

## Subject: Apparel Production Management

### Unit 3: Manufacturing Systems

#### Quadrant 1 – e-Text

#### Learning Objectives

The learning objectives of this unit are:

- Describe the various types of production systems.
- Identify the basic components of a production system.

#### 3.1 Production Systems



#### Types of Production system

An apparel **production system** is an integration of materials handling, **production** processes, personnel, and equipment that directs work flow and generates finished products.



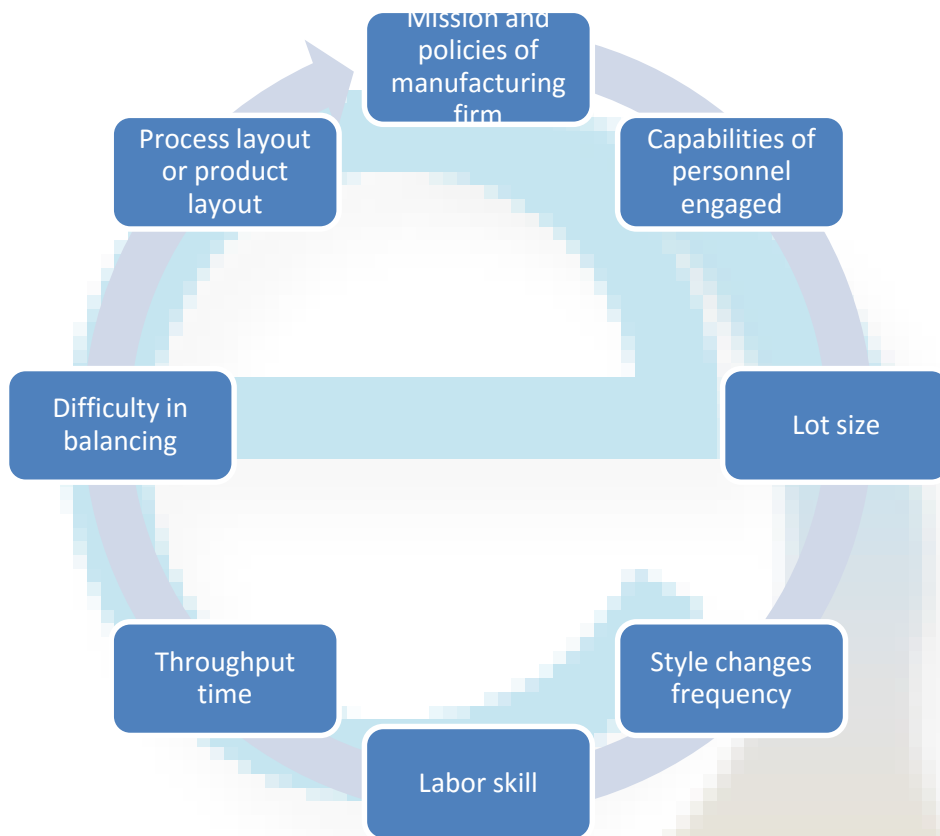
Each system requires different types of:

- Management philosophy
- Material handling arrangement
- Floor layout
- Employee training
- Companies may combine the systems or use only one depending on their need.

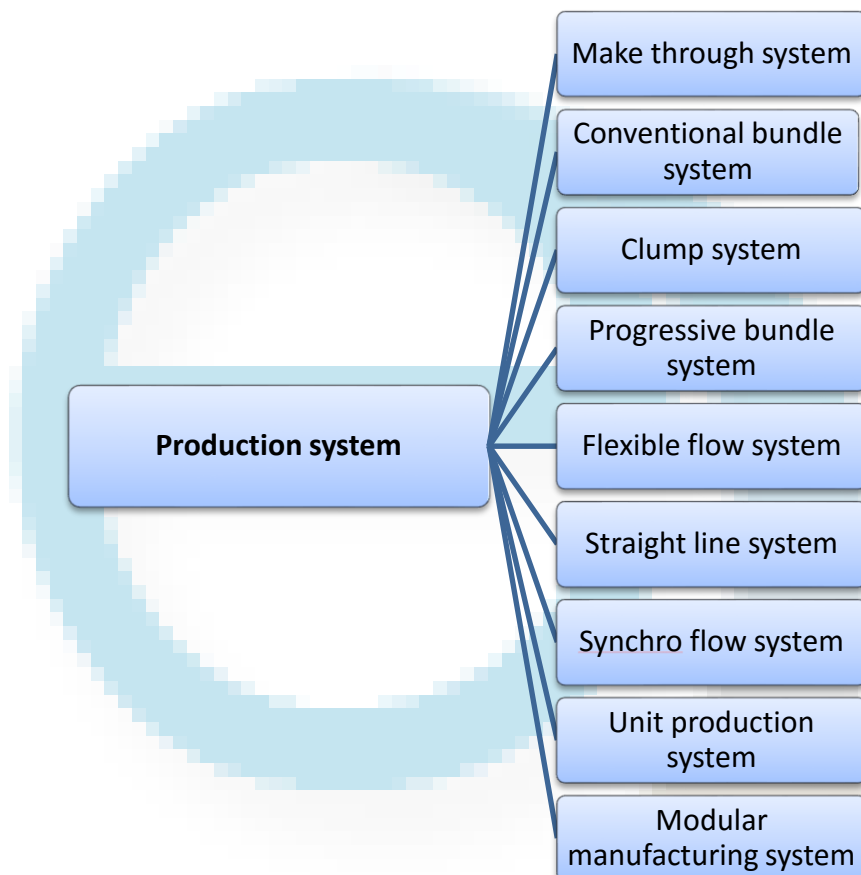
### **3.2 Principles of choosing a production system**

The Principles of choosing a production system includes:

- Mission and policies of manufacturing firm
- Capabilities of personnel engaged
- Lot size
- Style changes frequency
- Labor skill
- Throughput time
- Difficulty in balancing
- Process layout or product layout



There are many kinds of production systems, such as Make through system, Conventional bundle system, Clump system, Progressive bundle system, Flexible flow system, Straight line system, Synchro flow system, Unit production system Modular Production system.



