COURSE MATERIAL

IV Year B. Tech II- Semester

MECHANICAL ENGINEERING

PRODUCTION PLANNING&CONTROL

(R15A0340)

MALLA REDDY COLLEGE OF ENGINEERING & TECHNOLOGY

DEPARTMENT OF MECHANICAL ENGINEERING

(Autonomous Institution-UGC, Govt. of India)
Secunderabad-500100,Telangana State, India.
www.mrcet.ac.in

MALLA REDDY COLLEGE OF ENGINEERING & TECHNOLOGY

(Autonomous Institution – UGC, Govt. of India)

DEPARTMENT OF MECHANICAL ENGINEERING

CONTENTS

MALLA REDDY COLLEGE OF ENGINEERING & TECHNOLOGY

(Autonomous Institution – UGC, Govt. of India)

VISION

- To establish a pedestal for the integral innovation, team spirit, originality and competence in the students, expose them to face the global challenges and become technology leaders of Indian vision of modern society.

MISSION

- To become a model institution in the fields of Engineering, Technology and Management.
- To impart holistic education to the students to render them as industry ready engineers.
- To ensure synchronization of MRCET ideologies with challenging demands of International Pioneering Organizations.

QUALITY POLICY

- To implement best practices in Teaching and Learning process for both UG and PG courses meticulously.
- To provide state of art infrastructure and expertise to impart quality education.
- To groom the students to become intellectually creative and professionally competitive.
- To channelize the activities and tune them in heights of commitment and sincerity, the requisites to claim the never - ending ladder of **SUCCESS** year after year.

For more information: www.mrcet.ac.in

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Department of Mechanical Engineering

VISION

To become an innovative knowledge center in mechanical engineering through state-of-the-art teaching-learning and research practices, promoting creative thinking professionals.

MISSION

The Department of Mechanical Engineering is dedicated for transforming the students into highly competent Mechanical engineers to meet the needs of the industry, in a changing and challenging technical environment, by strongly focusing in the fundamentals of engineering sciences for achieving excellent results in their professional pursuits.

Quality Policy

- ✓ To pursuit global Standards of excellence in all our endeavors namely teaching, research and continuing education and to remain accountable in our core and support functions, through processes of self-evaluation and continuous improvement.
- ✓ To create a midst of excellence for imparting state of art education, industry-oriented training research in the field of technical education.

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Department of Mechanical Engineering

PROGRAM OUTCOMES

Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and teamwork**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1 Ability to analyze, design and develop Mechanical systems to solve the Engineering problems by integrating thermal, design and manufacturing Domains.

PSO2 Ability to succeed in competitive examinations or to pursue higher studies or research.

PSO3 Ability to apply the learned Mechanical Engineering knowledge for the Development of society and self.

Program Educational Objectives (PEOs)

The Program Educational Objectives of the program offered by the department are broadly listed below:

PEO1: PREPARATION

To provide sound foundation in mathematical, scientific and engineering fundamentals necessary to analyze, formulate and solve engineering problems.

PEO2: CORE COMPETANCE

To provide thorough knowledge in Mechanical Engineering subjects including theoretical knowledge and practical training for preparing physical models pertaining to Thermodynamics, Hydraulics, Heat and Mass Transfer, Dynamics of Machinery, Jet Propulsion, Automobile Engineering, Element Analysis, Production Technology, Mechatronics etc.

PEO3: INVENTION, INNOVATION AND CREATIVITY

To make the students to design, experiment, analyze, interpret in the core field with the help of other inter disciplinary concepts wherever applicable.

PEO4: CAREER DEVELOPMENT

To inculcate the habit of lifelong learning for career development through successful completion of advanced degrees, professional development courses, industrial training etc.

PEO5: PROFESSIONALISM

To impart technical knowledge, ethical values for professional development of the student to solve complex problems and to work in multi-disciplinary ambience, whose solutions lead to significant societal benefits.

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Department of Mechanical Engineering

Blooms Taxonomy

Bloom's Taxonomy is a classification of the different objectives and skills that educators set for their students (learning objectives). The terminology has been updated to include the following six levels of learning. These 6 levels can be used to structure the learning objectives, lessons, and assessments of a course.

1. **Remembering**: Retrieving, recognizing, and recalling relevant knowledge from long- term memory.
2. **Understanding**: Constructing meaning from oral, written, and graphic messages through interpreting, exemplifying, classifying, summarizing, inferring, comparing, and explaining.
3. **Applying**: Carrying out or using a procedure for executing or implementing.
4. **Analyzing**: Breaking material into constituent parts, determining how the parts relate to one another and to an overall structure or purpose through differentiating, organizing, and attributing.
5. **Evaluating**: Making judgments based on criteria and standard through checking and critiquing.
6. **Creating**: Putting elements together to form a coherent or functional whole; reorganizing elements into a new pattern or structure through generating, planning, or producing.

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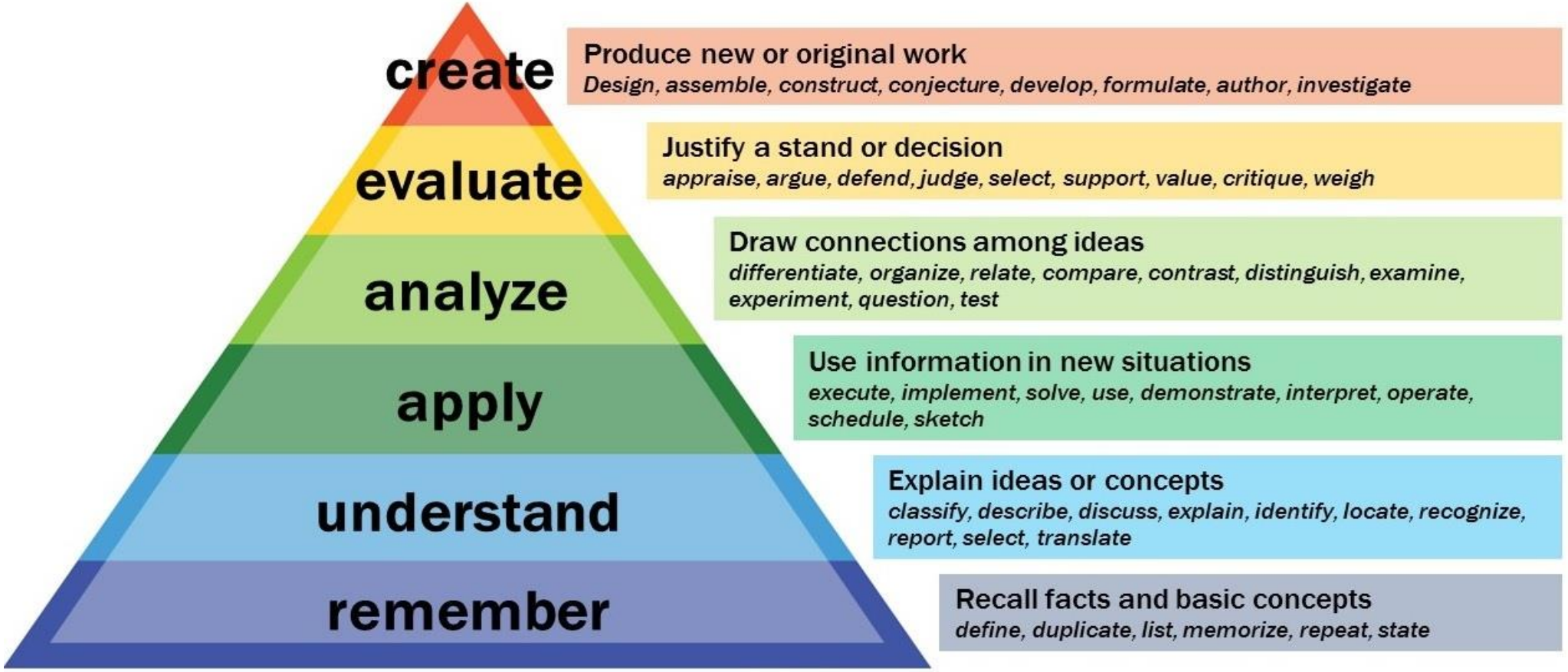
Department of Mechanical Engineering



COURSE SYLLABUS

MALLA REDDY COLLEGE OF ENGINEERING & TECHNOLOGY

IV Year B. Tech, ME-II Sem

L	T/P/D	C
5	1	4

(R15A0340) PRODUCTION PLANNING AND CONTROL
(CORE ELECTIVE – V)

Objectives:

- The objective of this subject is to provide knowledge of Planning and control of Industry.
- Able learn about different forecasting techniques.
- Able learn about Inventory Management.

