**Unit 3**

**Material and Inventory Management**

**Types of Production Planning**

If you work in a manufacturing plant as a supervisor you have heard the words “**production planning**” many times. This is the procedure that they use to decide just how many goods to manufacture. For the company to be successful efficiency is important. They do not want to over produce products and then have them just sit in the warehouse. That is profits down the drain, so to speak. A company wants to make sure that they are producing enough products to meet the demands. There are many different forms of production planning that goes under various titles in the world of business. There are three main types that many businesses use.

### ****Batch Production Planning****

This type of production planning involves producing many identical individual products from the same batch of raw material. For example, a seamstress would take some cloth and produce five individual identical dresses. In a manufacturing plant that produces many different products this can advance the efficiency of the employees and machines to produce one large batch of an individual product at the same time. In a factory, for example, the machines may be set up to produce a group of peas in cans, followed by a group corn in cans. Setting up the machines to follow this schedule is more efficient than changing the machines to produce a can one at a time as they are needed.

### ****Job-or Project-Based Production Planning****

This type is generally used in smaller businesses where one team or one person does the production of services or goods. A jewelry maker that makes custom engagement and wedding rings is an example of this type of production planning. Film production is a team so this is the type of planning they would use. Job-and project planning is very customizable to meet the requirements of the business and the customer. It should not be used if you are creating a flow of production that is consistent.

### ****Continuous or Mass Production Planning****

This one is used often to create products that are massed-produced and generally used by large factories to produce a steady flow of products. For this process to be cost-efficient, a demand for this product must be regular. The production services must also be streamlined. This is so the products go from one-step of the making the product to the next step effortlessly. This requires demanding pre-planning of production flow and layout.

**Conclusion:**In production planning, determining the right method for a business will normally depend on mathematical calculations and market forecasting. Some companies will use production planning software to capitalize on the company’s production capacity and to measure planning strategies cost-effectiveness. Through control, the methods of planning are often made to make the most of on the company’s potential.

# Process of Production planning and Control (PPC)

### ****Procedures for Production Planning****

**(i) Planning**

**(ii) Routing**

**(iii) Scheduling**

**(iv) Dispatching**

**(v) Follow-up or checking the progress**

**(vi) Inspection**

1. **PLANNING**

For planning of productive operations in detail, the planning department will receive full information from management about the quantity to be produced and the dates when delivery has been promised to customers. The planning department will also get the necessary engineering and drawing specifications from the engineering department.

1. **ROUTING**

Routing involves the determination of the path that work shall follow and the order in which various operations will be carried out. The objective of routing is to

find out the best and the cheapest sequence of operations. While preparing the route card, it must be kept in mind that machines in the plant are operated at their full capacity; and manpower and other facilities are best utilized.

1. **SCHEDULING**

Scheduling is the determination of the time that should be required to perform each operation and also the time necessary to perform the entire series, as routed, making allowance for factors concerned. It involves the preparation of a time-table, indicating the total time needed for the manufacture of a product as also the time expected to be spent at each machine and process.

In preparing schedules, the persons concerned will have to take into consideration the various types of orders on hand and the dates by which their completion has been promised. Some orders may be such as will require over-time work; because completion is not possible according to the delivery dates set for them, in the regular course of production.

1. **LOADING**

Loading involves assigning jobs to work centers and to various machines in the work centers. If a job can be processed on only one machine, no difficulty is presented. However, if a job can be loaded on multiple work centers or machines, and there are multiple jobs to process, the assignment process becomes more complicated. The scheduler needs some way to assign jobs to the centers in such a way that processing and setups are minimized along with idle time and throughput time.

Two approaches are used for loading work centers: infinite loading and finite loading. With infinite loading jobs are assigned to work centers without regard for capacity of the work center. Priority rules are appropriate for use under the infinite loading approach. Jobs are loaded at work centers according to the chosen priority rule. This is known as vertical loading.

