COURSE FILE

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IE 8693 PRODUCTION PLANNING AND CONTROL

UNIT I INTRODUCTION

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UNIT II WORK STUDY

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UNIT III PRODUCT PLANNING AND PROCESS PLANNING

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UNIT IV PRODUCTION SCHEDULING

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UNIT V INVENTORY CONTROL AND RECENT TRENDS IN PPC

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PRINCIPAL

Production Planning & Control (PPC)

Unit-I

Introduction to PPC

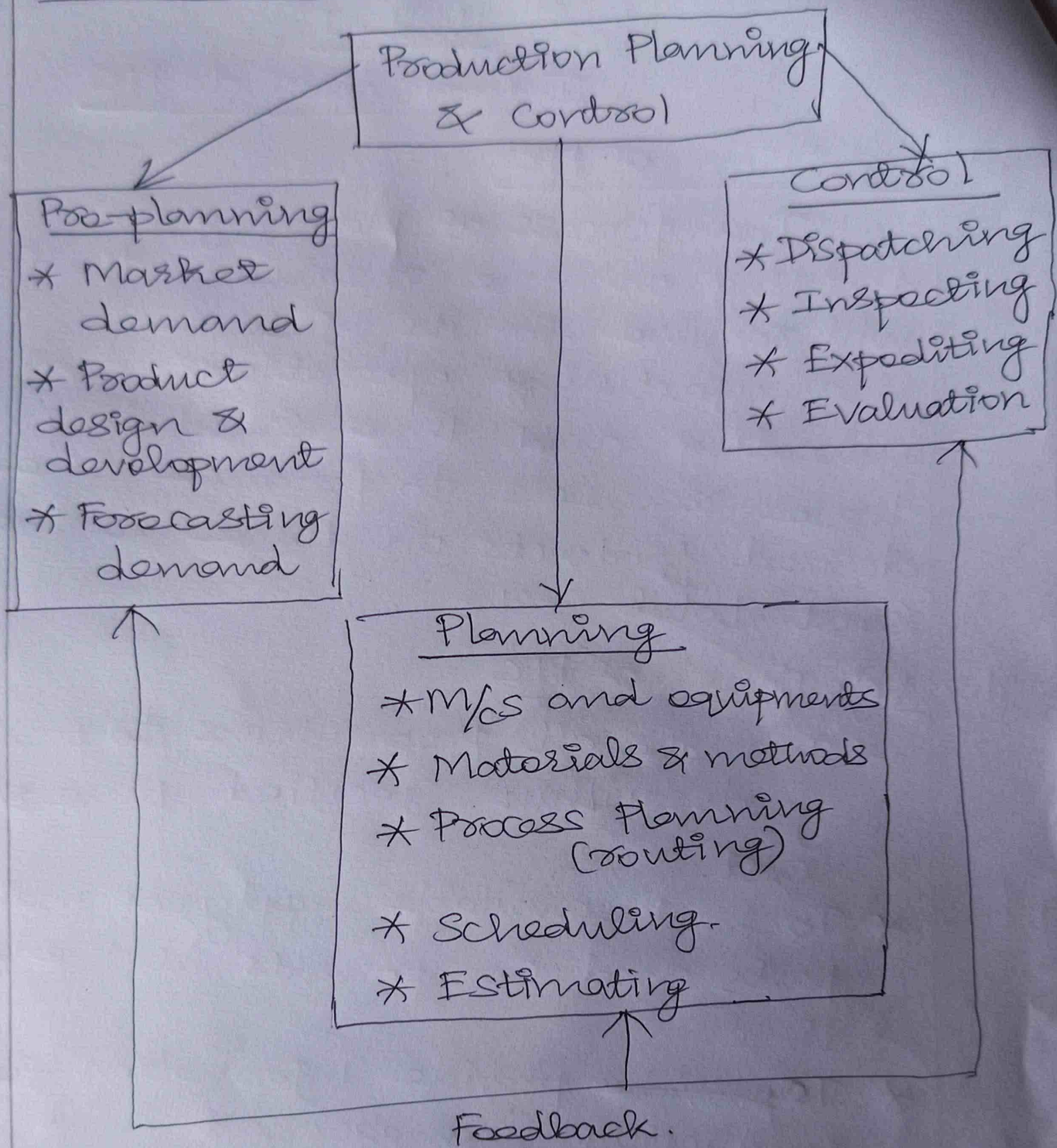
1.1 Definition of PPC

The process of planning or deciding on the resources the firm will require for its future manufacturing operations and of allocating and time scheduling these resources to produce the desired products on time at the least total cost.

1.2. Objectives of PPC

* To make all preparations to produce goods within specified time & cost.
* To make available supply of materials, parts and components at the right time.
* To ~~provide~~ provide information for production management and distribution of goods.
* To issue relevant orders to production personnels to implement the production plan

1.2. Functions of PPC

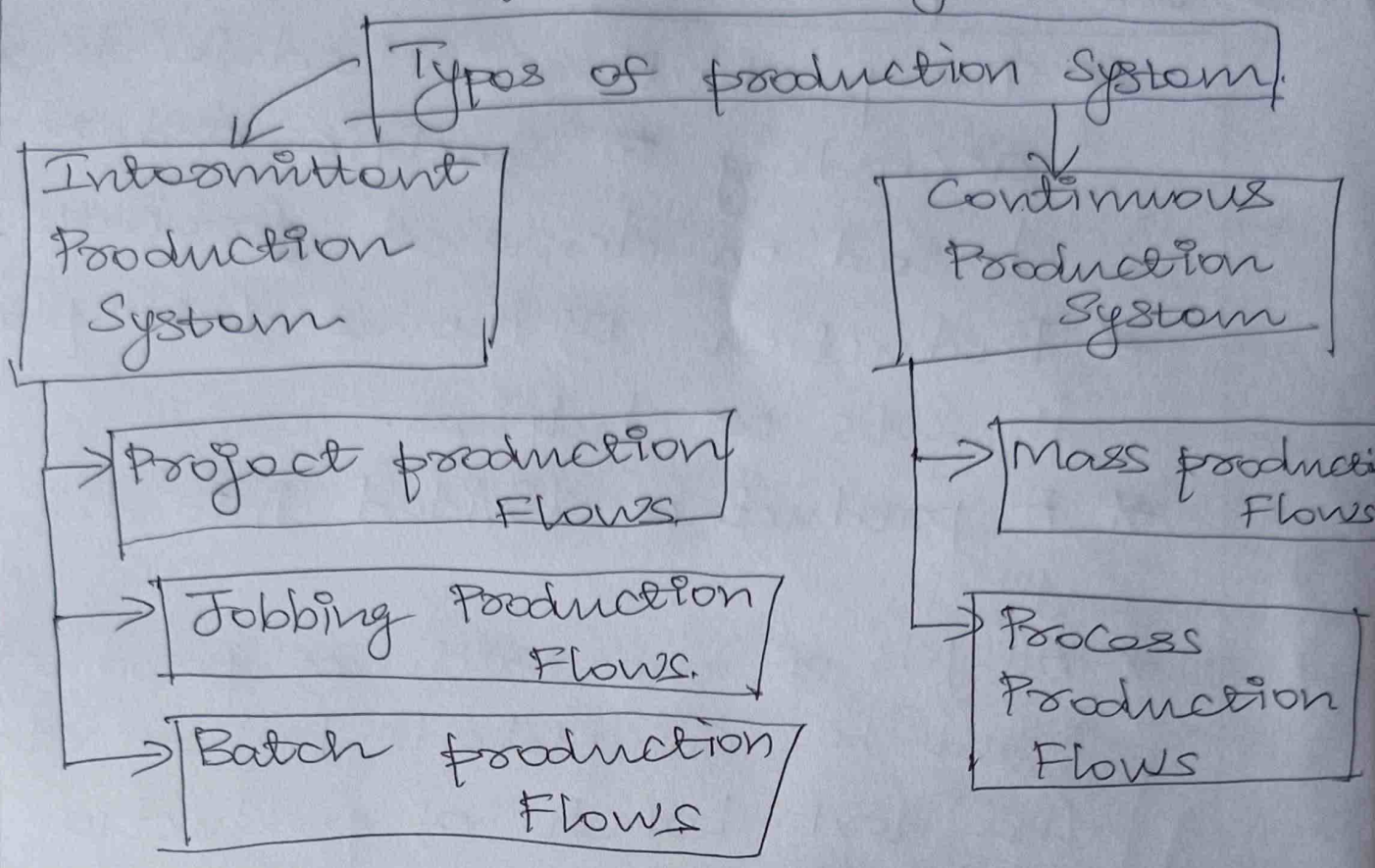


1.3. Types of Production Systems

The production System is classified into 2 groups.

1. Intermittent production System.

2. Continuous production System.



1.3.1. Job Production:-

* Company accepts a contract to produce either one or few units of a product strictly as per specifications given by the customer.
* The product is produced within a given period and at a fixed cost
* The cost is fixed at the time of signing the contract.

Example:-

- Services given by repair shops, tailoring shops, manufacturers of special m/cs.

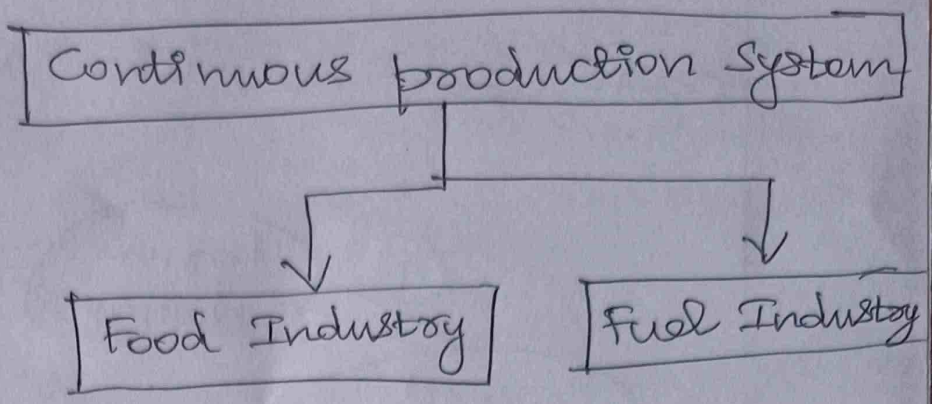
1.3.2 Batch production:-

* The production Schedule is decided according to specific orders or based on demand forecasts.
* Production of items takes place in lots or batches.
* A product is divided into different jobs.
* All jobs of one batch of production must be completed before starting the next batch of production.
* Examples.
  - Manufacturing of drugs and pharmaceuticals, medium and heavy m/c eries.

1.33. Continuous production:-

* Goods are produced constantly without any irregularities, as per demand forecast.
* Goods are produced on a large scale for stocking and selling
* They are not produced on customer's orders.