UNIT –I

Introduction : Definition – Objectives of production Planning and Control – Functions of production planning and control – Elements of production control – Types of production – Organization of production planning and control department – Internal organization of department.

UNIT –II

Forecasting: Importance of forecasting – Types of forecasting, their uses – General principles of forecasting – Forecasting techniques – qualitative methods and quantitive methods.

UNIT –III

Inventory management: Functions of inventories – relevant inventory costs – ABC analysis – VED analysis – EOQ model – Inventory control systems – P–Systems and Q-Systems, Introduction to MRP & ERP, LOB (Line of Balance), JIT inventory, and Japanese concepts.

UNIT –IV

Routing : Definition –Routing procedure –Route sheets – Bill of material – Factors affecting routing procedure. Schedule –definition – Difference with loading, Scheduling Policies – Techniques, Standard scheduling methods. Job shop, flow shop

UNIT –V

Line Balancing: Aggregate planning, Chase planning, Expediting, controlling aspects. Dispatching – Activities of dispatcher – Dispatching procedure – follow-up – definition – Reason for existence of functions – types of follow-up, applications of computer in production planning and control.

TEXT BOOKS:

1. Elements of Production Planning and Control / Samuel Eilon / Macmillan Publishers
2. Modern Production and operation managements / Baffa & Rakesh Sarin / John Wiley Publishers
3. Operations Management / Joseph Monks / McGraw-Hill Ryerson Publishers

REFERENCE BOOKS:

1. Operations Management / S.N. Chary/ TMH Publishers
2. Reliability Engineering & Quality Engineering / Dr. C. Nadha Muni Reddy and Dr. K.Vijaya Kumar Reddy / Galgotia Publications, Pvt., Limited.
3. Production Control A Quantitative Approach / John E. Biegel/ Prentice-Hall

OUTCOMES:

- Student should be able to understand the co-ordination between Production, Planning and control systems in manufacturing.
- Student should know about line balancing.
- Student should know about routing and scheduling.

UNIT 1

INTRODUCTION

Course objective

The objective of this unit is to provide basic knowledge of Planning and control of Industry.

Course Outcome

Student should be able to understand the co-ordination between Production, Planning and control systems in manufacturing.

Introduction : Definition – Objectives of production Planning and Control – Functions of production planning and control – Elements of production control – Types of production – Organization of production planning and control department – Internal organization of department.

Objectives of the Unit

a) The meaning of production system

b) Various types of production systems

c) Different types of manufacturing processes

d) Concept of production planning and control in any manufacturing organization

e) Factors affecting production planning and control decisions

f) Scope of production planning and control

Introduction

Production Planning is a managerial function which is mainly concerned with the following important issues:

What production facilities are required?

How these production facilities should be laid down in the space available for production?

And how they should be used to produce the desired products at the desired rate of production?

Broadly speaking, production planning is concerned with two main aspects:

(i) routing or planning work tasks
(ii) Layout or spatial relationship between the resources.

Production planning is dynamic in nature and always remains in fluid state as plans may have to be changed according to the changes in circumstances.

Production control is a mechanism to monitor the execution of the plans.

It has several important functions:

- Making sure that production operations are started at planned places and planned times.
- Observing progress of the operations and recording it properly.
- Analysing the recorded data with the plans and measuring the deviations.
- Taking immediate corrective actions to minimize the negative impact of deviations from the plans.
- Feeding back the recorded information to the planning section in order to improve future plan

OBJECTIVES AND BENEFITS

• Minimize costs / maximize profits
• Maximize customer service
• Minimize inventory investment
• Minimize changes in production rates
• Minimize changes in work-force levels
• Maximize the utilization of plant and equipment

FUNCTIONS OF PRODUCTION CONTROL

• Production function encompasses the activities of procurement, allocation and utilization of resources.
• The main objective of production function is to produce the goods and services demanded by the customers in the most efficient and economical way.

• Therefore efficient management of the production function is of utmost importance in order to achieve this objective.

Definition of Production Planning and control

Production planning and control involves generally the organization and planning of the manufacturing process. Specifically, it consists of the planning of the routing, scheduling, dispatching and inspection, co-ordination and the control of materials, methods, and machines, tooling and operating times.

Production planning and control is a predetermined process which includes the use of human resource, raw materials, machines etc. PPC is the technique to plan each and every step in a long series of separate operation. It helps to take the right decision at the right time and at the right place to achieve maximum efficiency.

The objectives of PPC are as follows:

1. To ensure safe and economical production process
2. To effectively utilize plant to maximize productivity
3. To maximize efficiency by proper coordination in production process
4. To ensure proper delivery of goods
5. To place the right man for the right job, at right time for right wages.
6. To minimize labour turnover
7. To reduce the waiting time

Functions of production planning and control:

(i) Systematic planning of production activities to achieve the highest efficiency in production of goods/services.

(ii) To organize the production facilities like machines, men, etc., to achieve stated production objectives with respect to quantity and quality time and cost.

(iii) Optimum scheduling of resources.

(iv) Coordinate with other departments relating to production to achieve regular balanced and uninterrupted production flow.

(v) To conform to delivery commitments.

(vi) Materials planning and control.

(vii) To be able to make adjustments due to changes in demand and rush orders.

MAIN ELEMENTS OF PRODUCTION PLANNING & CONTROL

The following are main elements of Production Planning and Control.

1. Routing
2. Loading
3. Scheduling
4. Dispatching
5. Follow up
6. Inspection
7. Corrective

1. Routing

It is about selection of path or route through which raw materials pass in order to make it into a finished product. The points to be noted while routing process are – full capacity of machines, economical and short route and availability of alternate routing. Setting up time for the process for each stage of route is to be fixed. Once overall sequence are fixed, then the standard time of operations are noted using work measurement technique.

2.&3. Loading and scheduling

Loading and Scheduling are concerned with preparation of workloads and fixing of starting and completing date of each operation. On the basis of the performance of each machine, loading and scheduling tasks are completed.

According to Kimball and Kimball, **scheduling** is defined as the determination of the time that should be required to perform the entire series as routed, making allowance for all factors concerned.

4. Dispatching

Dispatching is the routine of setting productive activities in motion through the release of orders and instructions, in accordance with previously planned time and sequence, embodied in route sheet and schedule charts. It is here the orders are released.

5. Expediting / Follow-up

It is a control tool which brings an idea on breaking up, delay, rectifying error etc., during the progress of work.

6. Inspection

Inspection is to find out the quality of executed work process.

7. Corrective

At evaluation process, a thorough analysis is done and corrective measures are taken in the weaker spots.

STAGES OF PRODUCTION PLANNING & CONTROL

Production Planning & Control is done in three stages namely,

- Pre-planning
- Planning
- Control.

Stage 1: Pre-Planning

Under this phase of production planning, basic ground work on the product design, layout design and work flow are prepared. The operations relating to the availability scope and capacity of men, money materials, machines, time are estimated.

Stage 2: Planning

This is a phase where a complete analysis on routing, estimating and scheduling is done. It also tries to find out the areas of concern for short time and long-time so that prominent planning can be prepared.

Stage 3: Control

Under this phase, the functions included are dispatching, follow up, inspection and evaluation. It tries to analyse the expedition of work in progress. This is one of the important phases of the Production Planning and Control.

Types of Production:

There are 4 different types of productions which are most commonly used.

The type of production should be used by the company depends on the type of product being manufactured, the demand of the product as well as the supply of raw materials.

Taking these factors into consideration, below are the 4 types of Production.

1) Unit or Job type of production

This type of production is most commonly observed when you produce one single unit of a product. A typical example of the same will be tailored outfits which are made just for you or a cake which is made just like you want it.

Example of Unit type of production

It is one of the most common types of products used because it is generally used by small businesses like restaurants, individual products providers or individual services providers.

It is also a type of production used by very premium companies like Harley Davidson, or Dell. Harley Davidson actually has a lot of accessories which can be customized, and which suit the individual. Same ways, you can design your own DELL laptop on their website with the given specifications.

