.5 Maintaining The New Method

- Once a method is installed, it should be maintained in its specified form, and is not allowed to slip back to old form or introduction of any other unauthorized changes.
- For proper maintenance, following steps are advised:

1. Copies of the job instruction sheets should be distributed to all concern.

- These sheets must supply the detail for setting up the job and proper operation.

2. Routine checks are necessary to compare what is actually being done against the job instruction sheets.

3. Selection and training of persons must be done according to the job specification for this new method.

4.7. Methods Improvement

- Methods can broadly be classified into two types:
    1. Big methods
    2. Small methods

4.7.1 Big methods

- This type of method improvement is normally associated with the engineering function.

1. Machines
    - (Pocket setters, profile setting, automatic hemmers, and label sewers)
2. Attachments
    - (Loading devices, stacking devices, folders, thread cutters)
3. Work aids
    - (Bins that carry work away from the machines, trays for positioning of work)
4. Machine adjustments (Needle positioner)
5. Construction changes in garment and clubbing of operations.

4.7.2 Small Methods

- The way the operator handles the work.
- The way she controls the machine.
- The way the operator disposes the machine etc.,
- This can be considered as everyone’s responsibility. But it is especially the responsibility of the executive (Seminar SCT, 2010).
- Small methods can be grouped into three, as below:
  (A) Basics
  (B) Principles of motion economy
  (C) Specifics of sewing jobs
- ***Basics***
  - Correct table height
  - Correct chair height
  - Operators posture at the machine
  - Both feet on treadle
- ***Principles of motion economy***
  - Motions should be simultaneous.
  - Motions should be symmetrical.
  - Motions should be natural.
  - Motions should be rhythmical.
  - Motions should be habitual.

- **Specifics of sewing jobs**

➢Types of operator motions/movements to be discouraged.

A. Operator being idle during machine time.
B. Operator unconsciously pit-pats the garment after sewing.
C. Operator unconsciously inspects each garment after sewing.
D. Operator stops while sewing more than absolutely essential.
E. Operator rides knee lift pedal.
F. Operator picks up, disposes, and picks up again.
G. Operator re-grasps or shifts from hand to hand.
H. Operator straightens out the material that is not sewn.

➢Types of operator motions/movements to be encouraged

A. Operator locates parts as close as possible to needle.
B. Operator folds anything that needs folding while moving to machine.
C. Operator uses simultaneous motions.