Demand Forecast



Production is on a large scale

* Features of Continuous production System

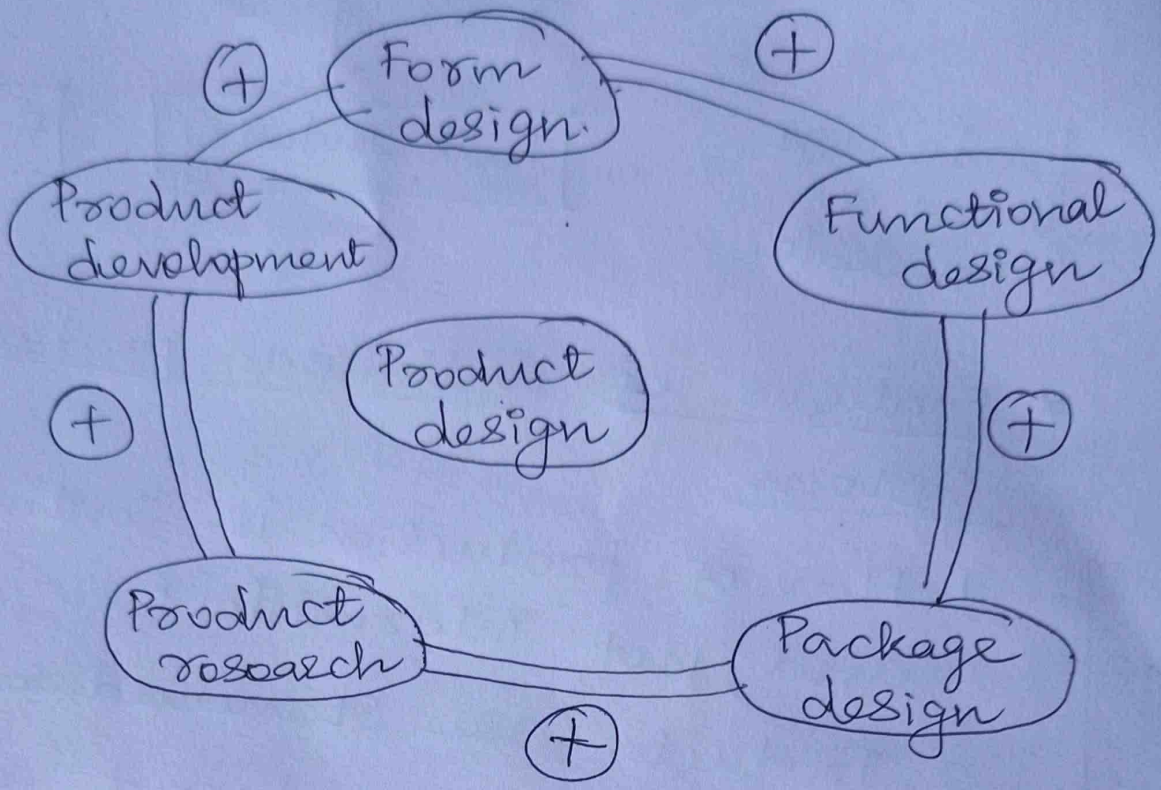
1. Flow of production is continuous and not intermittent
2. Products are Standardised.
3. Products are produced as per quality standards.
4. Products are produced in anticipation of demand.
5. Standardised routing sheets and schedules are prepared.

1.4. Product design and development

1.4.1. Product Design:-

Product design is the translation of intellectual wisdom, requirements of entrepreneurs or needs

customess, etc. into a Specific product



Product design includes form design and functional design.

(i) Form design

It means the shape and appearance of the product.

(ii) Functional design

It means the working of the product. That is, how the product works. It is very important because the product will sell only if it works as expected.

* Once a product is designed, it prevails for a long time. So, various factors are to be considered before designing it.

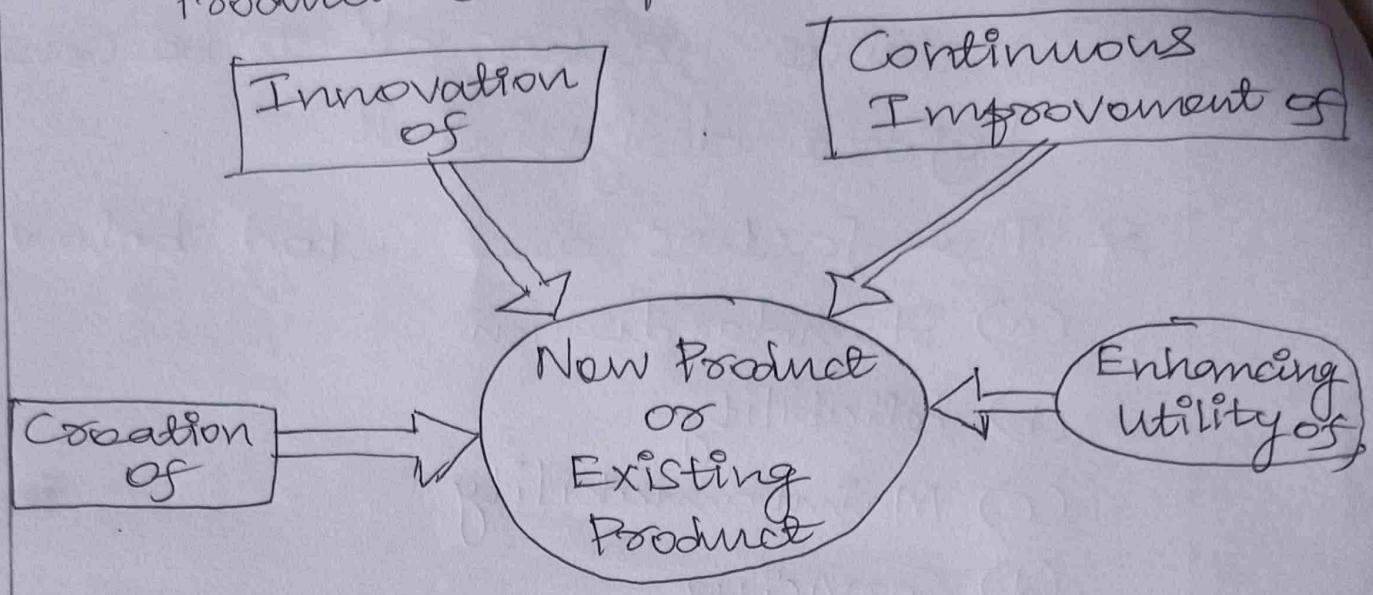
* The factors are listed below:

(a) Standardisation
(b) Reliability
(c) Maintainability
(d) Servicing
(e) Reproducibility
(f) Sustainability
(g) Product Simplification
(h) Quality Commensuration with Cost.
(i) Product Value
(j) Consumer quality
(k) Needs and tastes of Consumers.

1.4.2. Product development:-

The overall process of strategy, organization, concept generation, product and marketing plan creation and evaluation, and commercialization of a new product.

Product development is a,....



Product development takes place, works or functions as under:

1. Creation of an entirely new product or upgrading an existing product by exploring all possibilities and outcomes.
2. Innovation of a new or an existing product to deliver better and enhanced services to end-users.
3. Continuous improvement of a new product or enhancing an existing product by giving preference to satisfy the demand of end-users.
4. Enhancing the utility of a new product or upgrading features of an existing product, for the personal and/or commercial use, to expand the defined goal (objective)

* Factors that influence product design can be classified into 4 categories. They are:

1. Marketing aspect
2. Product characteristics
   (a) Functional aspect
   (b) Operational aspects
   (c) Durability and dependability aspects
   (d) Aesthetic aspects.
3. Economic analysis
   (a) Profit Consideration
   (b) Effects of Standardisation, Simplification and Specialisation
   (c) Break - Even analysis.
4. Production aspects

1.5. Marketing aspect:-

* Marketing is the process of perceiving, understanding, stimulating and satisfying the customer needs, wants and expectations through the goods and services of specially selected target market which is better than the competitors.

* The process of the business to build strong customer relationship in order to gain loyalty from them.
* In relation to our business, the bulk of our customers are the students in which the main needs are paper works for assignments, projects and other activities in the form of document and photo printouts that will be provided at affordable cost.

1.6 Product Characteristics

1.6.1. Functional aspect

* When the marketing possibilities have been explored, the functional scope of product has to be carefully analyzed and properly defined.
* The definition of objective itself rarely tells us very much about the functional scope envisaged.
* A washing m/c, for example has a clearly defined objective: to wash clothing.

1.6.2. Operational aspects

* Not only must the product function properly, it must be easy to handle and simple to operate
* Sometimes it has to be adaptable to various operational conditions and very often it is subjected to varying degrees of skill of potential operators.
* The scarcity of skill is a prohibitive limitation in this respect on the product designer.

1.6.3. Durability and Dependability aspects

* Durability is defined mainly by the length of the active life, or endurance, of the product under given working conditions.
* Durability need not always be associated with selection of good materials.
* The actual working life of a match or a rocket motor may be rather

limited, but that does not mean that materials for these articles may be of low quality

* Dependability is the capability of the product to function when called upon to do its job.

1.6.4. Aesthetic aspects:-

* The aesthetics are mainly concerned with moulding the final shape ~~of~~ around the basic skeleton.
* This moulding of shape may very often be severely limited in scope, and what finally emerges is sometimes termed a 'functional shape'.
* Functional shape is a concept in its own right among designers.
* Aesthetics are the governing factor in design and completely dominate its

1.6.5. Profit consideration:-

* Total cost of a product includes material cost, labour costs, expenses, overheads, storage & distribution costs.

* The total profit is determined by the margin of profit per unit and by the Sales Volume
* If the organisation seeks to increase its profit, it can use one of the following three methods.
  (i) Pure price Strategy.
  (ii) Marketing Strategy
  (iii) Reduction of in-house production Cost.

1.7. Standardisation:-

* Definition:-

It is defined as the process of defining and applying the 'conditions' necessary to ensure that a given range of requirements can normally be met with a minimum variety and in a reproducible and economic manner on the basis of best current techniques.

* Standardisation can help to maximize Compatibility, interoperability, Safety, repeatability or quality.

* It can also facilitate commoditization of formerly custom processes.
* Standardisation is the class or level of manufactured products, agricultural products.

1.8. Simplification:-

* It is also termed as 'Product line contraction'.
* Definition:-

It is the process of reducing the variety of products manufactured.

* Simplification is concerned with the reduction of product range, assemblies, parts, materials and design.
* Advantages:-
  - It reduces price of a product
  - It lowers the production cost.
  - It improves product quality
  - It reduces inventory and thus results in better inventory control.
* Disadvantages:-
  - It cannot fulfil a wide range of demand.
  - It cannot produce demand.
  - It produces a constant source of

conflict between marketing & production

1.9. Specialization

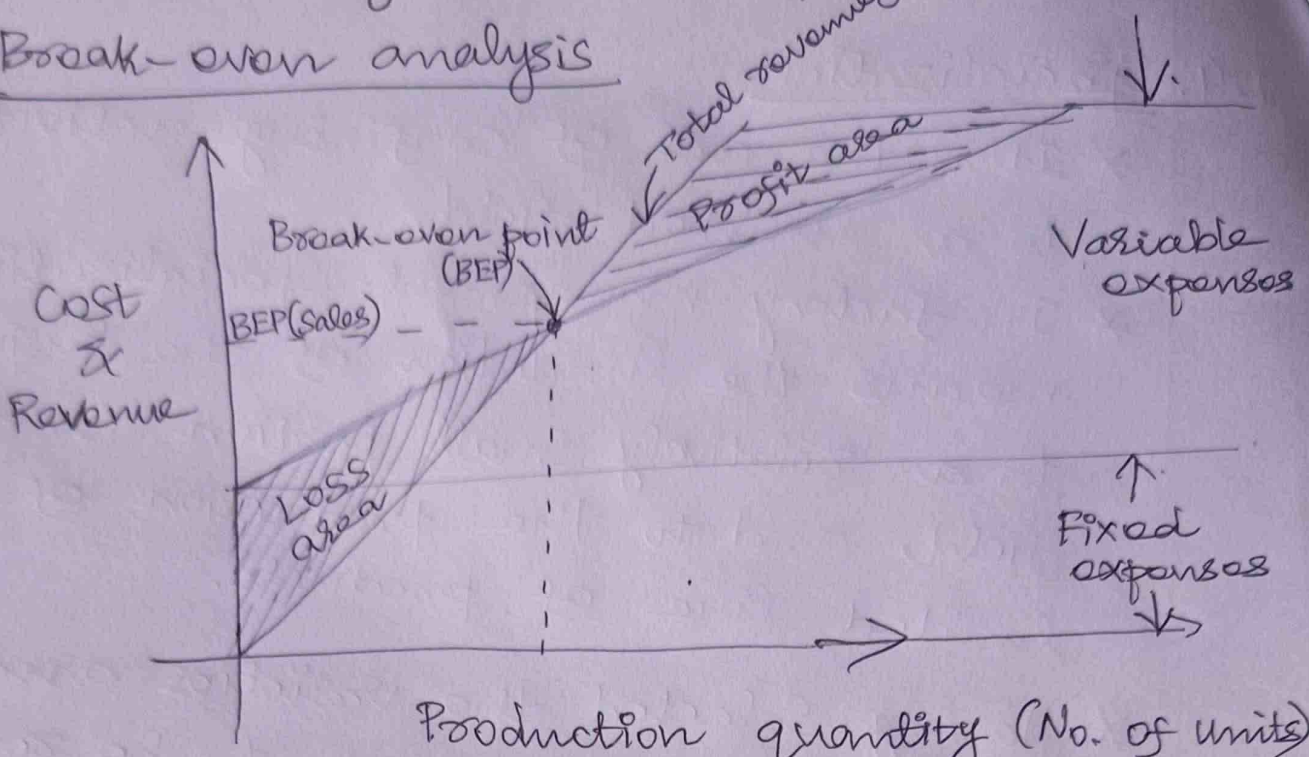
* It is the act of confining activities to a limited field.
* In factory management, Specialization means the limitation of the business to a relatively small portion of the field, and to the production of a limited line of products.
* Having selected the varieties and grades of the products to be retained as much of its manufacturing details are standardized as possible.