Features of Unit production or Job Production

- Depends a lot on skill
- Dependency is more on manual work than mechanical work
- Customer service and customer management plays and important role

2) Batch type of Production

It is one of the types of production most commonly used in consumer durables, FMCG or other such industries where there are large variety of products with variable demands. Batch production takes place in batches. The manufacturer already knows the number of units he needs to a manufacturer and they are manufactured in one batch.

So, if a manufacturer has the shortage of Product X and 100 units of this product is consumed in one month, then the manufacturer can give orders or batch production of 100 units of Product X.

Example of Batch production

LG has many different types of home appliance products in its portfolio. It has to manufacture all these different variants of the same type of product. There would be 10-20 types of mixer grinders alone in the product portfolio of LG home appliances. Thus, a company like LG manufactures these variants via Batch production.

First, one type of mixer will be manufactured completely and then the second type will be manufactured. They are manufactured on the basis of demand. Depending on demand, the batch production can produce the number of units required in one batch.

The batches may be as small as 10 units or they may be as large as 1 lakh units of the same products. However, as long as there is a defined quantity of product which has to be manufactured before moving on to the next item in the list, it is known as batch production. Examples of batch production include FMCG like Biscuits, confectionaries, packaged food items etc. It is used in Medicines, Hardware, Consumer durables and many such industries.

Features of Batch production

- Production is done in batches
- The total number of units required is decided before the batch production starts
- Once a batch production starts, stopping it midway may cost a huge amount to the company.
- Demand plays a major role in a batch production. Example – seasonality of products.

3) Mass Production or Flow production

One of the best examples of mass production is the manufacturing process adopted by Ford. Mass production is also known as flow production or assembly line production. It is one of the most common types of products used in the automobile industry and is also used in industries where continuous production is required.

An Assembly line or mass production plant typically focus on specialization. There are multiple workstations installed and the assembly line goes through all the workstations turn by turn. The work is done in a specialized manner and

each workstation is responsible for one single type of work. As a result, these workstations are very efficient and production due to which the whole assembly line becomes productive and efficient.

Products which are manufactured using mass production are very standardized products. High sophistication is used in the manufacturing of these products. If 1000 products are manufactured using mass production, each one of them should be exactly the same. There should be no deviation in the product manufactured.

Features of Mass Production

- Mass production is generally used to dole out huge volumes of the product
- It is used only if the product is standardized
- Demand does not play a major role in a Mass production. However, production capacity determines the success of a mass production.
- Mass production requires huge initial investment and the working capital demand is huge too.

4) Continuous production or Process production

There is a lot of confusion between mass production and continuous production. It can be differentiated by a single element. The amount of mechanical work involved. In Mass production, both machines and humans work in tandem. However, in continuous production, most of the work is done by machines rather than humans. In continuous production, the production is continuous, 24×7 hours, all days in a year.

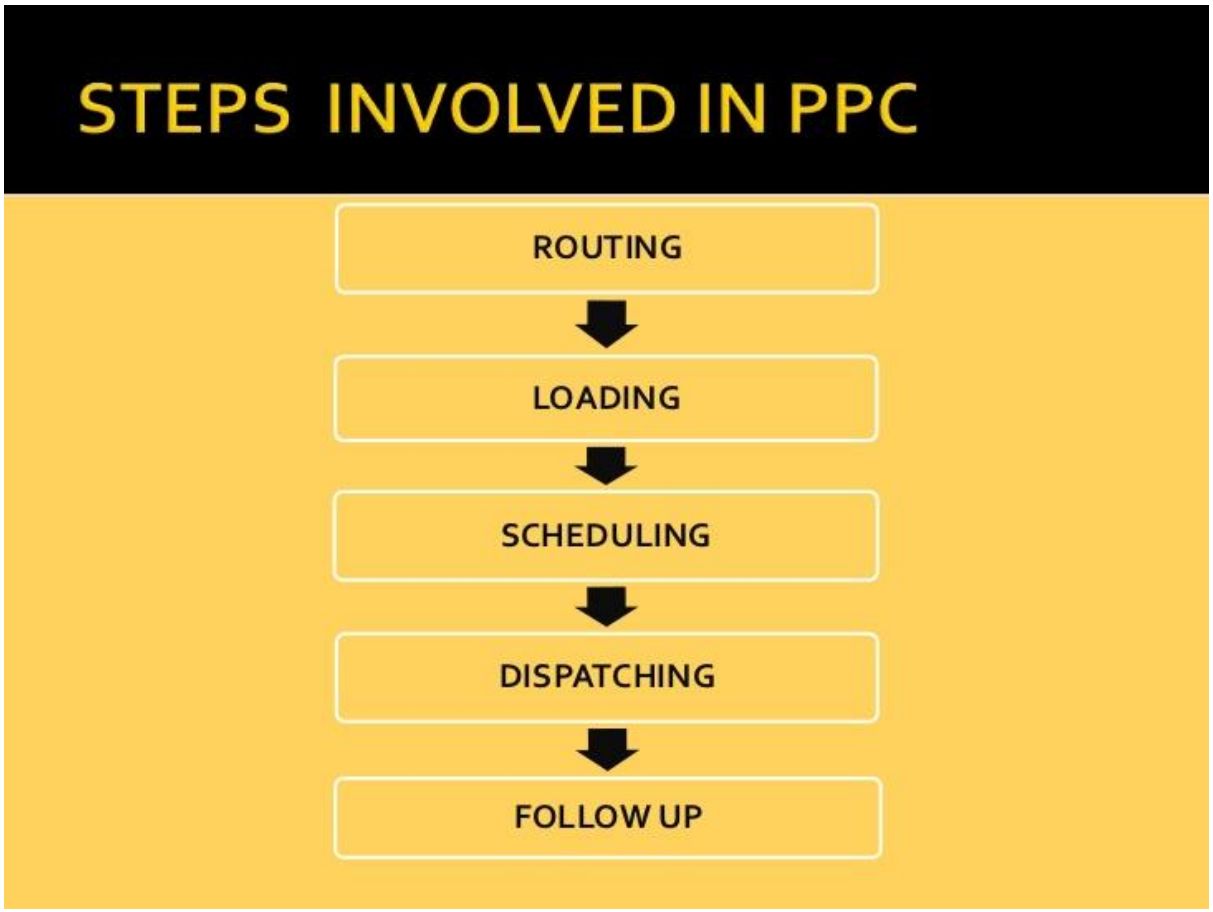
A good example of the Continuous production is brewing. In brewing, the production goes on 24 hours a day and 365 days a year. This is because brewing takes a lot of time and production is important. As a result, there is a continuous input of raw materials such as malt or water, and there is continuous output in the form of beer or other alcoholic drink. The key factor in this is that the brewing and fermentation process itself is time-consuming, and the maximum time is spent in the fermentation which is a continuous process.