Finite loading projects the actual start and stop times of each job at each work center. Finite loading considers the capacity of each work center and compares the processing time so that process time does not exceed capacity. With finite loading the scheduler loads the job that has the highest priority on all work centers it will require. Then the job with the next highest priority is loaded on all required work centers, and so on. This process is referred to as horizontal loading. The scheduler using finite loading can then project the number of hours each work center will operate. A drawback of horizontal loading is that jobs may be kept waiting at a work center, even though the work center is idle. This happens when a higher priority job is expected to arrive shortly. The work center is kept idle so that it will be ready to process the higher priority job as soon as it arrives. With vertical loading the work center would be fully loaded. Of course, this would mean that a higher priority job would then have to wait to be processed since the work center was already busy. The scheduler will have to weigh the relative costs of keeping higher priority jobs waiting, the cost of idle work centers, the number of jobs and work centers, and the potential for disruptions, new jobs and cancellations.

1. **DISPATCHING**

Dispatching literally means sending something towards a particular destination. Here, it means taking all such steps, as are necessary to implement the programme of production chalked out as per routing and scheduling steps.

In particular, dispatching refers to:

**(i) Procurement of necessary tools, jigs and fixtures etc.; before they are actually required by the workmen.**

**(ii) Giving workers the necessary work orders, instructions, drawings etc. for initiating the work.**

1. **Follow-Up (or Checking the Progress)**

Follow-up is the control aspect of production planning and control. It involves taking steps to check up whether work proceeds according to plans and how far there are variances from standards; and also taking necessary corrective steps to set things in order.

1. **Inspection**

Inspection is the quality control aspect of production planning and control. It ensures that goods produced are of the right quality. The inspectors may inspect materials, semi-finished and finished products either at the work bench or in special laboratories or testing rooms.

To ensure maintenance of high standards of quality, a programme of SQC (Statistical Quality Control) may be fused with a system of production planning and control.

1. **Just-In-Time (JIT)**

Just-In-Time (JIT) Manufacturing is a philosophy rather than a technique. By eliminating all waste and seeking continuous improvement, it aims at creating manufacturing system that is response to the market needs.

The phase just in time is used to because this system operates with low WIP (Work-In-Process) inventory and often with very low finished goods inventory. Products are assembled just before they are sold, subassemblies are made just before they are assembled and components are made and fabricated just before subassemblies are made. This leads to lower WIP and reduced lead times. To achieve this organizations have to be excellent in other areas e.g. quality.

According to Voss, JIT is viewed as a “Production methodology which aims to improve overall productivity through elimination of waste and which leads to improved quality”.

### ****JIT in Production and Operation Management****

JIT provides an efficient production in an organization and delivery of only the necessary parts in the right quantity, at the right time and place while using the minimum facilities”.

**Benefits of JIT**

The most significant benefit is to improve the responsiveness of the firm to the changes in the market place thus providing an advantage in competition. Following are the benefits of JIT:

**(i) Product cost:**is greatly reduced due to reduction of manufacturing cycle time, reduction of waste and inventories and elimination of non-value added operation.

**(ii) Quality:**is improved because of continuous quality improvement programs.

**(iii) Design:**Due to fast response to engineering change, alternative designs can be quickly brought on the shop floor.

**(iv)**Productivity improvement.

**(v)**Higher production system flexibility.

**(vi)**Administrative and ease and simplicity.

# KANBAN

**KANBAN** is a concept that relates to obtaining materials or required items “just in time” for their introduction into the assembly or process. The system of JIT or the just in time process was initiated by the Japanese firm Toyota in the 1940s.

KANBAN is a system to signal a need for action. This can be done by cards on a board (which is the traditional way) or by other devices that are used as markers, indicating the need to take action. Taiichi Ohno, the man who conceptualized the JIT system, says KANBAN is the means to achieve JIT.

Toyota felt the need in the 1940s to reduce costs by introducing proper inventory stocking techniques of required assembly parts. First, they studied supermarkets to understand how supermarkets ensure their shelves are always stocked with the materials that the customers want and in the required amount. Customers could always be assured of a constant supply of product and only pick up the number of items that they immediately required. They knew a future supply of wanted product would be available whenever desired. Toyota reasoned that if they could ensure this same supermarket guarantee of required parts for their assembly lines, there would be less of a need to maintain high inventories which in turn, drive up costs and storage requirements. Toyota also began maintaining strict controls on defective products, which in turn were kept from entering the process.