* Advantages:-
  - Reduction of costs through mass production.
  - Better quality of products through Specialization.
  - Interchangeability of parts
  - Better deliveries.

* Disadvantages:-
  - Inflexibility
  - Difficulty and expense of changes to new styles and models.

- Tendency to retard progress.

1.10 Break-even analysis



The Break even chart is a graphical representation of costs at various levels of activity shown on the same chart as the variation of income (or sales, revenue) with the same variation in activity.

Break-even Point

- The point at which total of fixed and variable costs of a business becomes equal to its total revenue is known as Break even Point (BEP)
- At this point, a business neither earns any profit nor suffers any loss.

$$\text{Break even point} = \frac{\text{Fixed Cost}}{\text{Selling price} - \text{Variable cost per unit}} = \frac{F}{S - V.}$$

Advantages:-

- It can be interpolated to find the changes in profit levels and break even points upon changes in fixed costs, variable costs and commodity prices.
- It is useful in capital budgeting techniques.
- It represents minimum amount of sales necessary to prevent losses.

Disadvantages:-

- Assumes that sales prices are constant at all levels of o/p.
- Assumes production and sales are the same.
- Break even charts may be time consuming to prepare.
- It can only apply to a single product or single mix of products.

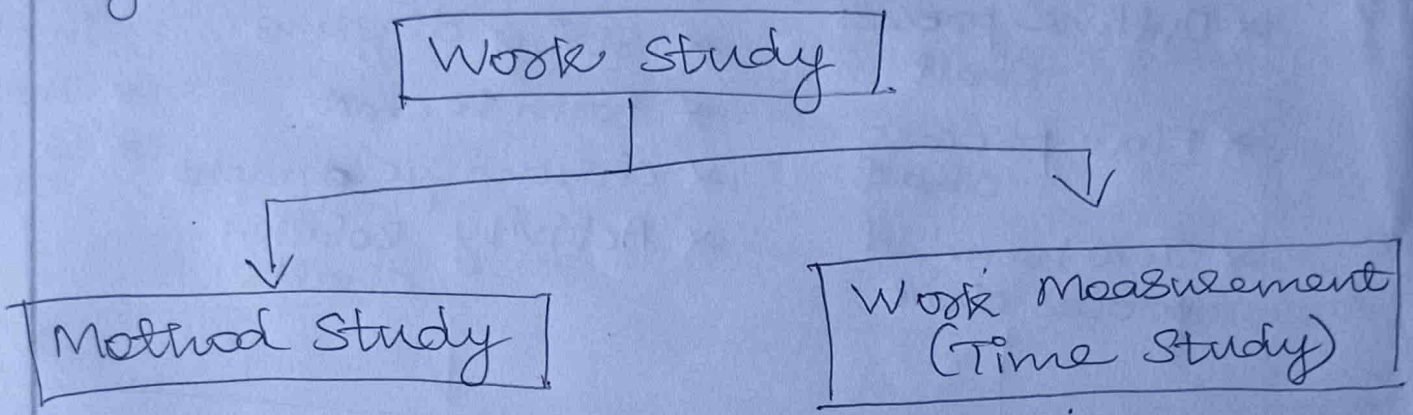
1.11. Economics of a new product design

* When the launching of a new design or model is considered a careful analysis of the economics of the proposed project has to be undertaken.
* The objective of introducing a new model to the market is two fold:
  1. To rise the profit of the organisation.
  2. To avoid decline in sales of an existing model due to severe competition.

Unit – II

Work Study

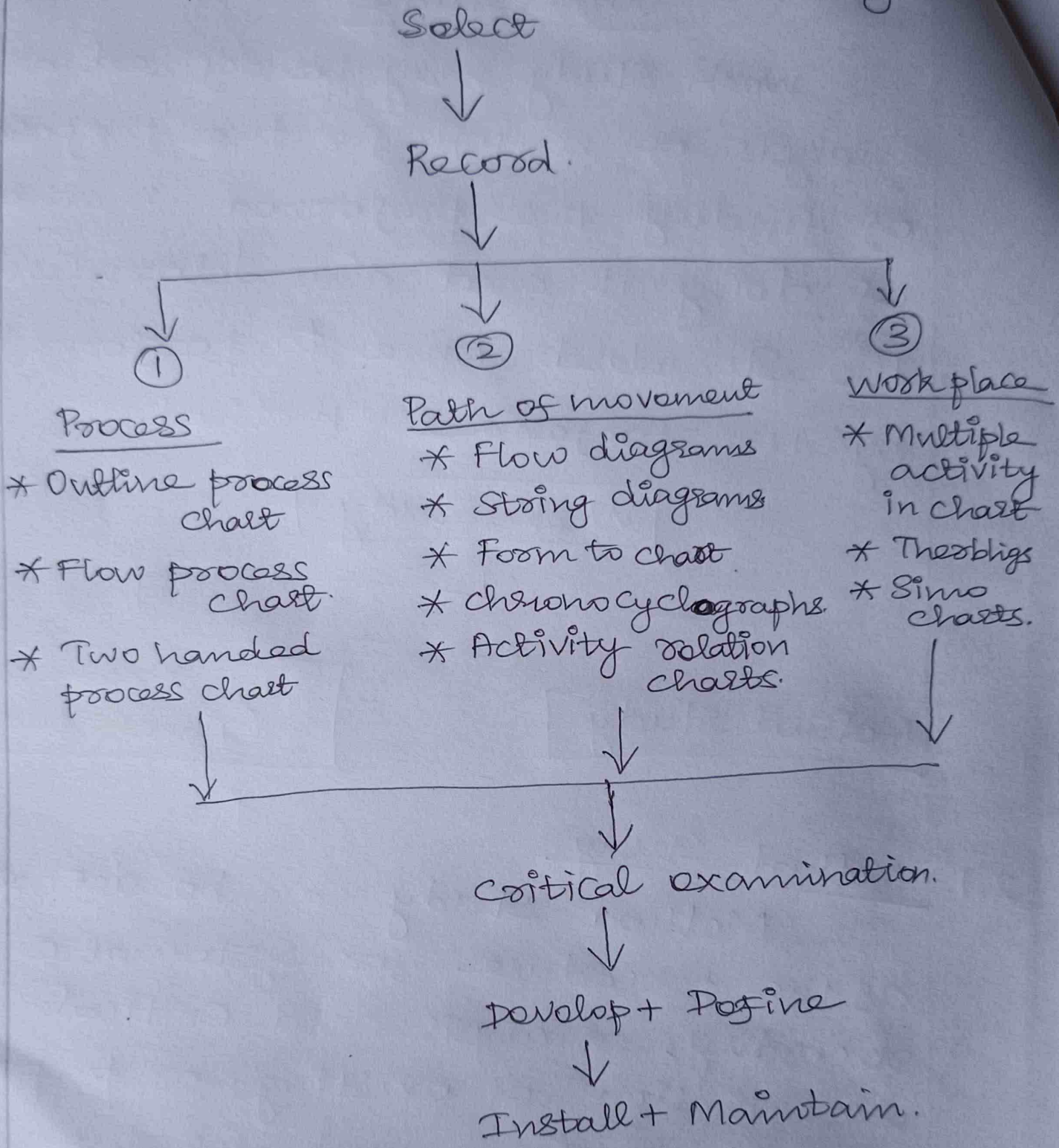
Work study may be defined as the analysis of a job for the purpose of finding the proposed method of doing it and also determining the standard time to perform it by the proposed method.



2.1. Method Study :-

Method Study can be defined as the procedure for systematic recording, analysis and critical examination of existing or proposed method of doing work for the purpose of development and application of easier and more effective method.

2.1.1. Basic procedure for method Study



2.1.1.1. Select (the work to be Studied)

* while selecting a job for method study, the following factors are to be considered.

(i) Economic Considerations:

The cost of study, loss of time due to investigation, costs short term and long term associated with prospective changes in the recommended working method.

(ii) Technical Considerations:

The important point is to make sure that adequate technical knowledge is available with which to carry out the study.

(iii) Human reactions:-

These are the most important considerations to be made, since mental and emotional reactions to investigation, and change of method has to be anticipated.

2.1.12 Record (all relevant information about that work)

* It is the phase of data collection.
* Data is relevant facts pertaining to the existing method which are collected and recorded to carry out

the investigation.

* Recording techniques depend on type and nature of the data.
* The broad techniques are,
  (1) charts
  (2) Diagrams & models
  (3) photographic aids.

2.1.1.3. Critical analysis

* critical examination is done by questioning technique.
* This step comes after the method is recorded by suitable charts & diagrams.
* The individual activity is examined by putting a number of questions
* The following factors are questioned.
  (i) Purpose
  (ii) Place
  (iii) Sequence
  (iv) Person
  (v) means

2.1.1.4. Development:-

The answer to the questions given below will result in the development of a better method.

(i) Purpose – what should be done?

(ii) Place – where should it be done?

(iii) Sequence – when should it be done?

(iv) Person – who should do it?

(v) Means – How should it be done?

2.1.1.5. Install:-

* The active support of both management and trade union is required in this step.

* Install stage consists of

(a) Gaining acceptance of the change by supervisor.

(b) Getting approval of management.

(c) Gaining the acceptance of change by workers and trade Unions.

(d) Giving training to operators in new method.

(e) To be in close contact with the progress of the job until it is

Satisfactorily executed.

2.1.1.b. Maintain :-

* The work study man must see that the new method introduced is followed.
* The worker after sometime may slip back to the old methods.
* This should not be allowed.
* The new method may have defects.
* This should be rectified in time by the work study man.

2.2. Micro-motion Study :-

* It is the technique of recording and analyzing the timing of basic elements of an operation with the objective of achieving the best method of performing the operation.

* It is a set of techniques intended to divide the human activities in a groups of movements or micro-motions (called Therbligs).

* Objectives:-

- To find most efficient way of doing work.
- Helps to study repetitive short cycle operation which cannot be studied by ordinary method.
- To train operator regarding motion economy.
- It assists in research project in the field of work study.

* Advantages:-

- It offers a permanent record of motion study on films.
- Films can easily show the difference b/w the present and the proposed technique.
- Films can be demonstrated to large work force at any desired speed.

2.3. Memomotion Study

* It was originated by M.E. Mundel.

* It is a special type of micromotion study in which the motion pictures or videotape are taken at slow speeds; say 50 or 100 frames per minute.

* Procedural Steps:-

(i) Identify and study the operation to be filmed.

(ii) Record the video film of selected operation.

(iii) Analyse the video film.

(iv) Depending upon the type of activities, construct an appropriate chart.

(v) Improve the method by using principles of motion economy.

* Advantages:-

- It can record long sequences of activities.

- It is more economical than micromotion study as it consumes less film.

2.4 Work measurement:-

* It is defined as "the art of observing and recording the time required to do each detailed element of an industrial activity/ operation".