### 3.3 Make through System

It is the traditional method of manufacture in which an operator makes right through one garment at a time. That is one operator will do all the stages of the sewing operations of one garment and after completing it he will go for the next garment.

The Make through system ensures quick throughput time, and is easy to supervise.

It is Pride of work and there are lot of chances of getting popularity, There is no WIP in make through, No problem of absenteeism, and it is easy to establish labour cost.

It is a work of creativity which a person enjoys while working, There is less chance of duplication of error if not supervised. Plant and machinery cost is less and it enables Non – repetitive job, there is no RSI.

The disadvantages are:

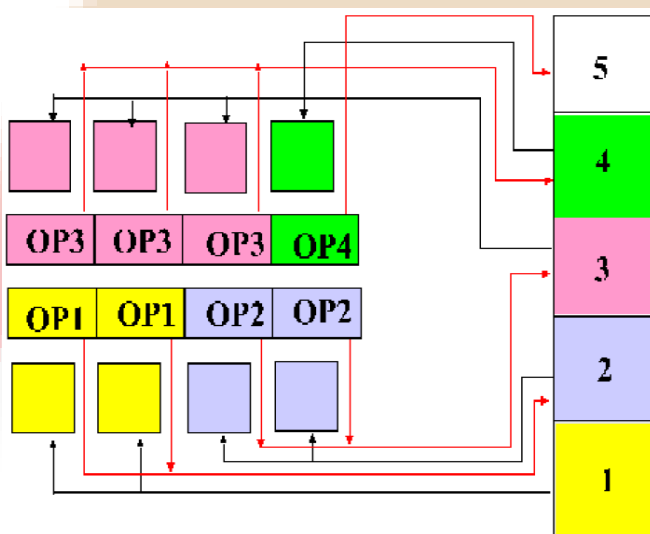
There is low productivity, with high labour cost. Only multi skilled experienced operators can be used on this system. It is the system suitable for Couture, sample making, high and low quantity of order. There is no scope of special machine or attachments. With this system it is difficult to identify errors and there is no possibility to improve productivity.



### 3.4 Conventional Bundle System

In the Conventional bundle system:

- Sewing machines are arranged in lines.
- The work flows from the central (store) area to the first machine, from the first machine back to the store, and then on to the next machine, and so forth.
- A distributor stationed at the store is responsible for receiving and dispatching the work.
- The work in progress is in the form of bundles.
- These bundles may be put on to a tray, a box, or a bag, or the garment parts may be wrapped and tied.

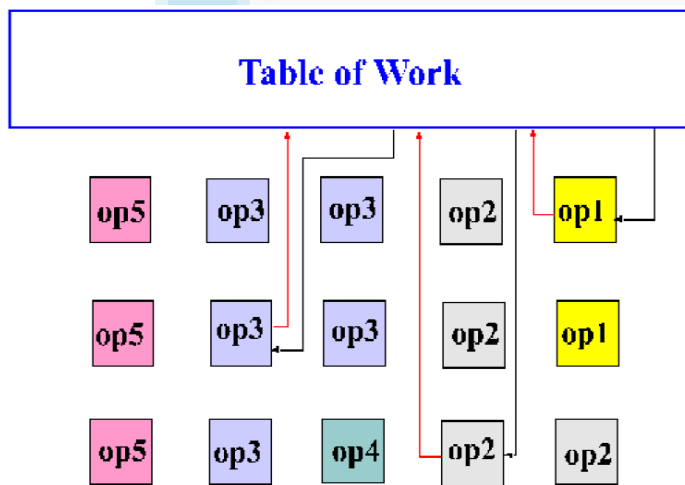


### 3.5 Clump System

#### In the Clump system:

- A worker collects a clump of materials from the worktable and carries out the first operation.
- After he has completed his part of the work, he returns it to the table.
- A worker for the second operation then continues the work and so on.

The process is 'collection - work -return' continues until the whole garment has been assembled.



### 3.6 Progressive Bundle System

The Progressive Bundle system, is a traditional production system. According To AAMA Technical Advisory Committee it is 80% used

- Sewing operations are laid out in sequence.
- Each operator receives a bundle, does his work, reties the bundle and passes it to the next operator.
- There is a storage facility such as rack, bin or table for storing the inter-process work between each operation.
- The work is routed by means of tickets.
- The use of the system decrease as firms seeks more flexibility.
- Machines and operations are organized into sections according to basic functions, which produce sub components.
- Within each sections works is balanced according to time required for each sub-functions.
- This system is the most widely used system in the garment industry today.
- It is used in shirt factories, jeans factories, jacket factories, etc.



Bundles are the most important feature of PBS.

- Bundle is number of garments processed together.
- Larger the bundle the smaller the bundle handling time, but greater the WIP, its weight and size.
- Various type of bundles are
  - Tied bundles
  - Bags
  - Pocketed bags
  - Boxes and baskets
  - Bundle trucks, etc





Bundles are assembled in the cutting room and then they are matched up with corresponding parts and **bundle tickets**. They are given to the operator scheduled to complete the operation. The operator is expected to perform the same operation on all the pieces in the bundle, retie the bundle, process coupon, and set it aside. The bundles are then picked up and moved to the next operation.