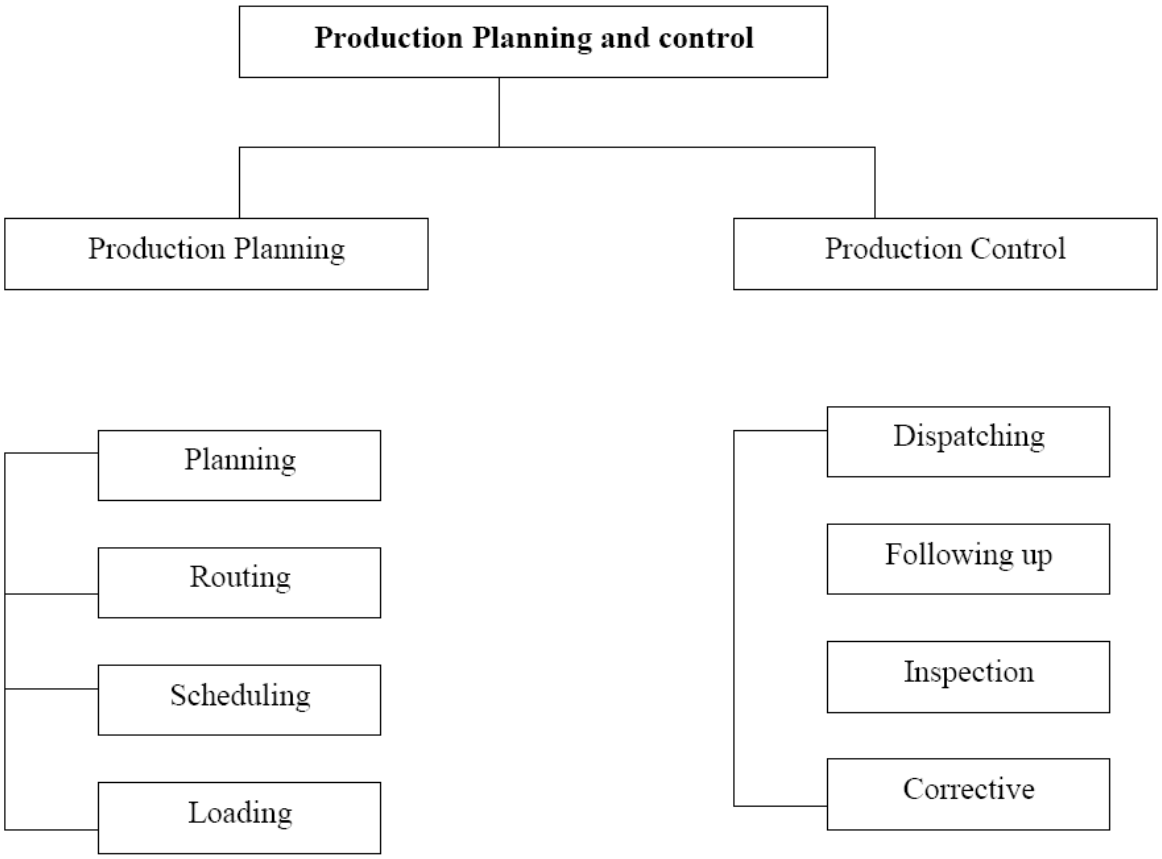
There are many chemicals which are manufactured in the form of a continuous process due to the huge demand across the world. Similarly, the Plastic industry is known to adopt the continuous production methodology where production can go continuously for weeks or months depending on the demand. Once the production starts, you only need to feed in the raw material, and the machines turn out the finalized products.

Features of Continuous production

- Majority of the work is done by machines rather than humans
- Work is continuous in nature. Once production starts, it cannot be stopped otherwise it will cause huge loss.
- A very controlled environment is required for continuous production.

Organization of production planning and control



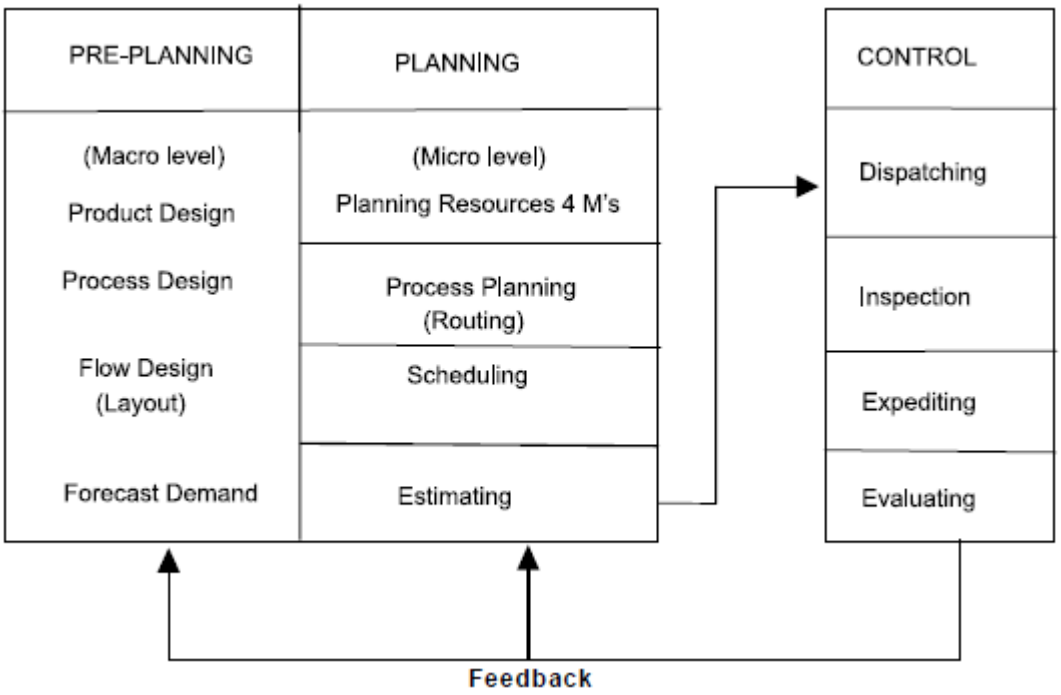


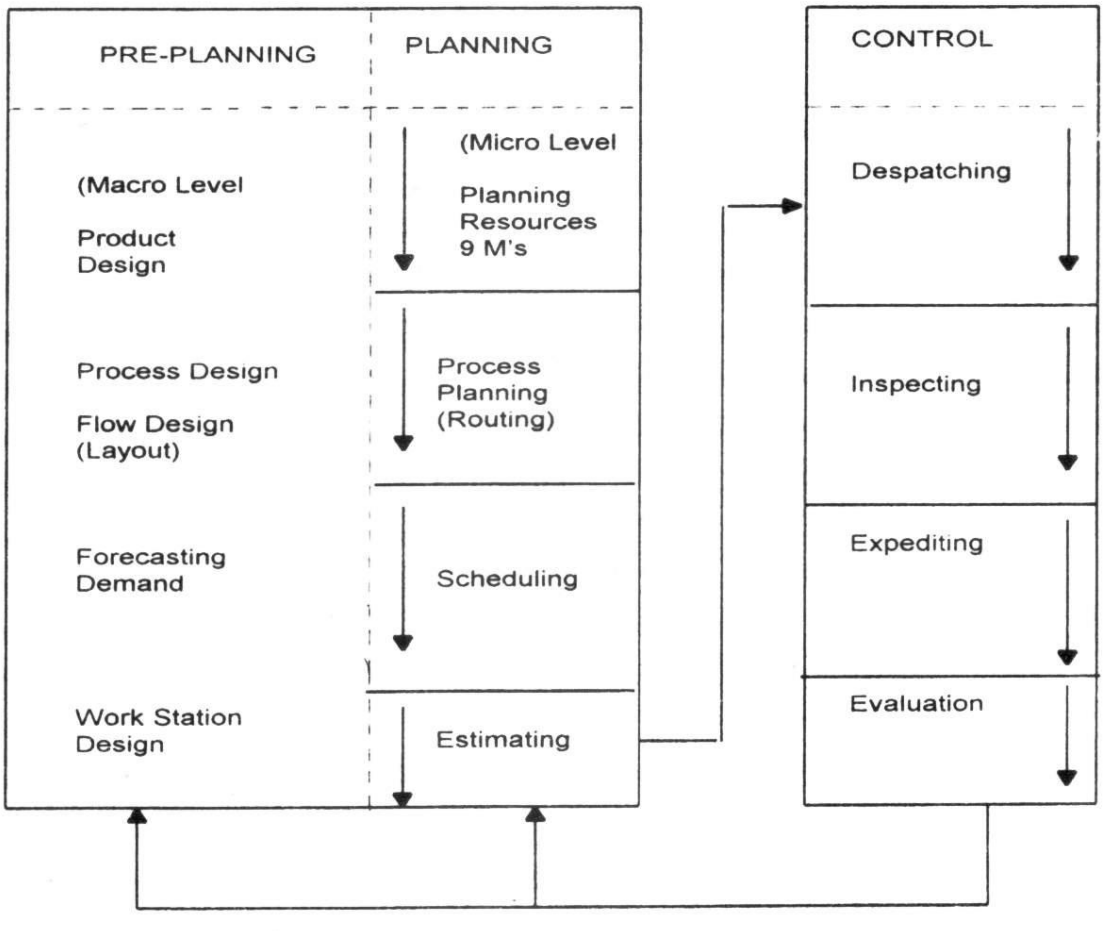
Production Planning and Control

ORGANISATION CHART FOR P.P.C. DEPARTMENT

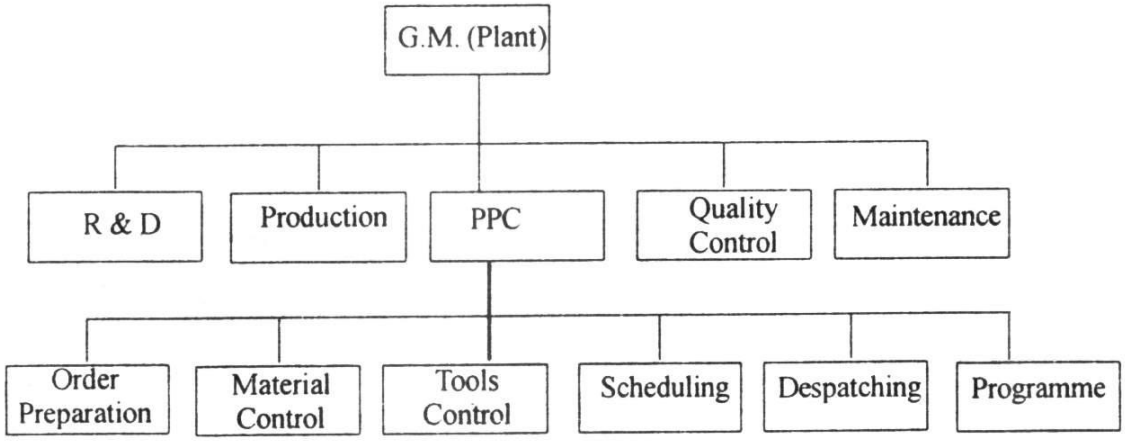
P.P.C.