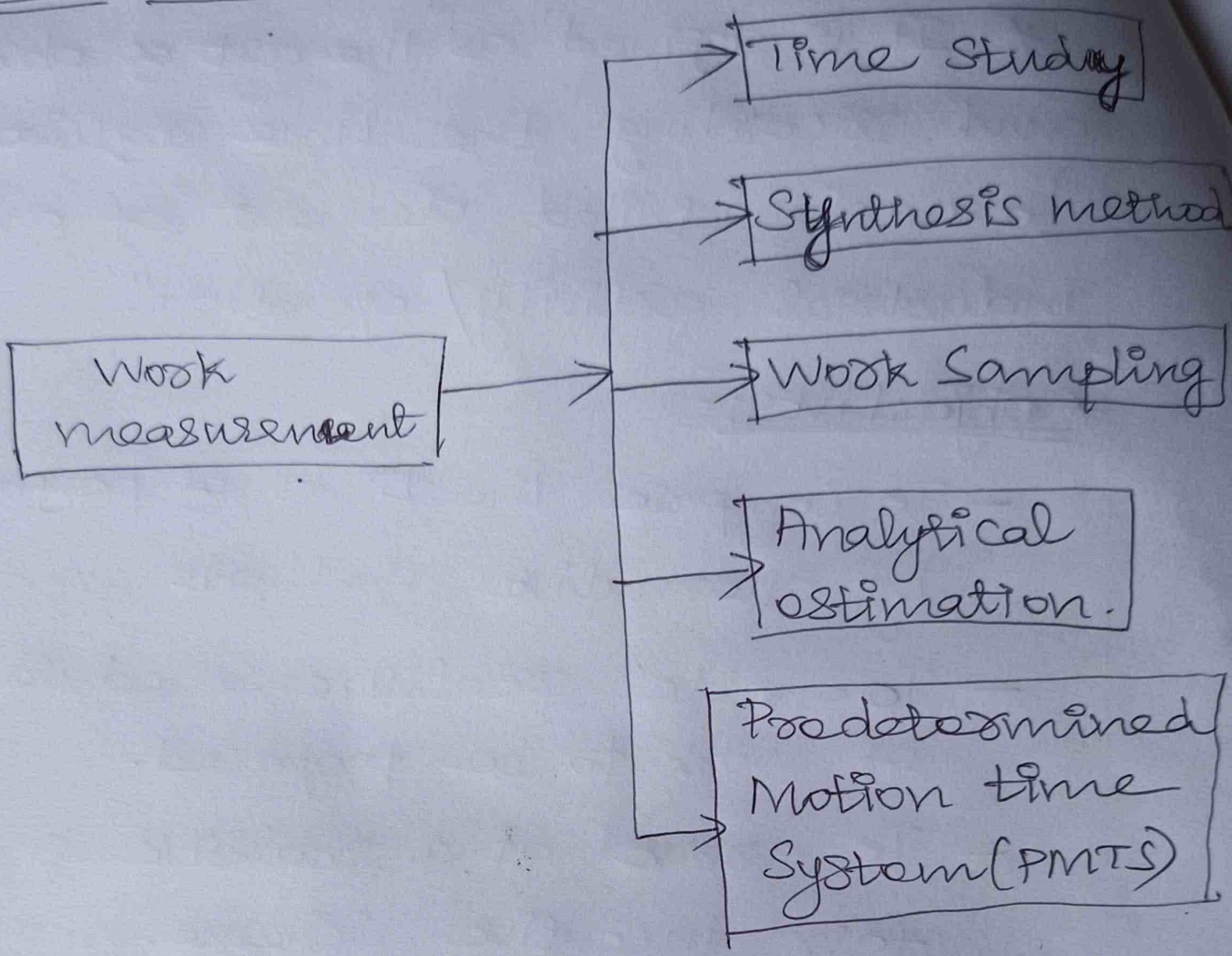
* objectives:-

- To Compare the times of performance by alternative methods.
- To enable realistic Schedule of Work to be prepared.
- To arrive at a realistic and fair incentive Scheme.
- To minimise the human effort.

* Uses:-

- It is used in planning work and in drawing out Schedules.
- It is used to determine Standard Costs.
- It is used as an aid in preparing budgets.
- It is used in balancing production lines for new products.

2.5. Work measurement techniques:-



2.6. Time Study:-

* It is a technique to estimate the time to be allowed to a qualified and well trained worker working at a normal pace to complete a specified task.

* Equipments:-
  1. Timing device

2. Time Study observation Sheet
3. Time Study Observation board.
4. Other equipment.

* Procedure:-

SELECT
The job to be timed

↓

DEFINE
The elements, break the job into elements convenient for timing.

↓

OBTAIN AND RECORD.
Details regarding method, operators, job and working conditions.

↓

EXTEND.
Observed time into normal time (Basic time)

↓

MEASURE
Time duration for each element and assess the rating

↓

COMPUTE
Standard time for the operation for defined job

↓

DETERMINE
Relaxation and personal allowances

2.7. Production Study

* It is defined as a continuous study of relatively lengthy duration often made with the object of checking an existing or proposed standard time or its constituents parts or obtaining information concerning the rate of O/P.

* Purpose:-

It is essential to carry out production studies to ensure that the calculations have been correctly made and that the people working to the values can achieve a reasonable performance.

* Uses:-

- Obtaining a detailed account of a representative period.
- Validation of issued standard and allowed times.

- Checking of contingencies for adequate coverage.
- Assessing the amount of waiting time and other ineffective time.

2.8. Work Sampling:-

* It is the Statistical technique for determining the proportion of time spent by workers in various defined categories of activity.

* Need:-

- To determine how long or how much of the work day is spent
- Work sampling may identify the fact that certain operators spend a large portion of their time waiting for work or performing paperwork tasks

or even performing activities that are not included in their job descriptions.

- One of the basic formulations of statistical sampling theory is the concept that the larger the sample size, the results will be more accurate.

* Advantages:-

- It is an economical method of doing the time study of work.
- It is a highly flexible method wherein data can be collected anytime without affecting the results.
- These methods are less tedious and fatiguing.

*Disadvantages:-

- It is not an economical process when a single operator/machine is involved.
- Doesn't provide any elemental time data.
- The process of work study is difficult to understand Compared to time study.

2.9. Synthesis from Standard data.

* Synthesis is a work measurement technique for building up the time for a job at a defined level of performance by totalling element times obtained previously from time studies on other jobs containing the elements concerned, or from synthetic data.
* In Synthesis method, the full job is first divided into elements (parts).
* Then the time taken to do each

element of the job is found out and Synthesized.

* This gives the total time taken for doing the full job.
* In this technique, the time taken to do each element of the job is found out from previous time studies.

* Advantages:-
  - It provides reliable information about standard time for doing different jobs. This is because it is based on many past time studies.
  - It is economical because there is no need to conduct new time studies.

2.10 Pre-determined Motion Time Standards (PMTS)

* PMTS may be defined as a procedure that analyses any

manual activity in terms of basic or fundamental motions required to perform it.

* Objectives:-

- Determine job time standards.
- To set time standards for various jobs.
- To provide a basis for estimation of labour cost and wage plans.
- To facilitate training of the workers and supervisory staff.

* Advantages:-

- No timing is required so it eliminates in accuracies associated with stop watch time study.
- They are an excellent training technique.
- Time standard for a job

can be arrived at without going to the workplace.

- The time and cost associated with finding the standard time for a job is considerably reduced.

* Limitations:-

- PMTS can deal manual motions of an operation only.
- They are not economical for non-repetitive operations.
- They cannot be applied to restricted work.

* Applications:-

- Determination of job time standards.
- Checking direct time study results.
- Estimation of man power, equipment and space requirements prior to setting up facilities and start of production.

Unit-3

Product Planning & Process Planning

3.1. Product Planning:-

* It is the process of creating a product idea and following through on it until the product is introduced to the market.

* objective:-
  - To offer products based upon customer needs.
  - To utilise the available resources more profitability.
  - To diversify, to capitalize on the Company's Strength.
  - To decide on the elimination of non-profitable products.
  - For long-term Survival.

* Components:-
  1. Product innovation.
  2. Product diversification

3. Product development
4. Product Standardisation.
5. Product elimination.
6. Product mix and product line.

* Product Planning Process:-

1. Marketing and marketing analysis.
2. Performance of feasibility Studies, and.
3. Advanced product planning.

3.2. Value analysis:-

* Value:-

The relationship b/w performance of a project, product or process and the cost of obtaining it.

* Value = Performance / Cost

* Types of Values:-

1. Use Value
2. Esteem Value

3. Cost Value
4. Exchange Value.

* Definition of Value analysis

Value analysis is the systematic application of recognized techniques which identify the function of a product or services establish a monetary value for the function and provide the necessary function reliability at that lowest overall cost.

* objectives:-

1. To simplify the product design
2. To substitute better and cheaper materials.
3. To identify and apply efficient processes.
4. To increase profitability.

* Steps in Value analysis

1. Establish the objectives.
2. Orientation/Preparation.
3. Information gathering.

4. Analysis
5. Innovation/ Creativity
6. Option evaluation.
7. Implementation & monitoring.

3.3. Problems in lack of Product Planning

* Several problems in lack of product planning are,

(1) what will be the production quantity?
(2) What are the characteristics of the products to be produced?
(3) The availability of equipment and what kinds of equipment are to be purchased and what will be the investment?
(4) What kind of labour is required?
(5) Make or buy the components required?

* Once these questions are answered, the product planning activity can be carried out.

3.4. Process Planning and Routing:-

* Process planning is the systematic determination of the methods by which a product is to be manufactured economically and competitively.

* Goal:-

The Goal of process planning is to improve and streamline the business methods of a Company. This would have results like:

(1) Lower costs, due to fewer staff needed to complete the same process.

(2) Higher efficiency, by eliminating problematic process steps like loops and bottlenecks.

(3) Higher accuracy, by including check points and success measures to make sure process

steps are completed accurately.

(4) Greater understanding by all staff of what they need to do to meet their department objectives.

3.5. Pre-requisite informations needed for Process Planning:-

(1) Quality of work to be done along with product specifications.

(2) Quality of work to be completed.

(3) Availability of equipment, tools and personnel.

(4) Sequence in which operations will be performed on the raw material.

(5) Names of equipments on which the operations will be performed.

(6) Standard time for each operation.

(7) when the operations will be performed?

(8) Cutting Speed.

(9) Feed.

(10) Material Specification.

(11) Job rating of labours.

3.6. Steps in Process Planning:-

(1) Analyse the part print to get an overall picture of what is wanted.

(2) Make recommendations to or Consult with product engineers on product design changes.

(3) List the basic operations required to produce the part to the drawing or Specifications.

(4) Determine the most practical and economical manufacturing method and the form of tooling required for each

operation.

(5) Devise the best way to combine the operations and put them in sequence.

(6) Specify the gauging required for the process.

3.7. Quantity determination in Batch production:-

* A variety of products are made but volume is not too large, to demand a separate line for each product.
* Here, items are processed in lots or batches and a new batch is undertaken for production only when the production on all items of a batch is complete.
* Batch production can be three types namely,
  (a) A batch produced only once.
  (b) A batch produced repeatedly

at irregular intervals, when the need arises.

(c) A batch produced periodically at known intervals, to satisfy continuous demand.

* Advantages of batch production

(1) Customers of different demands can be met.

(2) As goods are made for a specific customer, the cost of storing finished goods will be reduced.

(3) Use of specialist m/cs and automation reduce costs.

* Disadvantages of batch production:-

(1) It takes time to switch machinery from one setting to another - this increases costs.

(2) Components for different jobs may need to be stored - this

increases costs.

(3) Tasks may be repetitive and boring, demotivating workforce.

3.8. Machine Capacity

* Machine loading is the process of assigning specific jobs to m/cs, men or work centers based on relative priorities and capacity utilization.
* M/c loading ensures maximum possible utilization of productive facilities and avoids bottlenecks in production.
* It is important to avoid over loading or under loading the facilities, work centers or m/cs to ensure maximum utilization of resources.
* M/c loading is the job of deciding

Sequence of jobs to be processed on a production equipment or m/c.

* Objective

- To engage the m/c continuously at work.
- To assign dates for producing each part of a product so that the total orders can be procured in the shortest possible time.

3.9. Balancing

* other name:- Assembly line balancing.
* It is a critical activity for industries.
* It enhances their competitiveness in a market that increasingly demands a greater diversity of products.

* Definition:-

Line balancing is an analysis process that tries to equally divide the work to be done among workstations so that the number of worker or workstations requires on a production line is minimised.

* objective of line balancing

(i) Manage the workloads among assembleers.

(ii) Recognize the location of bottleneck.

(iii) Decide number of workstation.

(iv) Decrease production cost.

(v) Assigning task to each work station in such a way that there is little idle time.

*Steps in balancing an assembly line

(1) List the sequential relationships among tasks and then draw a precedence diagram.

(2) Calculate the required workstation cycle time.

(3) Calculate the theoretical minimum number of workstations.

(4) Choose a primary rule that will determine how tasks are to be assigned to workstations.

(5) Beginning with first workstation, assign each task, one at a time, until the sum of the task times is equal to the workstation cycle time or until no other tasks can be assigned due to sequence

or time restrictions

(6) Repeat Step 5 for the remaining workstations until all the tasks have been assigned to a workstation.

(7) Evaluate the efficiency of the line balance.

(8) Rebalance if necessary.

3.10 Analysis of Process Capacities in a Multiproduct System

* Estimating Capacity

- The balancing of m/cs for the production of single product was considered.
- The balancing for the production of multiproduct using the several stages in the production sequence.