The advantages of this system are:

It allows high productivity, a high level of labour utilisation can be achieved, and helps in reducing time and cost.

Semi – skilled labour can be used, Individual performance can be monitored and incentives offered.

A uniform high quality of work can be achieved, and productivity can be improved.

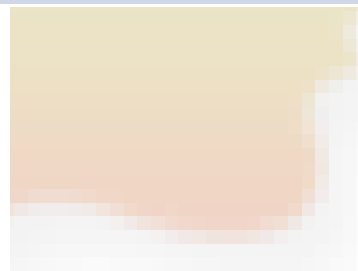
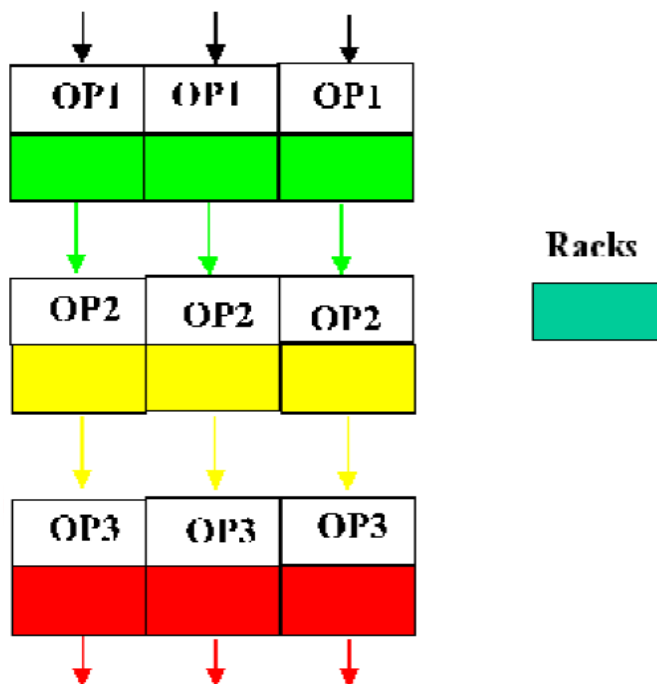
However the disadvantages are;

Investment in machines is high, and the system is not very adaptable for short-run production and frequent style changes, as these require rearrangement of the workstations.

It involves high handling costs for bundle handling and production, requires a high level of work in progress and therefore a high capital commitment, and requires a high level of supervisor skill to balance workflow.

Absenteeism is a very big problem and it is Repetitive job , with risk of RSI.

| Advantages   | Disadvantages   |
|--|---|
| High productivity  | Machine investment cost is high   |
| A high level of labour utilisation can be achieved             | The system is not very adaptable for short-run production and frequent style changes, as these require rearrangement of the workstations. |
| Training time and cost reduced                                 | It involves high handling costs for bundle handling and production.   |
| Semi – skilled labour can be used                              | It requires a high level of work in progress and therefore a high capital commitment.   |
| Individual performance can be monitored and incentives offered | It requires a high level of supervisor skill to balance workflow.   |
| A uniform high quality of work can be achieved.                | Absenteeism is a very big problem   |
| There is chance to improve productivity                        | Repetitive job , risk of RSI  |

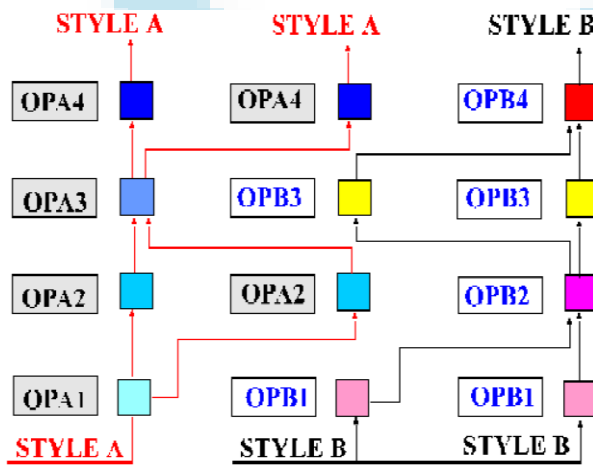


We can see the flow of WIP in this figure.

### 3.7 Flexible Flow System

**In the Flexible flow system:**

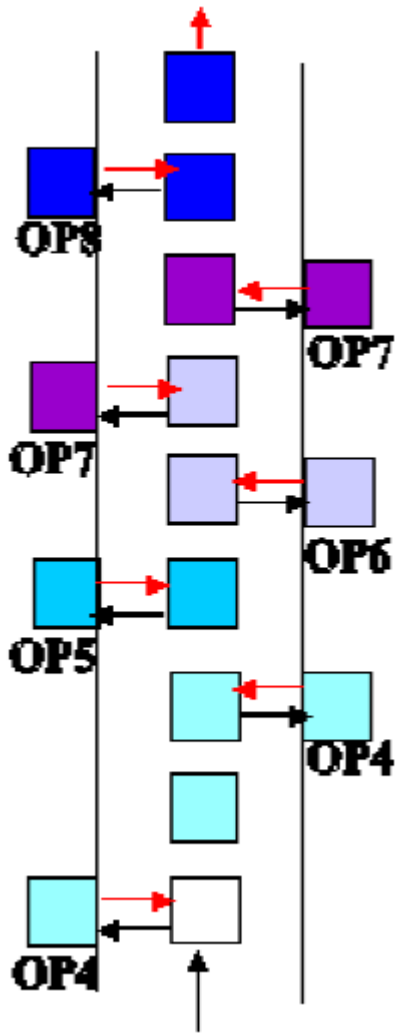
- A section of sewing operators, each with a supply of work in a rack at the side, work at an engineered work place.
- The machines are laid out in such a way that a flow of work can be planned using the correct number of operators in sequence.
- For style A garments, the work distributed after operation 1 can be distributed to the two operators performing operation 2. On completion, the work from both workers is then sent to operator 3. After operation 3, the work is continued by the two operators performing operation 4 and so on.
- When a new style is to be loaded on to the system, the number of operators needed for each operation must be planned in detail to ensure a balanced output.