**KANBAN** controls the rate of production by passing the demand for raw materials through a system of customer-store processes, which ensures that materials are received only when required. With Kanban, each process identifies only those products that are required for that exact process until that process is complete. Each subsequent process continues by only using products that are required for the next step of processing, and so on. Thus, production is equalized in all processes and stabilizes the production by fine-tuning inventory demand and requirement processes.

### ****The Three Bin System****



A very simple method of implementing **KANBAN** is the use of a three bin system. One bin is available on the floor of the production unit using the product. A second bin is available at the inventory department of the factory where the production staff obtains raw materials. Finally, a third bin is available at the premises of the supplier who has been selected to deliver the materials. Each bin contains cards with detailed information showing inventory numbers available within the bins and the date which they were received.

During the process, the factory floor uses the materials from the bin and, once the bin is depleted, its KANBAN card is returned to the inventory department. The inventory department immediately replaces the bin with a full bin obtained from the supplier or vendor. In turn, the inventory department sends the empty bin to the vendor or supplier for replenishment of materials. Suppliers and vendors stay on top of replenishing needed materials at their location, keeping them ready for the next exchange. This three bin method, therefore, doesn’t require on-site storage of materials until they are required.

Such bins, represented by **KANBAN cards**, are created for each of the items required in the production process. The number of KANBAN cards depends upon the actual number of the items required during each stage of the process. The control during the assembly is achieved by identifying every KANBAN card needed to complete the assembly or production. Hence, KANBAN is considered an effective tool in the Just In Time inventory process within an assembly line production.

# Types of inventories

**An inventory** is a stock of goods maintained for the purpose of future production or sales. In broad sense, the term inventory refers to all materials, parts, supplies, tools, in-process or finished products recorded in the books by an organization and kept in its stocks, warehouse or plant for some period of time. It is a list or schedule of materials held on behalf of an enterprise.

### ****Types/Classification of Inventory****

### ****Direct Inventories****

Direct inventories are those inventories that play a major role in the production and constitute a vital part of finished goods. These inventories can be easily assigned to specific physical units. Direct inventories may be categorized into four groups.

**(i) Raw materials**

Raw materials are the physical resources to be used in the manufacture of finished products. They include materials that are in their natural or raw form. For example, cotton in the case of textile mill, sugarcane in the case of sugar factory, oil seeds in the case of an oil mill etc. The chief objective of keeping raw material is to ensure uninterrupted production in the event of delays in delivery and also to enjoy the economies of large scale buying.

**(ii) Semi-finished Goods**

Semi-finished goods are those materials which are not cent per cent (100%) complete in all respects i.e., some processing still remains to be done before the product can be sold. For example, a person who is engaged in the manufacture of furniture, may purchase unpolished furniture from market and sell it after polishing the same.

**(iii) Finished Goods**

Finished goods are complete products that are ready for sale or distribution. For instance, in case of a hosiery factory, sweaters, shawls etc. are finished products.

**(iv) Spare Parts**

Spare parts means duplicate parts of a machine. Usually, almost all the industrial concerns maintain spare parts of various machines which they use for manufacture. This will enable them to ensure smooth running of machines which in turn provide for uninterrupted production.

### ****Indirect Inventories****

Indirect inventories include those items which are necessary for manufacturing but do not become component of the finished goods. They normally include petrol, maintenance materials, office materials, grease, oil lubricants etc. These inventories are used for ancillary purposes to the business and cannot be assigned to specific, physical units. These inventories may be used in the factory, the office or the selling and distribution divisions.

# Factors affecting Plant Location

**Eight Factors Affecting Plant Location**

1. **Selection of Region**

The selection of a region or area in which plant is to be installed requires the consideration of the following:

**(i) Availability of Raw Materials:** Proximity of sources of raw materials is the obvious explanation of the location of majority of sugar mills in Uttar Pradesh. This means that the raw material should be available within the economical distance. Easy availability of supplies required for maintenance and operation of the plant should also be considered.

**(ii) Proximity to Markets:** Cost of distribution is an important item in the overhead expenses. So it will be advantageous to be near to the center of demand for finished products. Importance of this is fully realized if the material required for the manufacturing of products are not bulk and fright charges are small.