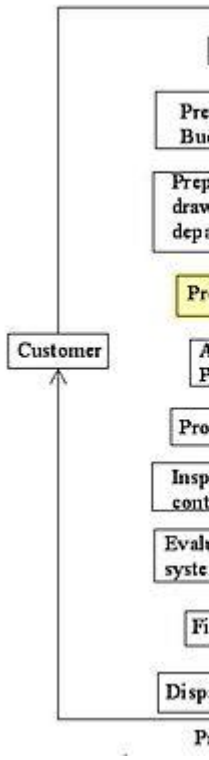
Production Planning	Production Control	Inventory Control
• Order Booking	• Despatching	• Stores management
• Production budget		
• Material Records	• Expediting	• Quality Control
• Methods		
• Machines		• Handling
		• Receiving
• Tools and Jigs		
• Operation Layout		• Simplification
• Time estimating		• Standardisation
• Scheduling		


PRE-PLANNING
PLANNING
CONTROL
(Macro level)
Product Design
Process Design
Flow Design
(Layout)
Forecast Demand
(Micro level)
Planning Resources 4 M's
Process Planning
(Routing)
Scheduling
Estimating
Dispatching
Inspection
Expediting
Evaluating
Feedback


PRE-PLANNING
PLANNING
CONTROL
(Macro Level
Product
Design
Process Design
Flow Design
(Layout)
Forecasting
Demand
Work Station
Design
(Micro Level
Planning
Resources
9 M's
Process
Planning
(Routing)
Scheduling
Estimating
Despatching
Inspecting
Expediting
Evaluation

Department Internal organization of department:





Short Answer Questions

1. What are the functions of PPC?
2. What is batch production?
3. What is continuous production?
4. What is job order production
5. What are the objectives of PPC?
6. List out the various functions of production planning and control.
7. What are the needs for PPC?
8. List out the various functions of production planning and control
9. What are the needs for PPC?

Long Answer Questions

1. Explain in details the pre-requisites of the PPC in the form of various types of data
2. Explain the scope of production planning and control.
3. Explain different types of production systems and differentiate between them.
4. Describe the functions of Production planning and control.
5. State the purpose of a manufacturing organization in an industry. Give a typical organization structure of a manufacturing organization.
6. Explain the relationship between 'Production planning' and 'control'.
7. Describe the activities in follow up or control phase of PPC.
8. Describe in brief, planning in manufacture organization.
9. Define production planning. State its objectives. List the information required for production planning.
10. State the advantages of better Production planning and control.
11. Name the various types of production systems. Describe the production system suitable for job work.
12. Explain the scope of production planning and control.
13. Explain different types of production systems and differentiate between them

The following details will bring out the objectives of production planning and production control:

Production Planning:

1. To determine the requirements for men, materials and equipment.

2. Production of various inputs at a right time and in right quantity.

3. Making most economical use of various inputs.

4. Arranging production schedules according to the needs of marketing department.

5. Providing for adequate stocks for meeting contingencies.

6. Keeping up-to-date information processes.

Production Control:

1. Making efforts to adhere to the production schedules.

2. Issuing necessary instructions to the staff for making the plans realistic.

3. To ensure that goods produced according to the prescribed standards and quality norms.

4. To ensure that various inputs are made available in right quantity and at proper time.

5. To ensure that work progresses according to the predecided plans.

Characteristics of Production Planning and Control

1. It is the planning and control of manufacturing process in an enterprise. The questions like—What is to be manufactured? When it is to be manufactured? How to keep the schedule of production etc.? —are decided and acted upon for getting good results.

2. All types of inputs like materials, men, machines are efficiently used for maintaining efficiency of the manufacturing process.

3. Various factors of production are integrated to use them efficiently and economically.

4. The manufacturing process is organized in such a way that none of the work centres is either overworked or under worked. The division of work is undertaken very carefully so that every available element is properly utilized.

5. The work is regulated from the first stage of procuring raw materials to the stage of finished goods.

UNIT 1

POWER POINT PRESENTATION

PRODUCTION PLANNING AND CONTROL

DEPARTMENT OF MECHANICAL ENGINEERING

PRODUCTION PLANNING

Meaning:-

Production planning involves management decisions on the resources that the firm will require for its manufacturing operations and the selection of these resources to produce the desired goods at the appropriate time and at the least possible cost.

Definition:-

"The planning of industrial operations involves four considerations, namely, what work shall be done, how the work shall be done and lastly, when the work shall be done - kimball and kimball

Need/Importance of Production Planning and Control

For Increasing Production:- *The main purpose of production planning, function is to arrange various inputs like men, materials and machines and integrating them for making their best use. When various factors of production are economically used then production will certainly go up. Efforts are made to avoid production stoppages for want of various inputs. A production control Programme will minimize the idleness of men and machines.*

For Co-coordinating Plant Activity: - *Production planning helps in controlling plant activities. Production targets are set on the basis of sales forecasts. The raw materials, men and equipment are arranged by keeping in view production plans. Different production activities are adjusted as per the plans. If production is carried out in a number of processes then their activities are synchronized for smooth working*.

OBJECTIVES OF PRODUCTION PLANNING

1. To determine the requirements of men, material and equipment.
2. Arranging production schedules according to the needs of marketing demand.
3. Arranging various inputs at a right time and in right quantity.
4. Making most economical use of various inputs.
5. To achieve coordination among various departments relating to production.
6. To make all arrangements to remove possible obstacles in the way of smooth production.
7. To achieve economy in production cost and time.
8. To operate plant at planned level of efficiency.
9. Making efforts to achieve production targets in time.
10. Providing for adequate stocks for meeting contingencies.

PRODUCTION CONTROL

Meaning:-

Production control guides and directs flow of production so that products are manufactured in a best way and conform to a planned schedule and are of the right quality.Control facilitates the task of manufacturing and see that every theme goes as per the plan.

Definition:-

"Production control refers to ensuring that all which occurs is in accordance with the rules established and instructions issued.“

-HENRY FAYOL

OBJECTIVES OF PRODUCTION CONTROL

1.To implement production plans by issuing orders to those who are supposed to implement them.
2.To ensure that various inputs like men, machine, materials etc. are available in the required quantity and quality.
3.Making efforts to adhere to the production schedules.
4.To ensure that goods are produced according to the prescribed standards and quality norms.
5.To undertake the best and most economic production policies.
6.To introduce a proper system of quality control.
7.To ensure rapid turnover of production and minimizing of inventories of raw materials and finished products

PRODUCTION PLANNING AND CONTROL

Meaning:-

Production planning and control is concerned with directing production along the lines set by the planning department.

Definition:-

"Production planning and control is the co-ordination of series of functions according to a plan which will economically utilize the plant facilities and regulate the orderly movement of goods through the entire manufacturing cycle from the procurement of all materials to the shipping of finished goods at a predetermined rate."

-CHARLES A. KOEPKE

CHARACTERISTICS OF PRODUCTION PLANNING AND CONTROL

1. It is the planning and control of manufacturing process in an enterprise.

2.Questions like-what is to be manufactured? when it is tobe manufactured? etc.

3.All types of inputs like materials,men,machines are efficiently used for maintaining efficiency of manufacturing process.

4.Various factors of production are integrated to use them efficiently and economically.