### 3.8 Straight Line System

**In the Straight line system:**

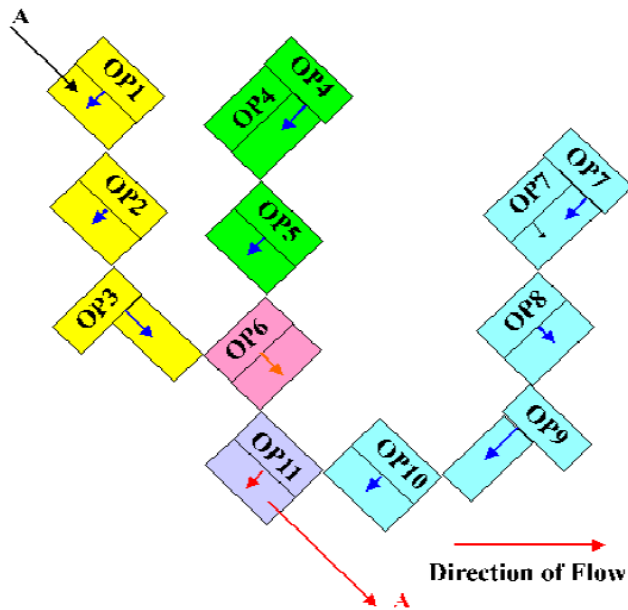
- The manufacturing process is broken down into several operations, which take the same time to complete.
- Groups of operators are required to handle only individual garments.
- The garment parts pass from one operator to the next, until the garment has been completely made up by one group of operators.
- The central distribution unit may be a fixed table or a conveyor belt (its speed will be set to suit the cycle time).



### 3.9 Synchro Flow System

**In the Synchro flow system:**

- Garment parts of the same size and color are processed separately.
- Different garment parts can be processed simultaneously for assembling.
- At the same time, collars, sleeves, cuffs, pockets, etc., from other lines also go down a central line.
- The different garment parts are then processed together to form completed garments.



### 3.10 Unit Production System

The Unit Production systems (UPS) is similar to a relay race, each production operator has a task and passes that garment on to the next person. Normally there is only one garment between operations.

As a mechanical system this has been in use for many years, but a major advance was made in 1983 when computers were first used to plan, control and direct the flow of work through the system.

The unit production system (UPS) is a computerized overhead transportation system that carries the pieces for a single garment to each operation.





Eton system



Switchtrack



Switchtrack

The essential features of this system are:

- Production operations are completed without removing the parts from the carrier.
- Automated materials handling replaces the traditional system of bundling, tying and untying, and manually moving garment parts.
- Electronic data can be collected from workstations, which provides payroll and inventory data, immediate tracking of styles, and costing and performance data for prompt decision.

All the components for one garment are loaded into a carrier at a work station specially designed for this purpose. The carrier itself is divided into sections, with each section having a quick – release retaining clamp which prevents the components from falling out during movement through the system. When a batch of garments has been loaded into carriers they are fed past a mechanical or electronic device which records the number of the carrier and addresses it to its first destination.

UPS has a Computer control center for tracking production and automatic balancing of work flow. It also provides information like payroll, inventory data, immediate track of style, amount of time operator works, time spent on individual unit, piece rate earned for each unit, operator who works on each unit, piece rate earned for each unit, efficiency rate, costing and performance data. So, real time production control can be done.

The process starts from staging area. Cut parts of one single style are loaded on hanger carrier. Carriers are then moved along the main conveyor and switched to an accumulating rail at the work station. When possible, operation is performed without removing from carrier. At the completion of an operation the operator presses a button, and the carrier moves on to the next operation.

| Advantages  | Disadvantages  |
|---|--|
| <b>The system is very flexible and complied with work measurement</b> | Investment of the system is high   |
| <b>The system has little work – in - progress</b>                     | Small orders are not economical for using this system because high preparation is needed for plant layout and line balancing |
| <b>Fast throughput can be achieved lower WIP of the system</b>        |  |
| <b>Application of Eton system reduces the handling time</b>           |  |
| <b>High Quality of garments can be made</b>                           |  |

The advantages of this system are:

The system is very flexible and complies with work measurement. It also has very little work in progress. Fast throughput can be achieved with lower WIP of the system. The application of Eton system reduces the handling time and High Quality of garments can be made.

The disadvantages are:

Investment in this system is high, and it is not economical for small orders, because high preparation is needed for plant layout and line balancing.