**(iii) Transport Facilities:** Since freight charges of raw materials and finished goods enter into the cost of production, therefore transportation facilities are becoming the governing factor in economic location of the plant. Depending upon the volume of the raw materials and finished products, a suitable method of transportation like rail, road, water transportation (through river, canals or sea) and air transport is selected and accordingly plant location is decided. Important consideration should be that the cost of transportation should remain fairly small in comparison to the total cost of production.

**(iv) Availability of Power, Fuel or Gas:** Because of the wide spread use of electrical power the availability of fuel or gas has not remained a deciding factor in most of the cases for plant location. The location of thermal power plants (like Bokaro Thermal Plant) and steel plants near coal fields are for cutting down cost of the fuel transportation. The reliability of continuous supply of these facilities is an important factor.

**(v) Water Supply:** Water is required for processing as in chemical, sugar and paper industries and is also used for drinking and sanitary purposes. Investigation for quality and probable source of supply is important, since the cost of treating water is substantial so the chemical properties like hardness, alkalinity and acidity.

**(vi) Disposal Facility for Waste Products:** Thorough study should be made regarding disposal of water like effluents, solids, chemicals and other waste products likely to be produced during the production process.

**(vii) Availability of Labour:**Potential supply of requisite type of labour governs plant location to major extent. Some industries need highly skilled labour while other need unskilled and intelligent labour. But the former type is difficult in rural areas in comparison with industrially developed location.

### ****Township Selection****

The factors to be considered regarding township selection are:

(i) Availability of men power of requisite skill

(ii) Competitive wage rates of workers

(iii) Other enterprises which are complementary or supplementary regarding raw materials, other input, labour and skill required.

(iv) Moderate taxes and the absence of restricting laws.

(v) Favourable cooperative and friendly attitude towards the industry.

(vi) Favourable living conditions and standards keeping in view the availability of medical and educational facilities, housing, fire service, recreational facilities, cost of living etc.

### ****Question of Urban and Rural Area****

Question of urban and rural area should be decided in view of the following:

**Advantages of Rural Area:**

(i) The initial cost of land, erection cost of building and plant is less in rural area as compared to urban or city area.

(ii) Acquisition for additional area for extension work expansion of plant is possible without much difficulty whereas urban area being congested; the additional land is not easily available.

(iii) Rural areas are free form labour trouble which is most common in towns and cities.

(iv) Over crowding of working class population in cities is avoided.

**Advantages of Urban Area:**

(i) Better modes of transportation for collection and distribution of materials and finished products.

(ii) Availability to requisite type of labour for special and specific jobs is there.

(iii) Utilities like water, power, fuels etc. are easily available.

(iv) Industries do not need to construct colonies to provide residential facilities to their workers since houses are available on rental basis whereas in rural areas, houses have to be build for workers.

### ****Location of a Factory in a Big City****

Generally factories are located in big cities for obvious reasons of skilled labour, market proximity for both raw materials and end products.

Its advantages and disadvantages are mentioned below:

(i) Existence of educational and recreational facilities is advantageous for children and dependents of workers.

(ii) Facilities for technical/ industrial education and training for children of workers are available.

(iii) Evening classes facilities are available.

(iv) Discussion opportunities and facilities for exchange of thoughts are available for interested people in societies and clubs.

(v) All types of skilled man power is available.

(vi) Repair, maintenance and service facilities for various utilities are available in abundance.

(vii) Banking facilities regarding finance (loan etc.) for industry in case of necessity are available.

(ix) Big markets for sale of products available.

(x) Better transport facilities for movement of raw materials, finished products and workers are available.

### ****Location of an Industry in Small Town****

There are some industries which are located in the rural areas or small towns specifically for the want of raw material and cheap labour.

Its advantages and disadvantages are mentioned below:

(i) Less labour trouble and co-ordinal employee-employer relation.

(ii) Suitable land for current and future requirements easily available.

(iii) Local bye laws do not impose problem in working of the unit.

(iv) No resistance from existing industries.

(v) Possibility of tax exemptions exist.

(vi) Not much congestion.

(vii) Lower rents in comparison to big cities and urban areas.

(viii) Lower wage rates for labour/ employees / workers.

(ix) Less fire risks.

(x) Noise not much problem.