- The product of identical capacities of the several stages in the production order for a multiproduct system is described.

* Multiproduct analysis

- The problem occur during balancing of one product is a one-dimensional model.
- In this, the conditions for full capacity of the processes are represented by a series of points on a straight line.
- The problem occur during balancing of two products is analysed by a two dimensional model.

- In this, the conditions for full capacity of the processes are represented by straight line.
- For any given ratios b/w the amounts required for the two products, a point of full balance can be determined.
- A three product balancing problem can be analysed by a three dimensional model.
- In this case, the conditions for full capacity being represented by planes.

* n-Product System

- For the case of n-product System, it is very challenging to present the n-dimensional

System in a graphical form.

- The analysis of n-product system is also fundamentally the same as that for two or three product system.
- However the capacity limitations are expressed by linear equation in the following form:

$$\left.\begin{aligned} a_1x_1 + a_2x_2 + a_3x_3 + \dots + a_nx_n &\leq P \\ b_1x_1 + b_2x_2 + b_3x_3 + \dots + b_nx_n &\leq Q \\ c_1x_1 + c_2x_2 + c_3x_3 + \dots + c_nx_n &\leq R \end{aligned}\right\} \quad (3.1)$$

where, x_1 = Amount of product 1

x_2 = Amount of product 2

x_3 = Amount of product 3

x_n = Amount of product n.

P = Capacity of process 1

Q = Capacity of process 2

R = Capacity of process 3.

In equation (3.1), the inequality Symbol $\leq$ Show that capacities cannot ~~Ex~~ exceed the maximum values on the right.

——X——

Unit-4

Production Scheduling

4.1. Introduction

Production Scheduling consists of the activities performed in a manufacturing company in order to manage and control the execution of a production process.

A Schedule is an assignment problem that describes into details which activities must be performed and how the factory's resources should be utilized to satisfy the plan.

4.2. Loading:-

Other name:- M/c Loading

Loading is defined as the assignment of work to a facility without specifying when the work is

to be done and in what sequence

Objectives:-

1. To help in fixing of reliable delivery possibilities.
2. To help in the efficient planning of new work.
3. To help in balancing the plant to the existing load.
4. To check the feasibility of production sequences.

M/C	Daily M/C Capacity (M/C hours)	Assigned hours. April.					
		1	2	3	4	5	6
CNC	80	80	72	64	50	–	–
Lathe	75	75	65	72	44	35	–
Drilling	45	40	30	44	42	20	–

Fig. 4.1. Loading chart

4.3. Scheduling.

It is the process of arranging, controlling and optimizing work and workloads in a production process.

Scheduling is used to allocate plant and machinery resources, plan human resources, plan production processes and purchase materials.

Inputs of Scheduling.

1. Performance standards
2. Units in which loading and Scheduling is to be expressed.
3. Effective capacity of the work centre.
4. Demand pattern and extent of flexibility to be provided for rush orders.
5. Overlapping of operations

6. Individual job Schedules.

Objectives of production Scheduling

1. Making efficient use of the labours
2. Making the best possible use of equipments that are available for the use.
3. Increasing the profit.
4. Increasing the o/p
5. Improving the sosvice level.
6. Maximizing the delivery performance
7. Minimizing the inventory
8. Reducing the manufacturing time.
9. Minimizing the production costs.
10. Minimizing the Worker Costs.

4.4. Master Scheduling

Other Name:- Master Production Scheduling (MPS).

MPS formalize the production plan and translate it into specific end item requirements over a short to immediate planning horizon.

objectives:-

1. To schedule and items to be completed promptly and when promised to customers.
2. To avoid overloading the production facility so that production capacity is efficiently utilized and low production costs result.

Inputs to MPS:-

(i) Forecast of demand of end items
(ii) Customer orders
(iii) Inventory on hand from the previous period.

Functions of MPS

(1) To translate aggregate plans into specific end items.
(2) Evaluate alternative schedules
(3) Generate material requirement
(4) Generate capacity requirements
(5) Facilitate information processing
(6) Effective utilization of capacity.

Master Production Scheduling Process

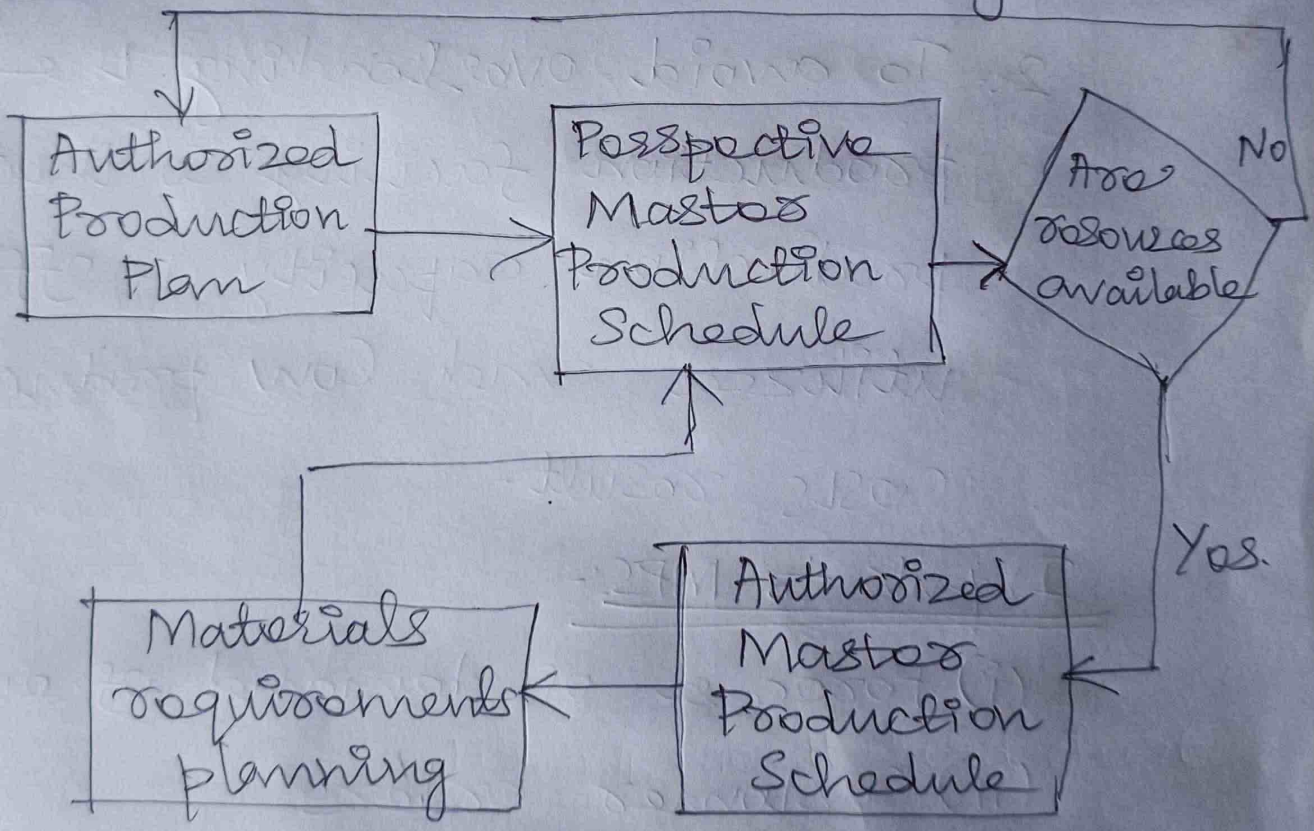


Fig. 4.2. Master Production Scheduling process.

4.5. Gantt charts

It is a form of horizontal bar chart and horizontal bars are drawn against a time scale for each project activity, the length of which represents the time taken to complete.

Objectives:-

To assess how long a project should take and to establish the order in which tasks need to be carried out by the ending of the project.

Types:-

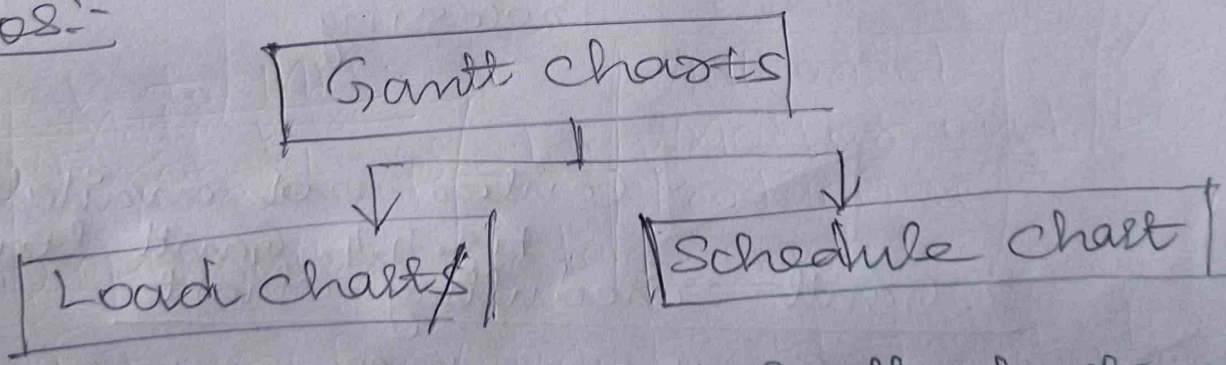


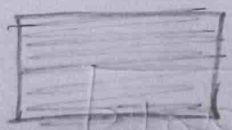
Fig. 4.3. Types of Gantt chart

1. Gantt Workload charts

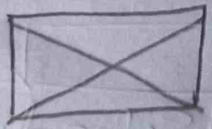
* A load chart depicts the loading and idle times for a group of m/cs or a list of departments.

* The chart shows when Certain jobs are Scheduled to start and finish and where to expect idle time.

Day / Work Centre	Mon Day	Tues Day	Wednes Day	Thurs Day	Fri day
Metal Works	Job 349			Job 350	
Mechanical		Job 349	Job 349	Job 408	
Electronics	Job 408			Job 349	
Painting	Job 295	Job 295	Job 480		Job 349



Processing



Centre not available

Fig. 4.4. Gantt load chart

2. Gantt Scheduling chart

Gantt Scheduling chart is used to track the progress of jobs as they pass

through departments in an organisation. A typical Gantt scheduling chart is shown in Fig. 4.5

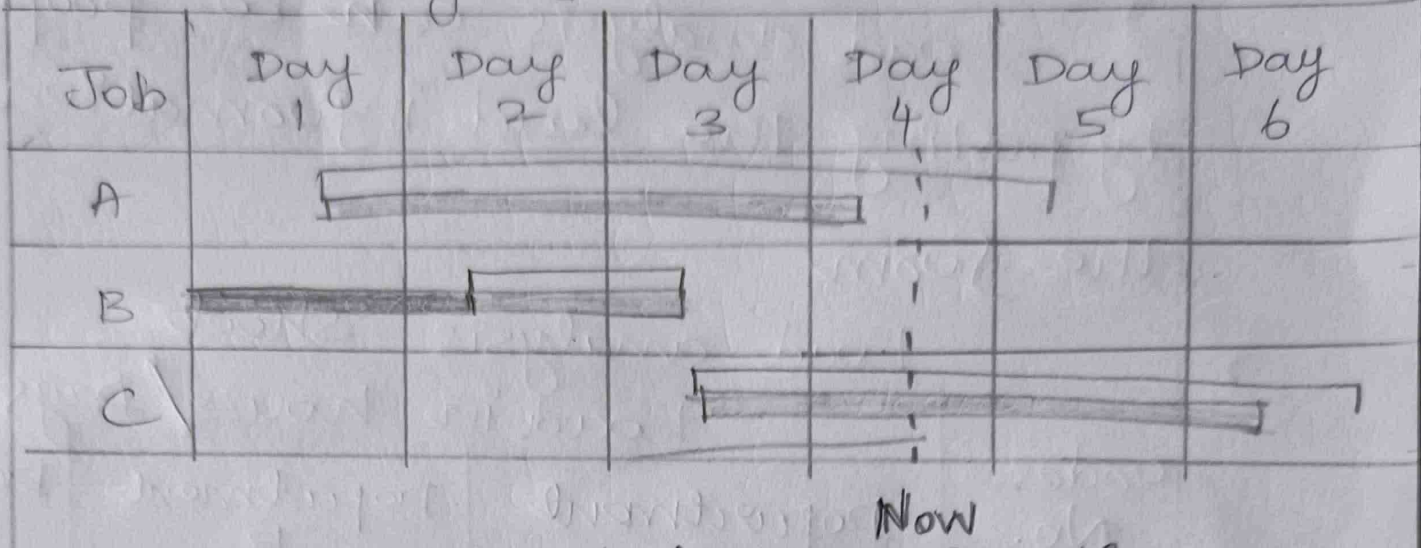


Fig. 4.5 Gantt Scheduling chart

4.6. Perpetual Scheduling

* In this method, a copy of each order is placed in an open file and moved as the job moves to different facilities
* A copy of the order remains in the file until the job is completed.