### 3.11 Modular Production System





### **Features of modular production system are:**

- Employee empowerment - There is transfer of authority and responsibility
- Team based system – Throughput, quality, production goal, smooth work flow, motivation, decide method of assembly
- Interdependency – relationship to utilize everyone's strength.
- Direct labor cost increase and indirect labor cost decrease
- Team meetings to discuss operational issues, problem solving, etc.
- Operator compensation is given in the form of group wages, bonus.
- The operators are cross trained and interchangeable among task
- Team may produce product or part of it.
- Engineers and supervisors are facilitators
- Work flow: It is a pull system which demands WIP from next operator. The WIP is minimum in this system
- Sitting arrangement: horse shoe configuration, operators stand up or sit down.
- Each operator is given a Work zone which is a group of sequential operations.

## Features of modular production system

- Employee empowerment
- Team based system
- Interdependency
- Labor cost
- Team meetings
- Operator compensation
- Operators Training
- Team output
- Facilitator
- Work flow
- Sitting arrangement
- Work zone

The advantages of this system are:

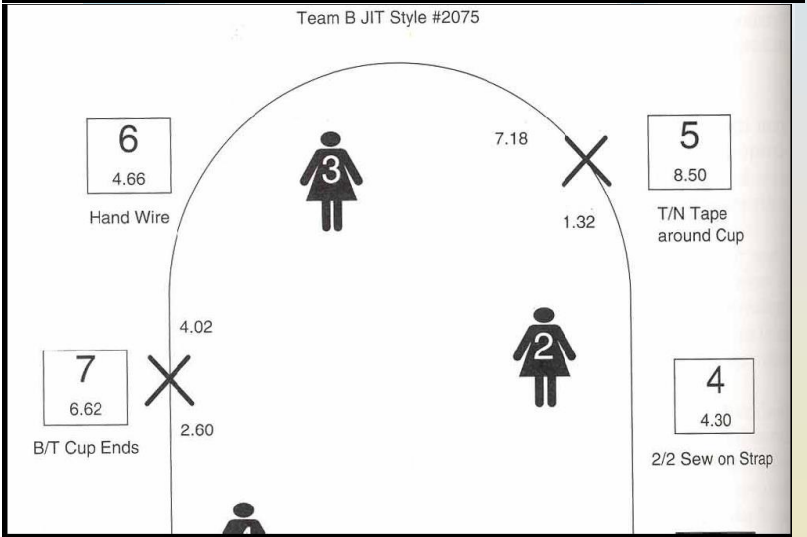
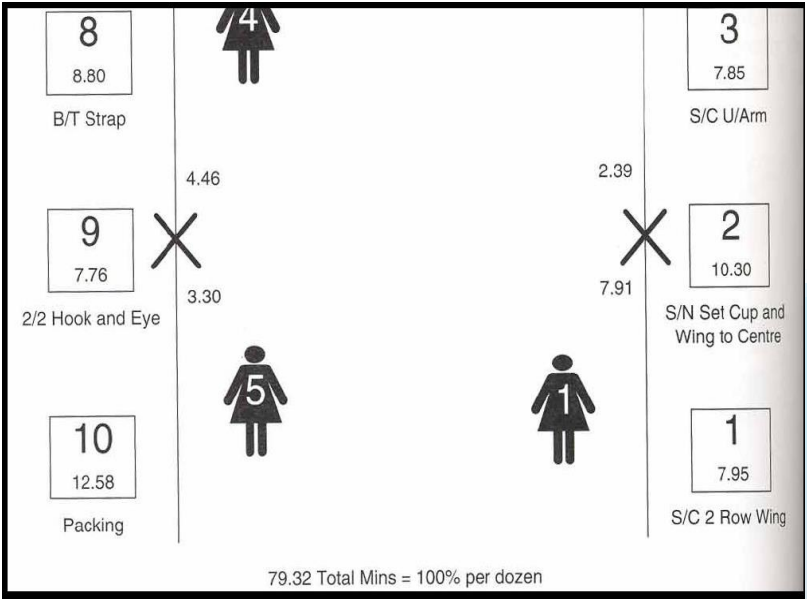
The operator can handle more than one task, and the system is very flexible and permits better line balancing.

Enables fast throughput time, lower WIP, and small batch size can be achieved. It requires less floor space.

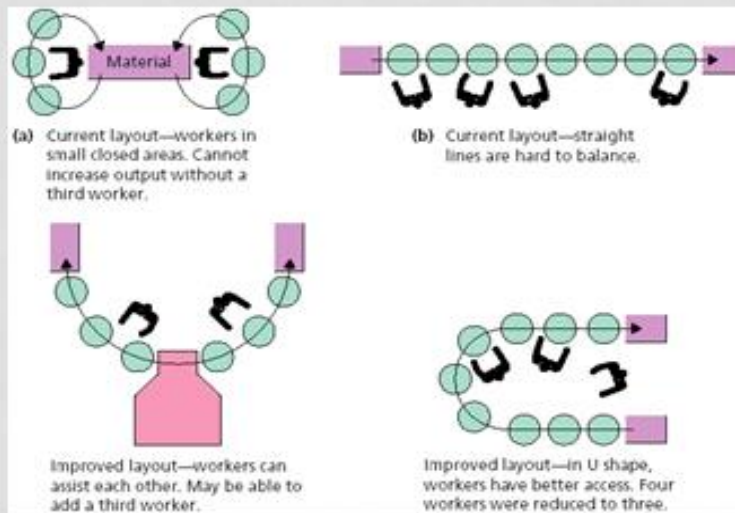
It allows more team work spirit, which creates a healthier working environment and improves quality. Since the system is more quick to respond to changes in fashion, this helps to develop fashion garments capability.

The disadvantages are:

Multi skilled experienced labour is needed and Success of the system needs high co-operation of team.