5.The manufacturing process is organised in such a way that none of the work centres is either overworked or under worked.

6.The work is regulated from the first stage of procuring raw materials to the stage of finished goods.

- ***For Cost Control: -*** *It helps in controlling various costs. In the absence of a proper production plan, the idleness of men, material and equipment may not be noticed. Whenever performance is below standards then corrective measures are taken to rectify it. A properly planned system of production will help in controlling costs by not only making full utilization of various inputs but also by increasing output and lowering overhead expenses per unit.*

- ***For Rationalisation of Production Activities: -*** *An important objective of production planning and control is also to regulate the flow of various inputs into the production system for running it smoothly. The system is planned in such a way that everything is done automatically. The supply of materials and men follows the demand for goods. The quality standards are followed in routine and sub-standard products are discarded in the processes. The process of entering of raw materials and converting them into finished*

- ***5. Consumers: -*** ***The consumer is ensured good quality goods. The process will help in raising quality standards of products. The supply of goods is also prompt and consumer has not to wait for them.Production schedules are prepared by keeping in mind the requirements of consumers. The supplies are regulated for meeting the demand for goods. The increase in production also helps the consumer in getting sufficient supply of goods.***

Limitations of production planning and control

1. ***Based on Assumptions: -*** ***Production planning and control is based on certain assumptions. In case the assumptions prove correct then the planning and control will go smoothly, otherwise it may not. The assumptions generally are about plant capacity, orders, availability of raw materials and power etc. if these assumptions go wrong then the process of planning and control will go weak.***

2. ***Rigidity: -*** ***Under production planning and control the things are pre-decided and fixed. There is rigidity in the behavior of employees and it may not help in smoothening the flow of work.***

3. ***Difficult for Small Firms: -*** ***This process is time consuming and small firms may not be able to make use of production planning and control.***

4. ***Costly: -*** ***It is a costly device as its implementation requires separate persons to perform the functions of planning, dispatching, expediting etc. Small firms cannot use the services of specialists due to cost factor.***

- ***Techniques or Elements of Production Planning and Control***
- ***The following are the techniques of production planning and control:***
  - ***A. Planning*** ***B.Routing***
- ***C. Scheduling*** ***D. Dispatching***
- ***E. Follow-up and Expediting*** ***F. Inspection***

Planning

- *It is the first element of production planning and control. Planning is given an important role in every business. A separate department is set up for this work. Planning is deciding in advance what is to done in future. Control devices are also decided in advance so that all activities are carried on properly. An organizational set up is created to prepare plans and policies. Various charts, manuals and production budgets are also prepared. If production planning is defective then control will also be defective. Planning provides a sound base for control.*

Routing

- *It is determining the exact path or routing which will be followed in production. The stages from which goods are to pass are decided after a proper thought. Routing may be compared to a train journey for reaching a particular place. If a passenger is to reach Delhi from Ambala Cantt then he has the option of going via Panipat and via Saharanpur. Both the routes will take him to Delhi. The question is – which route will be economical in time and money? The passenger will decide the route only after taking into consideration various factors affecting his journey. Similar is the case with production routing. It is the selection of the path from where each unit has to pass before reaching the final stage. The*

ROUTING PROCEDURE:-

- ***Deciding what part to be made or purchased: -*** ***The product is thoroughly analyzed to find out which parts are required for it. The second decision is taken regarding the production or purchase of various components. Some components may be manufactured by the firm and others may be procured from the market. During slack periods most of the components may be manufactured by the firm but when industrial activity is at its peak then supplies from outside may be contracted.***

- ***Determining Materials Required*****: -** ***The analysis of the product will enable us to know the type of materials required for producing various components. The right type of quality, quantity, and time when needed should also be decided in advance.***

- ***Determining Manufacturing Operations and Sequences: -*** *The manufacturing operations and their sequences can be determined from technical experience and layout of machines. A sound and economical operation is selected for manufacturing various components.*

- ***Determining of Lot Sizes: -*** *A decision has to be taken about the number of units to be produced in one lot. If production is carried on the basis of orders then size of the lot depends upon the quantity ordered plus some units for possible rejections during the process.*

- ***<u>Determining of Scrap Factors: -</u> There may be some scrap during the course of manufacture. The finished products are generally less then the units introduced at the beginning. The scrap during manufacturing should be anticipated so that routing is facilitated. If products pass through three processes and a normal scrap is 5% of input at every stage then it will be easy to anticipate the units entering various processes and arrange equipments, and manpower***

- ***Analysis of Cost of the Product: -*** *The determination of cost of products may be the duty of department but still production department makes records of direct materials, labour, direct and indirect expenses. These estimates are greatly useful to costing department also.*

- ***Preparation of Production Control Forms: -*** *The carrying out of routing will be facilitated if forms are prepared to collect information for control purpose. The requirements are: job cards, inspection cards, move tickets, labour cards, tool tickets, etc.*

SCHEDULING

- ***Scheduling is the determining of time and date when each operation is to be commenced and completed. it includes the scheduling of materials, machines and all other requisites of production.***
- ***Scheduling means" fitting specific jobs into a general time table so that order may be manufactured in accordance with contracted liability or in mass production, so that each component may arrive at and enter into assembly in the order and as is required."***
- ***-ALFORD AND BEATY***

TYPES OF SCHEDULES

- **Master scheduling**: *Scheduling starts with the master schedule. this schedule is prepared by keeping in view the order or likely sales order in near future. Master scheduling is the break up of production requirements. This may be prepared for a week, a fortnight, a month etc. No definite pattern may be suggested for master schedules because these may differ from industry to industry.*
- **Operation scheduling:** *Manufacturing or operation scheduling is used where production process is continuous. when same product is produced repeatedly or comparatively small number of products are required then operation schedules are useful. the name and number of the product and the quantity to be produced in a given time are required to prepare a manufacturing schedule.*
- **Detail operation scheduling:** *It indicated the time required to perform each and every detailed operations of a given machine or process.*

DESPATCHING

- ***The term dispatching refers to the process of actually ordering the work to be done. It involves putting the plan into effect by issuing orders. it is concerned with starting the process and operation on the basis of route sheets and schedule charts.***
- ***"Dispatches put production in effect by releasing and guiding manufacturing order in the sequence previously determined by route sheets and schedule."***

PROCEDURE:

- *1.Moving of materials from process to process.*
- *2.Assigning of work to machines.*
- *3.Issuing of tools to production departments.*
- *4.Issuing of job orders.*
- *5.Recording of time taken.*
- *6.Ensuring necessary changes.*
- *7.Having proper liaison with routing*

IMPORTANT DOCUMENTS

1.Material requisitions

2.work order

3.control sheet

4.Internal delivery note

5.Tool and gauge ticket

FOLLOW UP AND EXPDITING

Follow up or expediting is that branch of production control procedure which regulates the progress of materials and part through the production process".

PROCEDURE:

1.Progress should be checked

2.Causes of differences should be ascertained

3.Helping in removing the deviations

4.Report with departments supplying materials

INSPECTION

- ***Inspection is also an important function of control. the purpose of inspection is to see whether the products manufactured are of requisite quality or not. It is carried on at various levels of production process so that pre-determined standards of quality are achieved. Inspection is undertaken both of products and inputs.***

DEPARTMENT OF MECHANICAL ENGINEERING

UNIT I

INDUSTRIAL APPLICATIONS

Scheduling (production processes) Scheduling is the process of arranging, controlling and optimizing work and workloads in a production process or manufacturing process. Scheduling is used to allocate plant and machinery resources, plan human resources, plan production processes and purchase materials.