Steps in Perpetual Schedule:-

Perpetual Schedule has 2 steps.

1. Preparation of load analysis sheet:

Load analysis can be prepared by posting the load information on the form

Load analysis Sheet

Order No.	Load in hours/Days		
	Department A	Department B	Department C
1201	30	25	25
1202	25	21	24
1203	20	30	15
1204	16	32	22

Fig. 4.6 Load analysis Sheet

2. Presentation in Gantt chart

Gantt Load chart

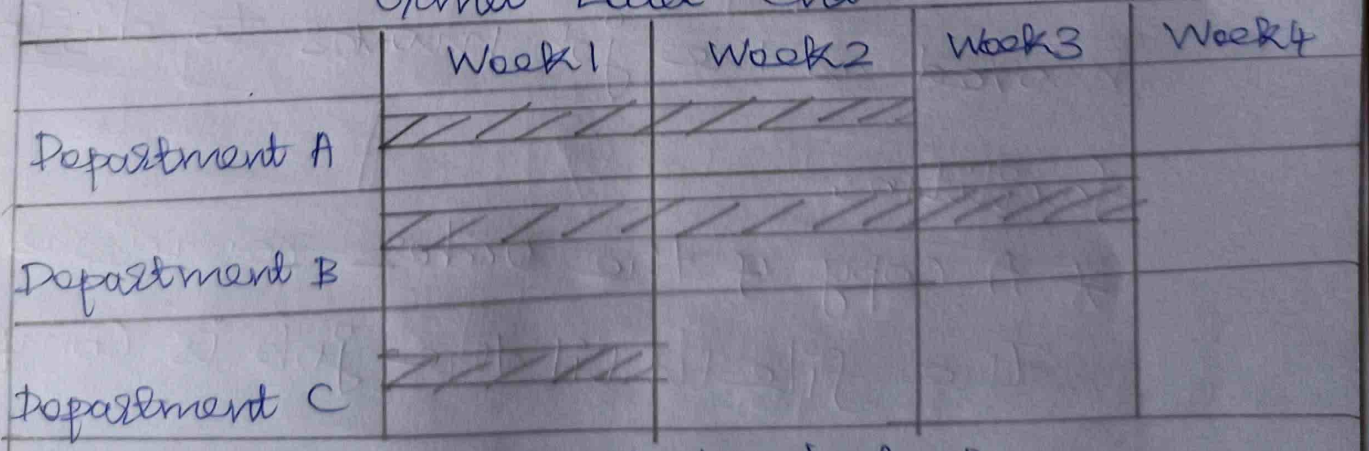


Fig. 4.7. Gantt Load chart.

when the load on each department is summed up and knowing the weekly capacity of the department, the no. of weeks of loading for each department is calculated.

4.7 Basic Scheduling problems

Basic Scheduling problems include (1) Job Shop Scheduling (2) Batch production Scheduling (3) Flow production (4) Product Sequencing.

Scheduling	Job	Batch	Flow/Mass
Main feature	Single one-off items	Group of identical products pass through each stage together	Mass production of standardized products
Essential requirements	Highly skilled workforce	Labour & m/cs must be flexible to switch to make batches of other designs	* Specialized often expensive, capital equipment
Advantages	High levels of worker motivation	Faster production with lower unit costs than job production.	* Lower unit costs * High Labour cost

4.8. Line of balance (LOB)

* It is a method of showing the repetitive work that may exist in a project as a single line on a graph.

* The purpose of the LOB method is to ensure that the many activities of a repetitive production process stay "in balance".

Input to LOB

(i) Schedule of delivery
(ii) Lead time of these events
(iii) Sequence of events
(iv) key operations in creating the product which is essential to be controlled.

Charts used in LOB

(i) operation programme chart
(ii) objective chart
(iii) Progress chart
(iv) Line of balance chart.

4.9. Material Requirement Planning (MRP)

MRP is a production planning, Scheduling and inventory control System used to manage manufacturing processes.

MRP objectives:-

(1) Reduction in inventory cost.

(2) Meeting delivery schedule

(3) Improved performance

(4) Realistic delivery committments.

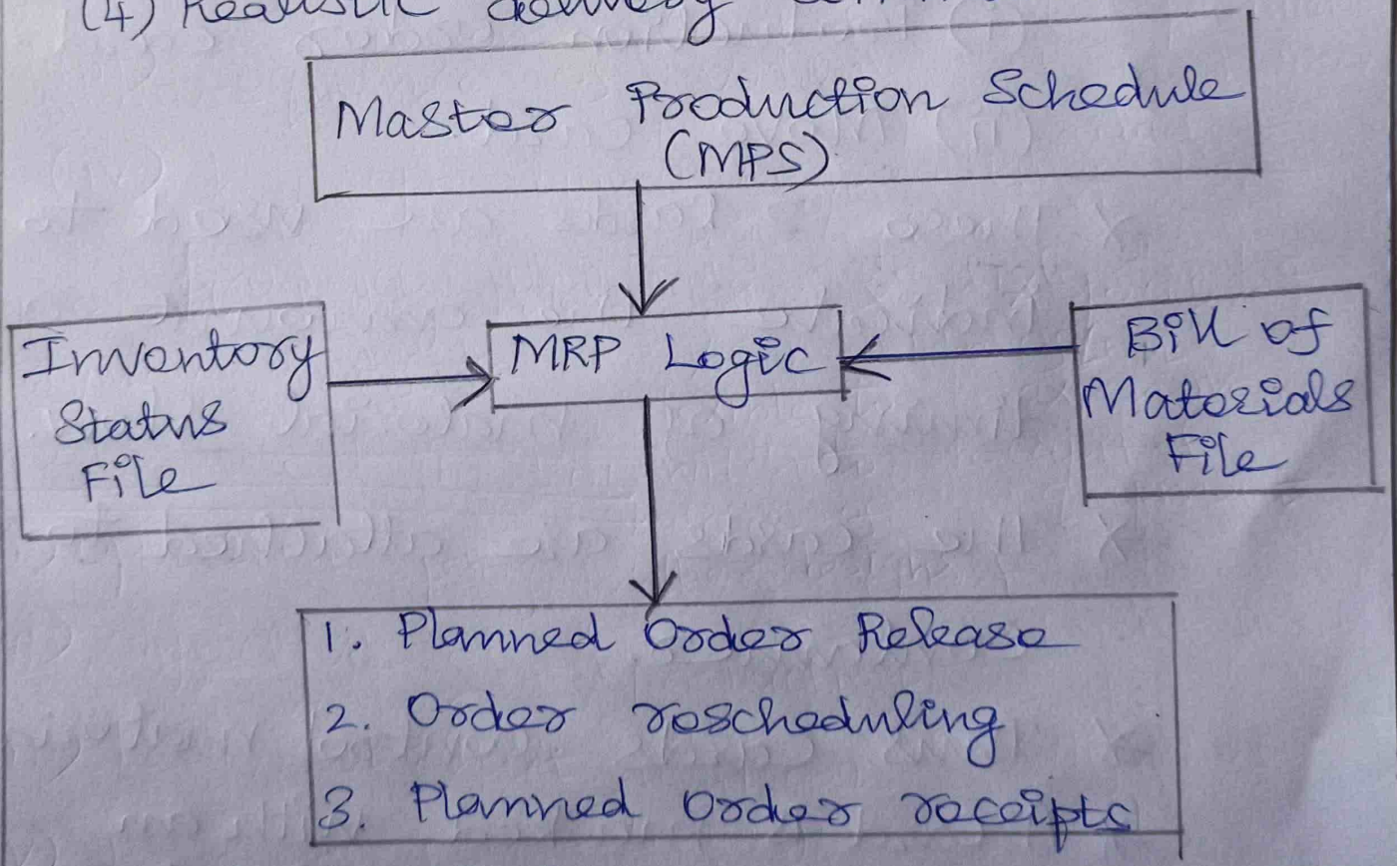


Fig. 4-8. MRP System Architecture

4.10 Kanban

* Kanban mean card or visible record in Japan Toyota, Japan uses cards to control the flow of materials/ inventory in a production process.
* It helps in implementing JIT System in the industry.
* Two main types of cards used in Kanban are:
  (i) Production order card.
  (ii) Move card.
* These 2 cards are used to indicate the amount and timing of material flow.
* The cards are attached to the containers.
* Thus cards control material flow.
* A card is masked with an
  (i) identification no. (ii) Part no.
  (iii) Part description (iv) Place of issue
  (v) no. of items.

4.11. Dispatching:-

Dispatching may be defined as setting production activities in motion through the release of orders and instructions in accordance with the previously planned time schedules and routings.

Dispatching rules:-

(1) FCFS (First come, First-Served)
(2) Earliest Due Date (EDD)
(3) Shortest operating time (SOT)
(4) Slack Time Remaining (STR)
(5) STR per operations (STR/OR)
(6) Queue ratio (QR)
(7) Critical ratio (CR)

Common Forms used in Dispatching

(i) Material requisitions
(ii) Job cards
(iii) Move tickets
(iv) Tool and gauge tickets
(v) Inspection Cards.

4.12 Progress reporting and expediting

This is the control tool that keeps a close observation on the progress of the work.

Need:-

Need of expediting may arise due to the following reasons

(1) Delay in supply of materials
(2) Excessive absenteeism
(3) changes in design specifications
(4) changes in delivery schedules initiated by customers.
(5) Breakdown of m/cs or tools, jigs and fixtures
(6) Errors in design drawings and process plan.

Types:-

(1) Programme control
(2) Order processing
(3) Shortage chasing
(4) Daily plan progressing.

4.13 Manufacturing Lead time

* Manufacturing lead time is the time period b/w the placement of an order and the shipment of the completed order to the customer.

* A short manufacturing lead time is a competitive advantage; many customers want the delivery of their products as soon as possible following the placement of the order.

* Manufacturing lead time consists of wait time and throughput time.

4.14. Techniques for aligning completion time and due date production.

(1) Synchronised Finite Capacity Scheduling

Finite capacity scheduling calculates the net processing time of each process while synchronizing the schedules of subsequent processes it can calculate the shortest manufacturing lead time realistically allowed by the available capacity of the resources.

(2) Operation Splitting

Lengthy operations can be split and assign the split operations in parallel on multiple resources.

(3) Time constraint method:-

It refers to the method of controlling the time relationship b/w subsequent processes.

(4) Bottleneck-oriented Scheduling

It performs backward assignment on processes previous to the fixed operations and forward assignment on following processes, optimizing start times while shortening production lead times.

(5) External Setup

By converting internal setups into external setups, manufacturing lead time can be shortened while increasing throughput on bottleneck resources.

Unit-5

Inventory Control and Recent trends in PPC

An inventory is a stock of an item or idle resource held for future use.

5.1. Inventory Control

Inventory control may be defined as the scientific method of determining what to order and how much to order and how much to stock so that costs associated with buying and storing are optimal without interrupting production and sales.

Functions:-

(1) Effective running of the Stores

(2) Technological responsibility for the stage of merchandise.

(3) Stock control System.

objectives:-

(i) To ensure continuous supply of materials so that production should not suffer at any time.

(ii) To maintain the overall investment in inventory at the lowest level

(iii) To keep inactive, waste, surplus, scrap and obsolete items at the minimum level.

(iv) To ensure timely action for replenishment.

5.2. Purpose of holding stock.

(1) To maintain independence of operations.

(2) To meet variation in product demand.

(3) To allow flexibility in production scheduling

(4) To provide a safeguard for variation in raw material delivery time.

(5) To take advantage of price discounts.

(6) To utilise the advantage of price fluctuation

(7) To prevent loss of orders.