## IMPROVING LAYOUTS BY MOVING TO THE CELLULAR MANUFACTURING CONCEPT



Source: Source Gary Render and Jay Heizer, Principles of Operations Management, 2nd ed., © 1997. Reprinted by permission of Prentice Hall, Inc., Upper Saddle River, NJ, May 18, 2006. LIS580- Spring 2006

FIGURE 16-4  
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According to the study done by Chopra & Meindl/Coordination, these are the Apparel Industry results with Modular Manufacturing.

### Apparel Industry Results with Modular Manufacturing

| <i>Product</i>    | <i>Cycle Time</i> |              | <i>Space Reduction</i> | <i>Quality % Defective</i> |              |
|-------------------|-------------------|--------------|------------------------|----------------------------|--------------|
|                   | <i>Before</i>     | <i>After</i> |                        | <i>Before</i>              | <i>After</i> |
| Tailored Clothing | 13 days           | 2 days       | 12%                    | 5.3%                       | 1.0%         |
| Knit Shirts       | 4 days            | 10 mins.     | 25%                    | 2%                         | 1.2%         |
| Dress Shirts      | 3 days            | 1 hour       | 50%                    | 2%                         | 0.2%         |

As we see in this chart, the cycle time of the garments has reduced drastically. Also there is significant reduction in defect pieces.

Now, that we have seen the different types of production system, let us move on to learn about the basic components of a production system.

**The basic components of a production system are:**

- The degree of sectionalization
- Bundle type and size
- Method(s) of movement and storage
- Production flow and storage pattern(straight line or PBU or conveyor)
- Control

**WIP can be moved by different methods: By hand, roller conveyor, trolley or by rail.**

1. By hand – single garment, tied bundles, garment in bags and boxes
2. By roller conveyer – by hand, boxes
3. By trolley - wheels under boxes, wheeled bins, combination trolley
4. By rail – hangers with clamps, boxes or combination cords.

#### **WIP MOVEMENT BY DIFFERENT METHODS**



By hand in boxes



By roller conveyer



By rail



By trolley

**There are different Types of Bundles.**

1. Tied bundles: Time is wasted in tying and untying the bundle. Garment parts may get creased and soiled. The advantage of this type of bundle is that it is cheap. Cutting room waste can be used as ties-offs.
2. Bags: are used where bundles are large and where creasing is not important. They are dragged on floor due to which bags get torn and let in dirt.
3. Pocketed bags: They are used for parts, trimming and in simple hanging systems. Pocketed bags are better than bundles as they have no lint and thread. As garment parts are in bags they are less accessible.
4. Box and baskets: The garment parts may have some creasing. It is useful with conveyer belt system. The bag has a pocket outside to hold document. The frames may be with wheels. It is easy to stack boxes in storage.
5. Clamps on rail: clamp on wheel is useful for long garment parts. Sewing of the garment part can be done without removing it from the clamp. E.g. finishing trouser bottom
6. Clamps on cord: In this system cloth peg tied are attached to nylon cord. This runs on overhead rail system e.g. Swiftrack – pull the cord toward machine and stitch ‘off the rail’
7. Bundle Trucks: these are big trolleys for carrying bundles.

#### Different Types of Bundles



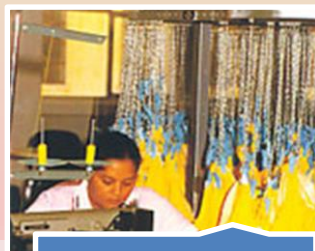
Tied bundles



Box and baskets



Clamps on rail



Clamps on cord



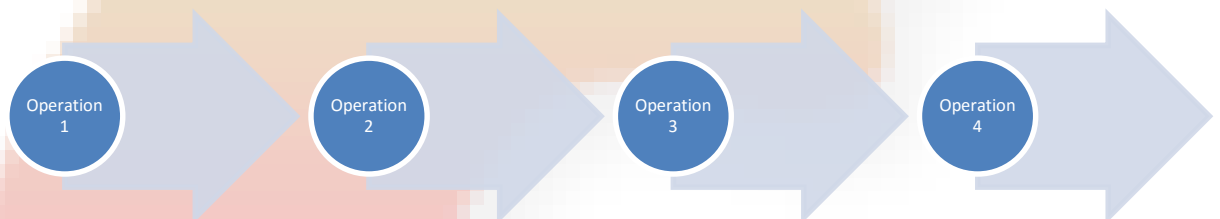
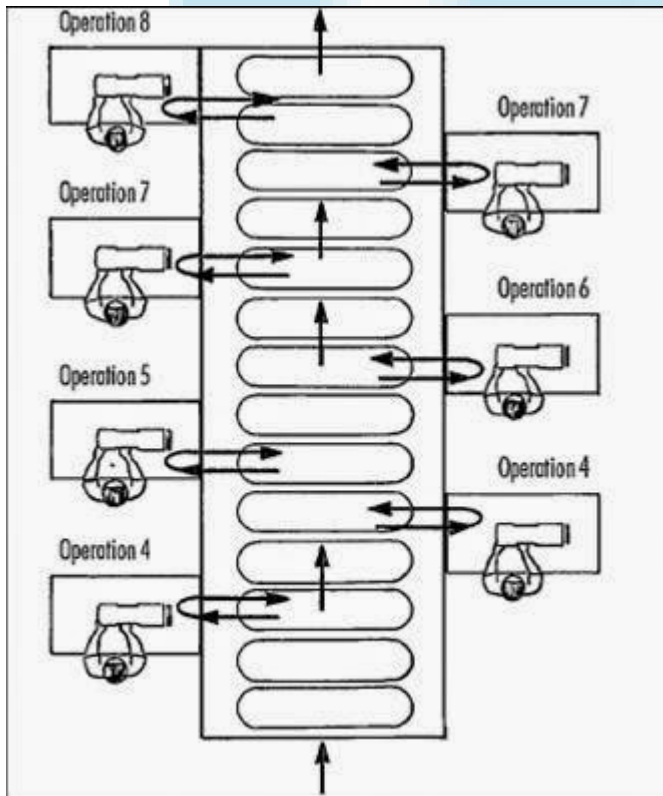
Bundle Trucks