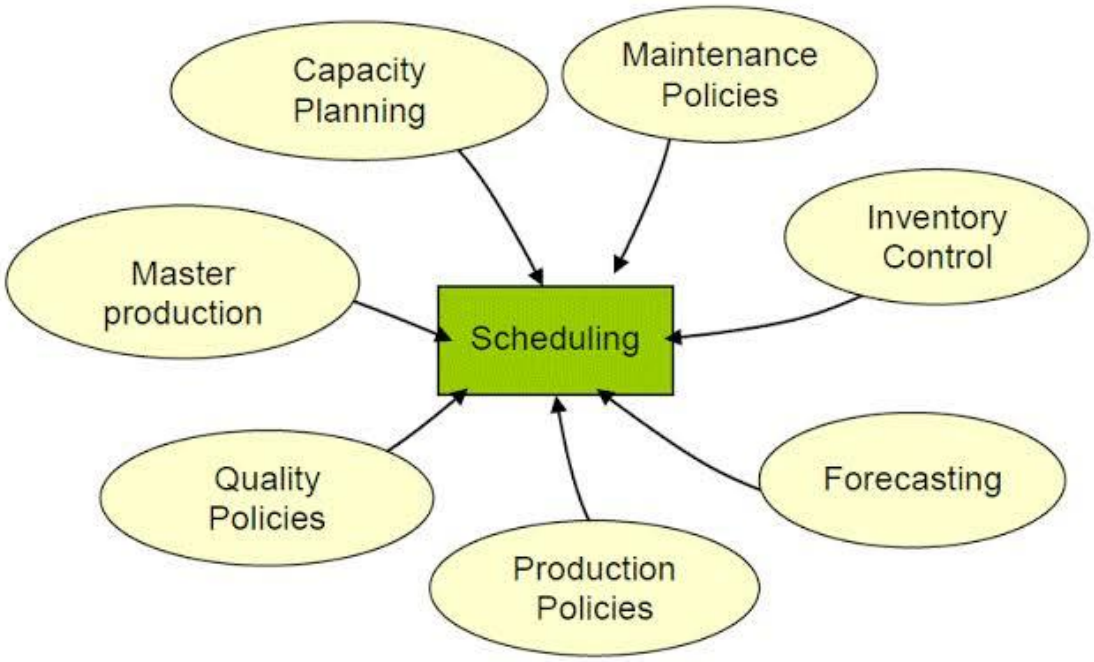
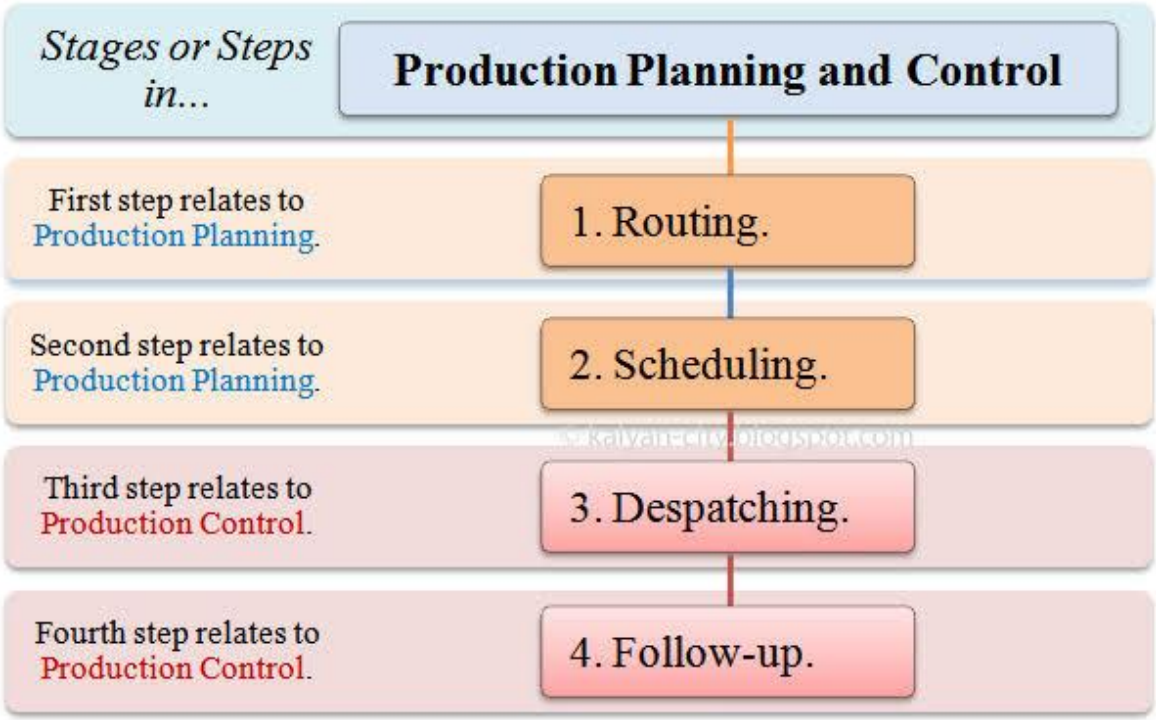
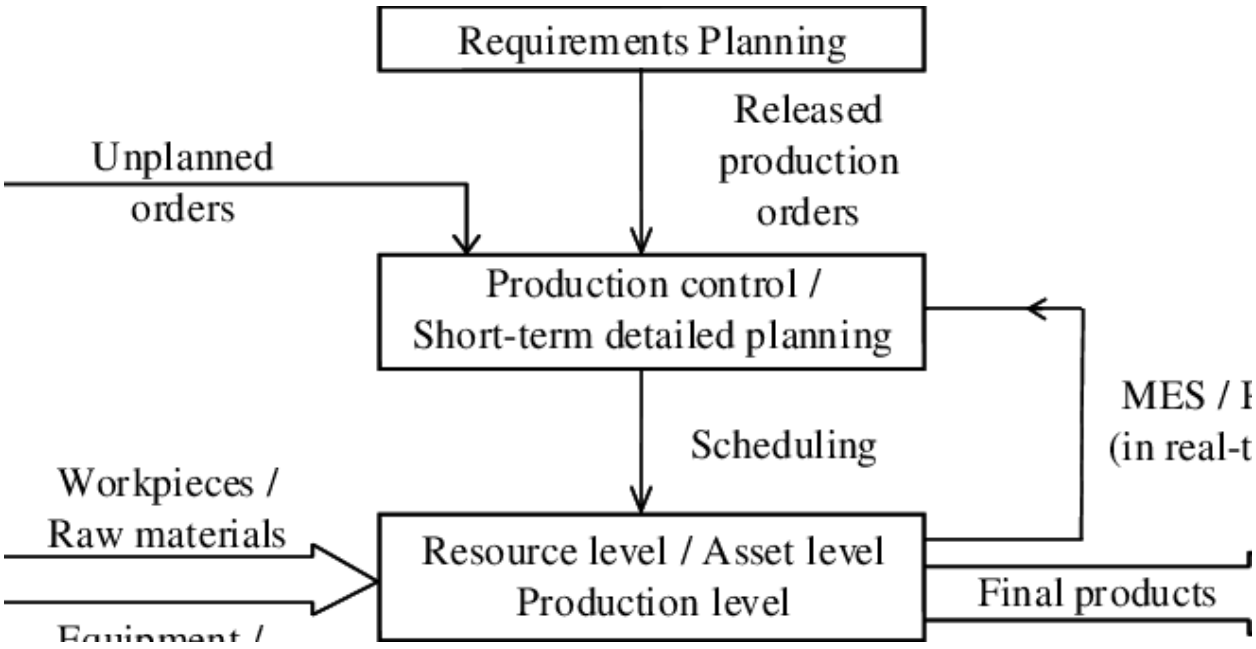


Figure 1: Functions impacting scheduling


Stages or Steps in...
Production Planning and Control
First step relates to Production Planning.
1. Routing.
Second step relates to Production Planning.
2. Scheduling.
Third step relates to Production Control.
3. Despatching.
Fourth step relates to Production Control.
4. Follow-up.


Requirements Planning
Released production orders
Unplanned orders
Production control / Short-term detailed planning
Scheduling
MES / I
(in real-t
Workpieces / Raw materials
Resource level / Asset level Production level
Final products

UNIT I

ASSIGNMENT

MECHANICAL IV YEAR II SEM—SUB: PPC

UNIT I

SHORT QUESTIONS.

1. Define the term production planning and control?
2. Define the terms planning and controlling?
3. Explain mass production?
4. Describe continuous production?
5. Explain the relationship between production planning and control?
6. Define production planning and control.
7. List the objectives of PPC.
8. What are the phases of production planning and control?
9. List various functions of PPC.
10. What is production system?
11. List the types of production system
12. What are the objectives of product analysis?
13. List the various factors that influence the product design.
14. What is meant by standardization?
15. What is meant by simplification?