5.3. Ordering procedures

There are 2 types of inventory systems. They are,

(1) Fixed order quantity models (Q Models)

(2) Fixed time period models (P Models)

(1) Fixed Order Quantity models

Other Names:-

1) Economic Order Quantity (EOQ) model

2) Q model

3) Reorder point inventory System

4) Perpetual inventory System.

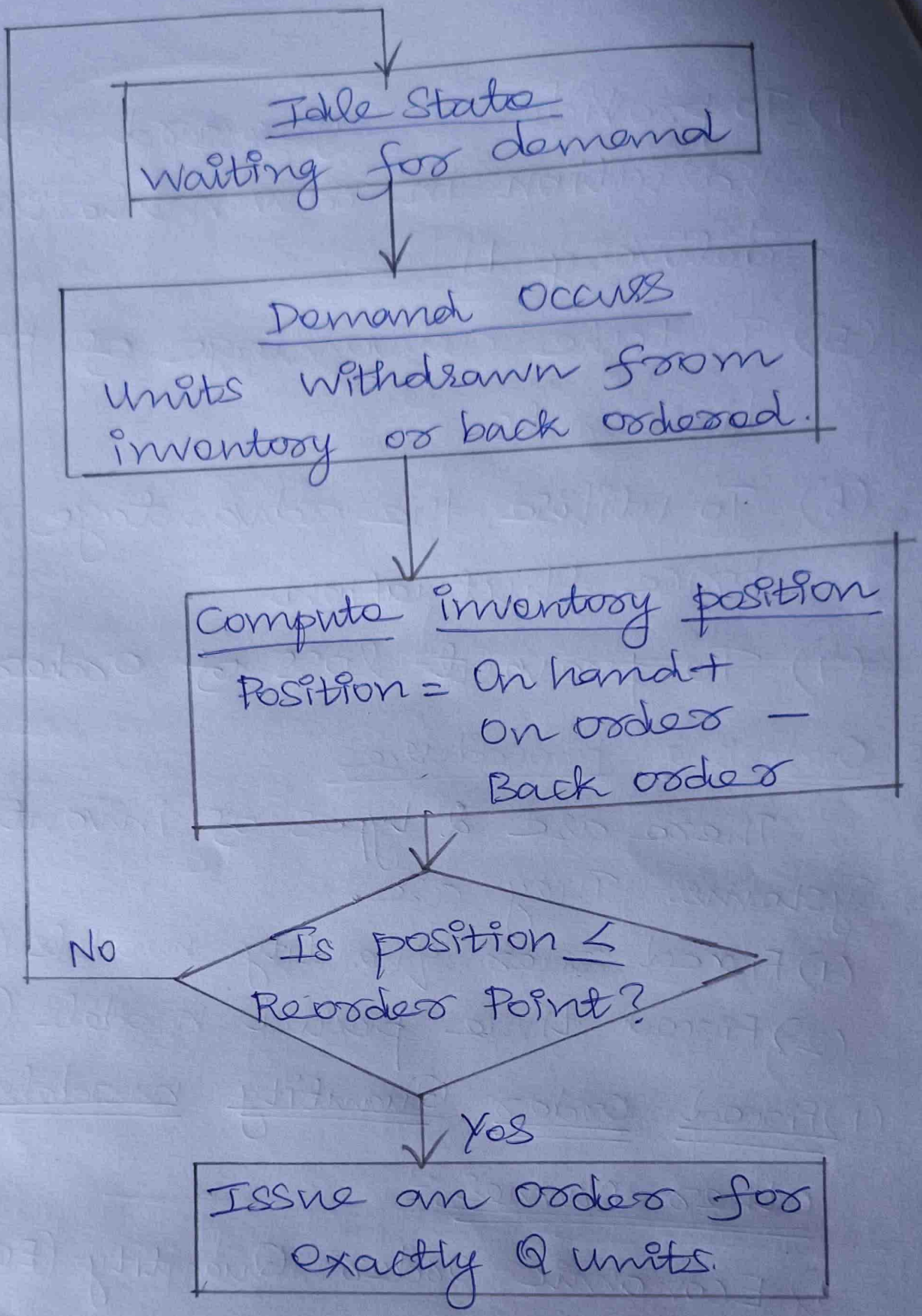


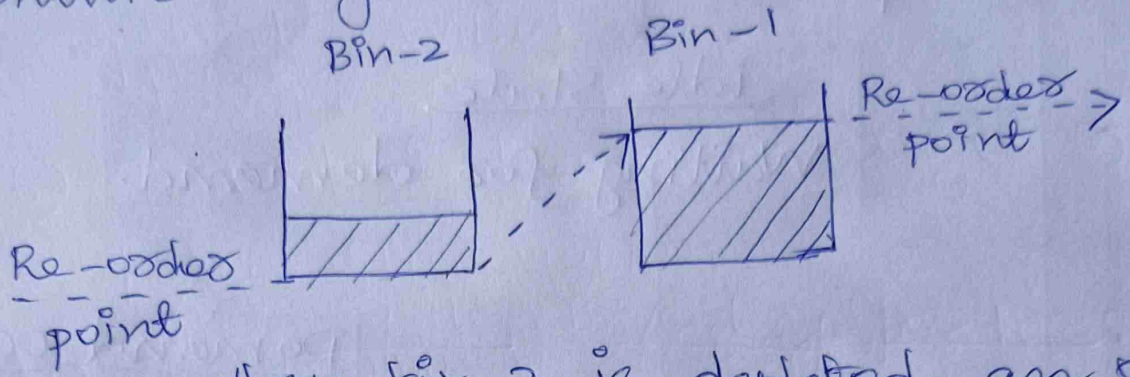
Fig. 5.1 Q-System procedure

Two bin System - Application of Q Model

Other Name → Min - Max System.

In the two bin system, the

physical inventory of any item is placed in 2 seperate lots called bins. Consider two bins (Bin-1 & Bin-2) as shown in Fig. 5.2.



When bin-2 is depleted, an order is placed. When a replenishment order is received, bin-1 is filled to the re-order point level and remainder of the order is placed in bin-2. If bin-1 is at the re-order point level, all of the incoming items are placed in bin-2. When bin-2 is emptied, a new order is placed.

(2) Fixed Time period Models

Other Names → (1) Periodic Systems
(2) Periodic review Systems
(3) Fixed order interval System
(4) P model

In a fixed-time period system periodic review of inventories are made and an order is invariably placed in that period.

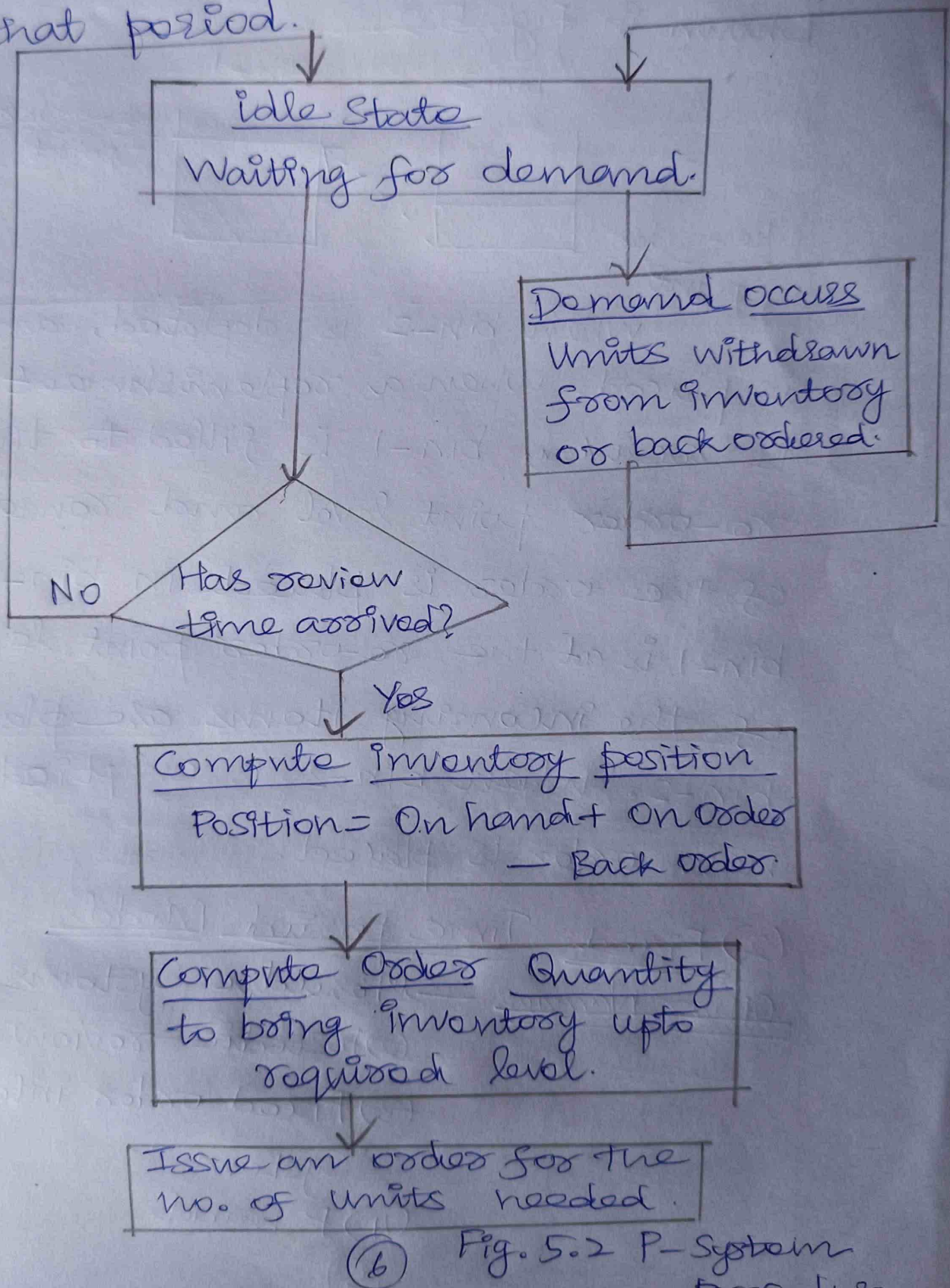


Fig. 5.2 P-System Procedure

5.4. Effect of demand on inventories

In order to realise the dynamics and significance of inventory management, the effects of demand fluctuations on the desirable levels of stocks has to be understood.

Whenever supply and demand are linked together in several stages, the o/p of one constitutes the i/p to another. Thus any demand variation for finished goods at the end of the production line triggers off a chain reaction, and the effect is amplified as the wave travels along the line. These effects can be reduced:

(i) by selection of an appropriate % age of safety stock.

(ii) By proper directives in the stock control system.

(iii) By reduction of the no. of links in the chain.

5.5 Determination of Economic Order Quantity (EOQ) and economic lot size

The amount of material procured or quantity produced during one production cycle is known as order Quantity or lot size.

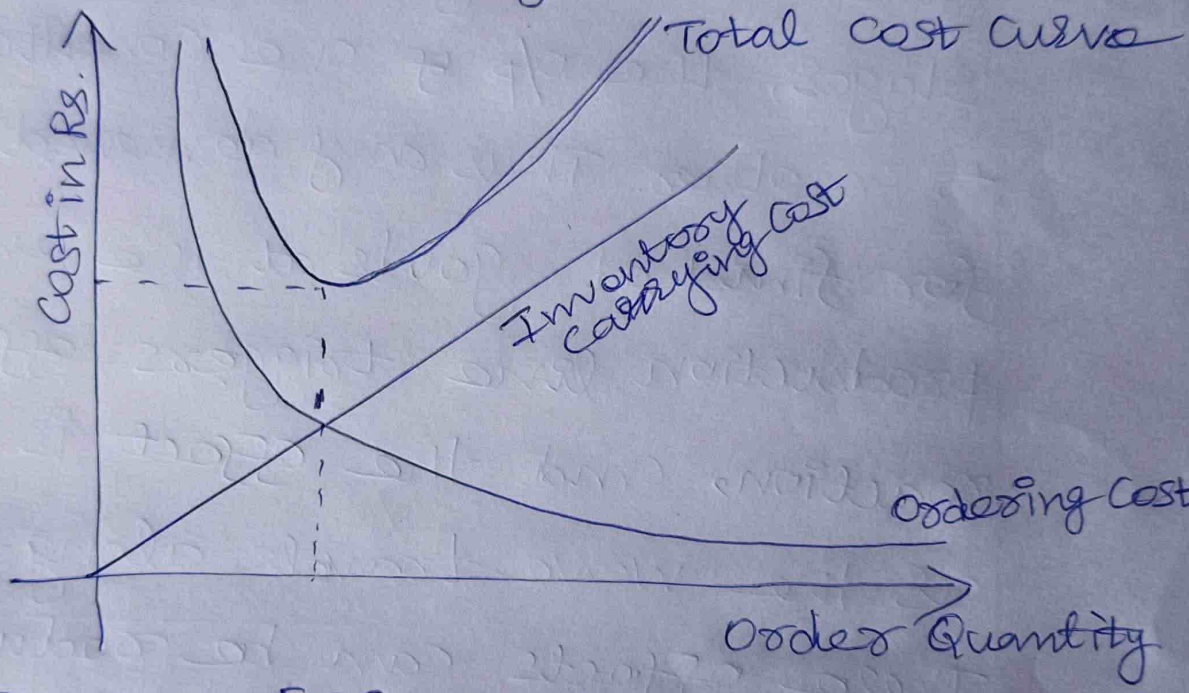


Fig. 5.3. EOQ graph.