**3.12 Production flow types are of two types: One way and Two way.**

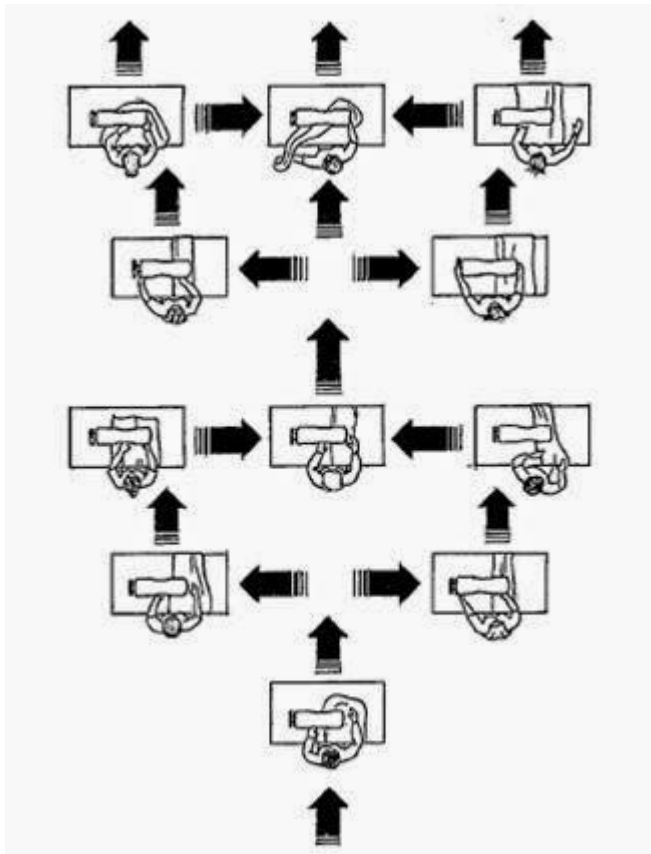
1. One way – It is a progressive system in which it is not possible to transport back.