### ****Site Selection****

The third step is to select the exact plant site with the following considerations:

(i) The cheap availability of land for current and future requirements, soil characteristics sub soil water, availability or possibility of economic drainage and waste disposal system are desirable parameters.

(ii) The site should be easily accessible to various modes of transport as required so that apart from input materials, employees can also reach the site conveniently.

(iii) The site should be free from zonal restrictions like from railways or civil aviation restrictions.

### ****Current Trends in Plant Location****

**(I) Location in Proximity of Cities:**First tendency is to locate the industries or enterprises in the proximity of cities rather than in rural or urban areas. These sub-urban sites offer today practically all advantages, facilities and services available in cities and towns with the added advantage of land required for future expansion on cheap rates.

**(II) Planned Industrial Centers:** While industrial towns may be planned and developed by big industrial houses or govt., the late trend is to develop areas as industrial estates and sell these to people interested in starting their units at various places. Noida and Faridabad are the examples of this type of development.

**(III) Competition for Development of Industries:** In order to generate the employment opportunities the state and central govt. offer concessions to attract industrialists to set up industries in their states or territories.

### ****The Design of Factory Plant Building****

After a plant location has been decided upon, management’s next problem deals with the design of building. A building is designed and built to protect the property and employees of an organization. This basic fact is mostly overlooked in planning the requirement for building structures.

For those plants where employees, materials and infrastructure facilities require protection, the problems involved in designing and constructing effective and economical structures are many.

# Inventory Control Techniques:

# EOQ, ABC and others

### ****Five Techniques of Inventory Control****

### ****Economic Order Quantity (****EOQ)

A problem which always remains in that how much material may be ordered at a time. An industry making bolts will definitely would like to know the length of steel bars to be purchased at any one time.

This length is called “economic order quantity” and an economic order quantity is one which permits lowest cost per unit and is most advantages.

**This can be calculated by the following formula:**

Q = √2AS/I

Where Q stands for quantity per order

A stands for annual requirements of an item in terms of rupees

S stands for cost of placement of an order in rupees; and

I stand for inventory carrying cost per unit per year in rupees.

### ****Inventory Models****

Inventory models determine when and how inventory to carry.

(i) Inventory models handle chiefly two decisions:

* How much to order at one time.
* When to order this quantity to minimize total costs.

(ii) Lowest-cost decision rules for inventory management pertain to either buying products from outside or producing then within the company.

(iii) Single inventory models assume no delivery delay and that demand is known.

(iv) Probabilistic models handle situations of risks and uncertainty.

### ****ABC Analysis****

In order to exercise effective control over materials, A.B.C. (Always Better Control) method is of immense use. Under this method materials are classified into three categories in accordance with their respective values. Group ‘A’ constitutes costly items which may be only 10 to 20% of the total items but account for about 50% of the total value of the stores.

A greater degree of control is exercised to preserve these items. Group ‘B’ consists of items which constitutes 20 to 30% of the store items and represent about 30% of the total value of stores.

A reasonable degree of care may be taken in order to control these items. In the last category i.e. group ‘Q’ about 70 to 80% of the items is covered costing about 20% of the total value. This can be referred to as residuary category. A routine type of care may be taken in the case of third category.

This method is also known as ‘stock control according to value method’, ‘selective value approach’ and ‘proportional parts value approach’.

If this method is applied with care, it ensures considerable reduction in the storage expenses and it is also greatly helpful in preserving costly items.

### ****Material Requirements Planning (MRP)****

MRP is a computational technique that converts the master schedule for end products into a detailed schedule for raw material and components used in the end products. The detailed schedule indentifies the quantities of each raw material and component items. It also tells when each item must be ordered and delivered so as to meet the master schedule for the final products.

### ****VED Analysis****

Vital essential and desirable analysis is used primarily for the control of spare parts. The spare parts can be divided into three categories:

**(i) Vital**

**(ii) Essential**

**(iii) Desirable**

**(i) Vital:** The spares the stock out of which even for a short time will stop production for quite some time and future the cost of stock out is very high are known as vital spares.

**(ii) Essential:** The spare stock out of which even for a few hours of days and cost of lost production is high is called essential.

**(iii) Desirable:** Spares are those which are needed but their absence for even a week or so will not lead to stoppage of production.