EOQ is that size of order which minimises the total costs of carrying inventory and ordering.

$$EOQ = \sqrt{\frac{2 \cdot D \cdot S}{H}}$$

D → Annual demand in units/year

S → Ordering cost/order

H → Annual holding cost/unit

5.b **ABC Analysis**

* The most widely used method of inventory control is known as ABC analysis.
* ABC analysis is a technique which is used to classify the items in stores into A, B and C class items based on demand of the stock.
* "A" or the highest value items should be under tight control and under responsibility of the most experienced personnel, while "C" or the lowest value may be under simple physical control.

Category of item	Consumption Value	% of items	% of Usage Value
class A	High	10 to 20%	70 to 80%
class B	Medium	20 to 30%	15 to 20%
class C	Low	60 to 70%	5 to 10%

5.7. Introduction to Computer integrated Production Planning Systems

With the advances both in computer software and hardware, certain manufacturing decisions presently are taken with the help of computer in efficient manner. With a suitable computerised production planning and control system, top management is generally able to get timely information of o/p of shop floor.

Some of the common manufacturing subsystem that completes a PPC systems include:

1. Product - structure processor
2. Material requirement

3. Product Costing System
4. Inventory management System
5. Master production Scheduling System
6. Capacity planning System
7. Shop floor control and monitoring System etc.

5.8. Elements of Just In Time (JIT) Systems

JIT is System in Operation management under which the production is made as per the demand at a particular moment.

Objectives of JIT

(1) To be more responsive to customers
(2) To be more flexible.

(3) To have better communication among departments and Suppliers.

(4) To achieve better quality

(5) To reduce product cost.

Waste :-

* Any activity that does not add value to the product or service in the eyes of the customer is a waste.

* Types of Waste

(1) Waste of overproduction
(2) Waste of waiting
(3) Waste of movement
(4) Waste of inventories
(5) Waste of motion
(6) Waste of making defects
(7) Waste of process itself.

Basic elements of JIT :-

(1) Flow layout
(2) Smooth built up rate
(3) Mixed model scheduling
(4) Buffer Stock removal
(5) Quality
(6) Product & process simplification
(7) Standard Containers
(8) Preventive maintenance
(9) Flexible work force
(10) Organisation in modules or cells
(11) Continuous improvement

5.9. Fundamentals of MRP-II

Manufacturing resource planning - II (MRP-II) is defined as a method for the effective planning of all resources of a

manufacturing company.

Structure of MRP-II

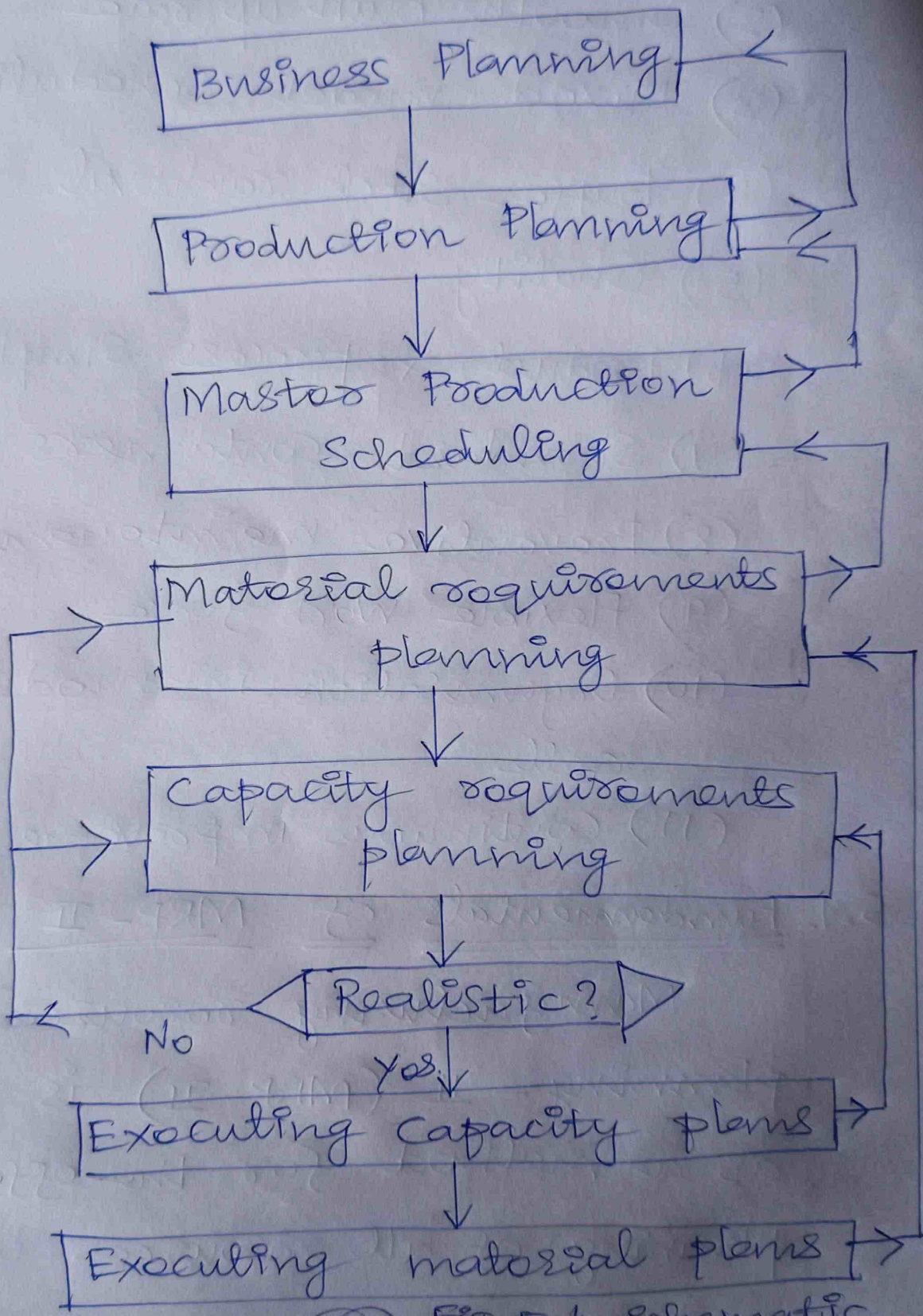


Fig. 5.4 Schematic diagram of MRP-II

Benefits of MRP-II in Engineering, Finance & Costing

(1) Better Control of inventories
(2) Improved Scheduling
(3) productive relationship with Suppliers
(4) Improved design control
(5) Better quality & quantity Control
(6) Reduced working Capital for inventory
(7) Improved cash flow through quicker deliveries
(8) Accurate inventory records.

5.10 Enterprise Resource Planning (ERP)

ERP is defined as an accounting oriented information system for identifying and planning the enterprise-wide resources to make, ship and account for

Customers orders.

ERP implementation :-

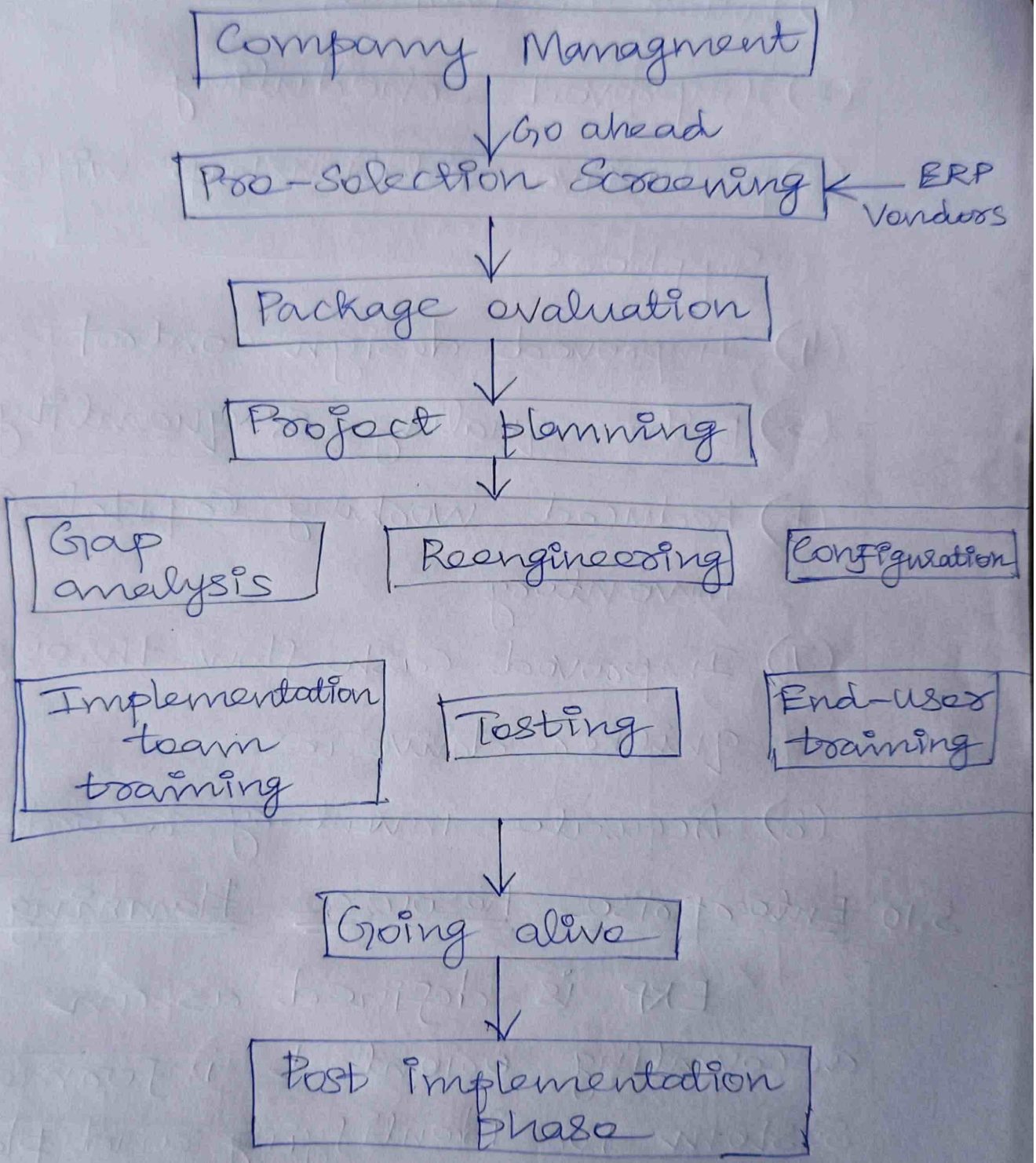


Fig. 5.5. Different phases in ERP implementation life cycle

ERP Characteristics

(1) Flexibility
(2) Modular and open
(3) Comprehensive
(4) Beyond the Company
(5) Best Business practices.

ERP Packages in India

(1) SAP
(2) Oracle Financials
(3) Mfg/Pro
(4) JD Edwards
(5) BPCS
(6) MAMIS
(7) BaaN
(8) Marshal

Advantages of ERP implementation

(1) Efficiency
(2) Integrated information

(3) Reporting

(4) Customer Service

(5) Security