Transport is done by hand or other methods. It is of following three types-

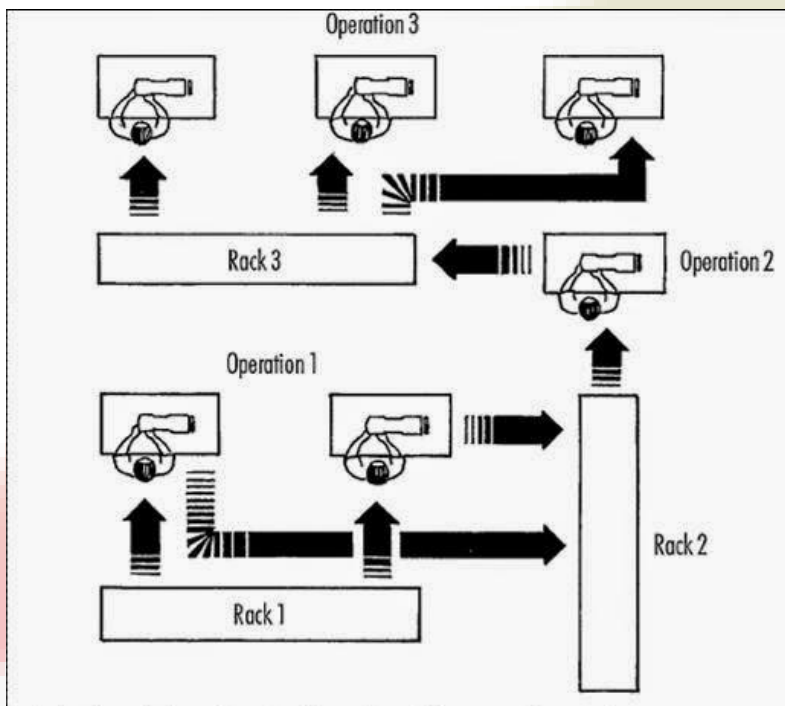
- Straight line or conveyer



- Progressive line or synchro flow

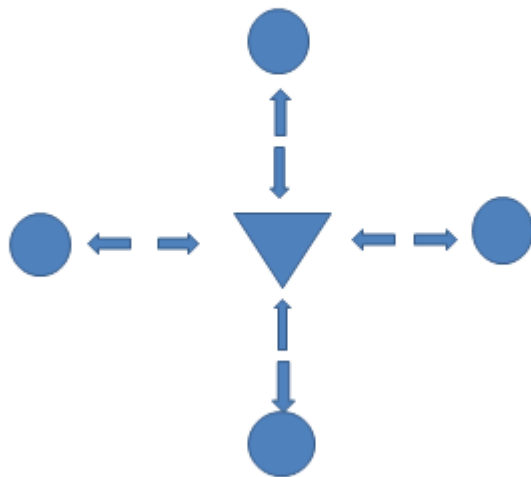


- Progressive bundle unit

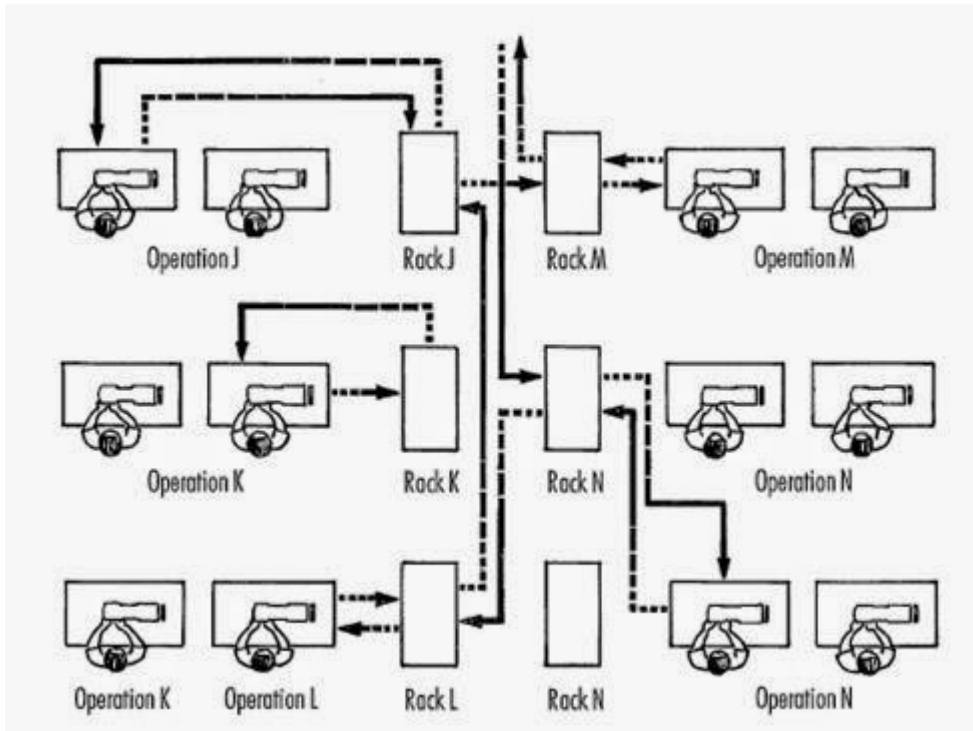


1. Two way: In this system flow of WIP is two way. It is of three types

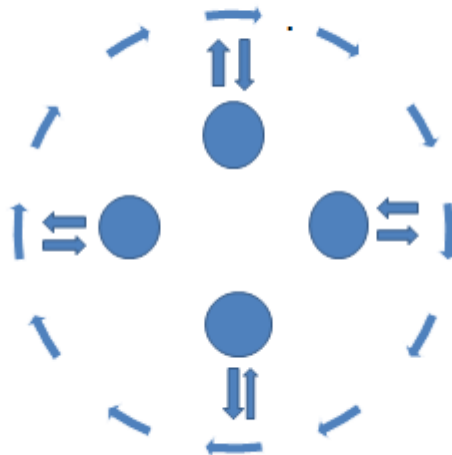
- Central storage



- Interflow



- Selector type



Any production system has four primary factors, which make up the system. Processing Time + Transportation Time + Temporary Storage Time + Inspection Time = Total Production Time.

Processing time is sum total of working time of all operations involved in manufacture of a garment. Transportation time involves the time taken to transport semi-finished or finished

garments from one department to another or from one operation/machine to another. Temporary storage time is time during which the garment/bundle is idle as it waits for next operation or for completion of certain parts. Inspection time is time taken for inspecting semi-finished garments for any defects during manufacturing or inspecting fully finished garments before packing.

The main aim of any production system is to achieve minimum possible total production time. This automatically reduces in-process inventory and its cost. The sub-assembly system reduces temporary storage time to zero by combining temporary storage time with transportation time.

### 3.13 Conclusion

The choice of best apparel production system will depend on the product and policies of the company and on the capacities of manpower. Where style changes are frequent and lot sizes small, it may be advantageous to use skilled labour who can make whole garment and use one of the whole garment system. As the lot size increases it is advisable to use section production system.

The sub-assembly system is superior to the progressive bundle system as it takes less time. That is the processing time for a garment in both system is same but sub-assembly system has less waiting or temporary storage time. However the space requirement, machinery requirement and labour costs are high for sub-assembly system.

In most cases the choice of a production system depends on the cost of the inventory-in process. Inventory-in process is the total number of garments in the production line. This consists of all garments being processed at sewing machines, under inspection and in temporary storage between operations. When material, labour, space and interest costs are high, synchronised sub-assembly system which yields the least possible in-process inventory is more suitable.

One of the aims of any production system is to make total production time as minimum as possible. This automatically reduces inventory cost to a minimum. Sub-assembly system provides many opportunities to economise on temporary storage and transportation space and time. No definite answer can be given as to which is the best, as it depends on garment style, specifications, machinery and manpower and manufacturing policies.

Finally, let us look at the method of Calculation of Cost of inventory in process in a production system.

Formula:  $i(t)(m+s+1)$

**M**=cost of material in the inventory in process

**S**=cost of temporary storage space, lightening, equipment etc.

**L**= Cost of labor put into inventory in process

**T** = the time the amount of inventory in process is in process

**I** = the cost of money; the annual rate of interest for borrowing the money

To summarize, in this unit, you have learnt about the different kinds of production systems. Companies follow a particular type or combination of different systems. An appropriate selection of a production system ensures the effective coordination of various production activities.