# Types of Plant layout

### ****Four Main Types of Plant Layout****

1. **Product or Line Layout**
2. **Process or Functional Layout.**
3. **Fixed Position Layout.**
4. **Combination type of Layout.**

### ****1. Product or Line Layout****

If all the processing equipment and machines are arranged according to the sequence of operations of the product, the layout is called product type of layout. In this type of layout, only one product of one type of products is produced in an operating area. This product must be standardized and produced in large quantities in order to justify the product layout.

The raw material is supplied at one end of the line and goes from one operation to the next quite rapidly with a minimum work in process, storage and material handling. Fig. 8.3 shows product layout for two types of products A and B.

**Advantages offered by Product Layout:**

(i) Lowers total material handling cost.

(ii) There is less work in processes.

(iii) Better utilization of men and machines,

(iv) Less floor area is occupied by material in transit and for temporary storages.

(v) Greater simplicity of production control.

(vi) Total production time is also minimized.

**Limitations of Product Layout:**

(i) No flexibility which is generally required is obtained in this layout.

(ii) The manufacturing cost increases with a fall in volume of production.

(iii) If one or two lines are running light, there is a considerable machine idleness.

 (iv) A single machine break down may shut down the whole production line.

(v) Specialized and strict supervision is essential.

### ****Process or Functional Layout****

The process layout is particularly useful where low volume of production is needed. If the products are not standardized, the process layout is more low desirable, because it has creator process flexibility than other. In this type of layout, the machines and not arranged according to the sequence of operations but are arranged according to the nature or type of the operations. This layout is commonly suitable for non repetitive jobs.

Same type of operation facilities are grouped together such as lathes will be placed at one place, all the drill machines are at another place and so on. See Fig. 8.4 for process layout. Therefore, the process carried out in that area is according to the machine available in that area.

**Advantages of Process Layout**

(i) There will be less duplication of machines. Thus, total investment in equipment purchase will be reduced.

(ii) It offers better and more efficient supervision through specialization at various levels.

(iii) There is a greater flexibility in equipment and man power thus load distribution is easily controlled.

(iv) Better utilization of equipment available is possible.

(v) Break down of equipment can be easily handled by transferring work to another machine/work station.

(vi) There will be better control of complicated or precision processes, especially where much inspection is required.

**Limitations of Process Layout**

(i) There are long material flow lines and hence the expensive handling is required.

(ii) Total production cycle time is more owing to long distances and waiting at various points.

(iii) Since more work is in queue and waiting for further operation hence bottle necks occur.

(iv) Generally, more floor area is required.

(v) Since work does not flow through definite lines, counting and scheduling is more tedious.

(vi) Specialization creates monotony and there will be difficult for the laid workers to find job in other industries.

### ****Fixed Position Layout****

This type of layout is the least important for today’s manufacturing industries. In this type of layout the major component remain in a fixed location, other materials, parts, tools, machinery, man power and other supporting equipment’s are brought to this location.

The major component or body of the product remain in a fixed position because it is too heavy or too big and as such it is economical and convenient to bring the necessary tools and equipment’s to work place along with the man power. This type of layout is used in the manufacture of boilers, hydraulic and steam turbines and ships etc.

**Advantages Offered by Fixed Position Layout**

(i) Material movement is reduced

(ii) Capital investment is minimized.

(iii) The task is usually done by gang of operators, hence continuity of operations is ensured

(iv) Production centers are independent of each other. Hence, effective planning and loading can be made. Thus total production cost will be reduced.

(v) It offers greater flexibility and allows change in product design, product mix and production volume.

**Limitations of Fixed Position Layout**

(i) Highly skilled man power is required.

(ii) Movement of machines equipment’s to production centre may be time consuming.

(iii) Complicated fixtures may be required for positioning of jobs and tools. This may increase the cost of production.

### ****Combination Type of Layout****

Now a days in pure state any one form of layouts discussed above is rarely found. Therefore, generally the layouts used in industries are the compromise of the above mentioned layouts. Every layout has got certain advantages and limitations. Therefore, industries would to like use any type of layout as such.

Flexibility is a very important factory, so layout should be such which can be molded according to the requirements of industry, without much investment. If the good features of all types of layouts are connected, a compromise solution can be obtained which will be more economical and flexible.