LONG QUESTIONS

1. Differentiate between job order production and batch production systems?
2. Describe the functions of production planning and control?
3. Explain planning in manufacturing organization?
4. What are the objectives of production planning?
5. State the purpose of manufacturing organization in an industry?
6. Briefly explain the prerequisites of PPC.
7. Explain the production lifecycle with the aid of a graph.
8. "PPC regulates and controls "how," "where," and "when" work is to be done." What do you understand by this statement?
9. State the principles of good production planning and control.
10. What are the levels of aggregation in forecasting for a manufacturing organization? How should this hierarchy of forecasts be linked and used?
11. List out the advantages and disadvantages of short term long term forecasting.
12. A firm uses simple exponential smoothing with $\alpha = 0.1$ to forecast demand. The forecast for the week of February 1 was 500 units, whereas actual demand turned out to be 450 units.
13. Forecast the demand for the week of February
14. Assume that the actual demand during the week of February 8 turned out to be 505 units. Forecast the demand for the week of February 15, Continue forecasting through March 15, assuming that subsequent demands were actually 516, 488, 467, 554 and 510
15. Explain the scope of production planning and control.

UNIT 2

FORECASTING

Course Objective

The objective of this unit is to provide knowledge of forecasting in production Planning and control of various industries.

Course Outcome

Student should be able to understand thedefinition,methods of forecasting and importance of forecasting in the industry.

Forecasting: Importance of forecasting – Types of forecasting, their uses – General principles of forecasting – Forecasting techniques – qualitative methods and quantitate methods.

FORECASTING is essential for number of planning decisions and often provides a valuable input on which operations of the business enterprises depend. Forecasting is a process of estimating a future event by casting forward past data.

Production Forecasting is an important input into the decision-making process and investment scenario evaluation, which are crucial for an upstream organization.

The production forecast flows through the central nervous system of an organization and helps to identify opportunities and decide on the best way forward.

Production forecasting objectives

It is important to have the objective of the production forecast in the decision-making process in mind while forecasting. It is important to go through a process to identify and address the requirements in generating a production forecast. This could be a three step process:

- Identify what decisions will be made using the information from the forecast
- Identify what uncertainties matter for these decisions
- Design of the forecast

The models or techniques of production forecasting are listed as follows:

Brainstorming technique.

Goal oriented forecast technique.

Graphic charting technique.

Matrix technique.

Nominal group technique (NGT).

Delphi technique.

Simple average technique.

1. Brainstorming technique

Brainstorming technique is used to forecast demand, especially for new products. In this method, many experts sit together and each expert gives his own idea (forecast) and reason for it. One idea leads to many more ideas. The group of experts will develop much more ideas than one person. Based on these ideas, demand can be forecasted.

2. Goal oriented forecast technique

In this technique, a goal is first fixed. Then the technological developments which are required for achieving that goal is identified. Later, a forecast is made about when these technological developments would take place in the future So, an estimate is made about the timing of these technological developments in an upcoming future. This method is used by large companies, which have their own research and development departments.

3. Graphic charting technique

Graphic charting technique is used to forecast future technological developments by plotting past technological developments on a logarithmic scale. This technique is based on the assumption that knowledge expands. This technique estimate, when the next major (big) technological development is likely to take place.

4. Matrix technique

Matrix is a combination of two or more matters relating to the production process. A matrix is prepared with technological developments, product functions and time factor. Matrix technique is comprehensive. It is flexible and so it can adjust with the changing times. This technique is used only by large companies.

5. Nominal group technique (NGT)

In nominal group technique (NGT), the group members think independently. Each group member contributes his own ideas. This technique does not allow interaction between the group members at an early stage. Interaction takes place only when the ideas are presented by every single member of the group.

6. Delphi technique

Delphi technique is very much similar to the brainstorming technique. The only difference between brainstorming and Delphi technique is that in a Delphi method, group members don't interact personally. Here, such personal interaction is impossible because group members are physically present at different places.

7. Simple average technique

In simple average technique, forecasts are based on the average value for a given period of time.

A simple average (SA) is the average of demand (sales) for all previous periods. The demands of all periods are equally weighted.

SA equals 'Sum of Demands for all periods' divided by 'Number of periods.'

Average calculations are made at different intervals in order to reduce error due to seasonal variations. Instead of taking the simple average of the full year's sales, quarterly averages or monthly averages are taken. This gives realistic trends. Averaging reduces the chances of being misled by gross fluctuations that may take place in any single period. However, if the underlying pattern changes over time, simple averaging will not detect the change.

TYPES OF FORECASTING METHODS

Forecasting methods can be classified into two groups: qualitative and quantitative.

Qualitative forecasting methods

Forecast is made subjectively by the forecaster.

Qualitative forecasting methods, often called judgmental methods, are methods in which the forecast is made subjectively by the forecaster. They are educated guesses by forecasters or experts based on intuition, knowledge, and experience. When you decide, based on your intuition, that a particular team is going to win a baseball game, you are making a qualitative forecast. Because qualitative methods are made by people, they are often biased. These biases can be related to personal motivation

("They are going to set my budget based on my forecast, so I'd better predict high."), mood ("I feel lucky today!"), or conviction ("That pitcher can strike anybody out!").

	Qualitative Methods	Quantitative Methods
1. Characteristics	Based on human judgment, opinions; subjective and nonmathematical.	Based on mathematics; quantitative in nature.
2. Strengths	Can incorporate latest changes in the environment and "inside information."	Consistent and objective; able to consider much information and data at one time.
3. Weaknesses	Can bias the forecast and reduce forecast accuracy.	Often quantifiable data are not available. Only as good as the data on which they are based.

Principles of forecasting

- At any point in time, there is only one best estimate forecast for a project that reflects the current understanding of subsurface uncertainty and best development and commercial assumptions.
- This forecast should always be accompanied by an uncertainty range.
- The forecast uncertainty range should always have remaining reserves or EUR as an objective function.
- The forecast and uncertainty range should be based on defined projects, with incremental forecasts for subsequent projects.

With these principles, forecasting is part of asset management throughout the year. It may be envisaged as a continuous loop through the whole upstream lifecycle Fig 1. Forecast updates are triggered by reserves and corporate planning, but also by ad hoc changes and events, such as studies and subsurface information and development plan updates. Note that for the official forecasts (reserves and corporate planning), reasonable freeze dates should be agreed upon for input data and should be adhered to. Subsequent changes due to new wells, workovers or wells failing should be reflected in the ad hoc updates, The forecast model is kept up-to date and consistent with the latest surveillance data and development assumptions and when reserves or corporate forecast need to be updated, it may simply be derived from the latest model.

Forecast: A prediction, projection, or estimate of some future activity, event, or occurrence.

Types of Forecasts

1. Economic forecasts

   Predict a variety of economic indicators, like money supply, inflation rates, interest rates, etc.

2. Technological forecasts

   Predict rates of technological progress and innovation.

3. Demand forecasts

   Predict the future demand for a company's products or services.

TYPES OF FORECASTING METHODS

Qualitative methods: These types of forecasting methods are based on judgments, opinions, intuition, emotions, or personal experiences and are subjective in nature. They do not rely on any rigorous mathematical computations

Quantitative methods: These types of forecasting methods are based on mathematical (quantitative) models, and are objective in nature. They rely heavily on mathematical computations.

QUANTITATIVE FORECASTING METHODS

Time-Series Models

Time series models look at past patterns of data and attempt to predict the future based upon the underlying patterns contained within those data.

Associative Models

Associative models (often called causal models) assume that the variable being forecasted is related to other variables in the environment.

Model	Description

Naïve	Uses last period's actual value as a forecast
Simple Mean (Average)	Uses an average of all past data as a forecast
Simple Moving Average	Uses an average of a specified number of the most recent observations, with each observation receiving the same emphasis (weight)
Weighted Moving Average	Uses an average of a specified number of the most recent observations, with each observation receiving a different emphasis (weight)
Exponential Smoothing	A weighted average procedure with weights declining exponentially as data become older
Trend Projection	Technique that uses the least squares method to fit a straight line to the data
Seasonal Indexes	A mechanism for adjusting the forecast to accommodate any seasonal patterns inherent in the data

PRINCIPLES OF FORECASTING

There are many types of forecasting models. They differ in their degree of complexity, the amount ofdata they use, and the way they generate the forecast. However, some features are common to all forecasting models. They include the following:

1.Forecasts are rarely perfect. Forecasting the future involves uncertainty. Therefore, it is almost impossible to make a perfect prediction. Forecasters know that they have to live with a certain amount of error, which is the difference between what is forecast and what actually happens. The goal of forecasting is to generate good forecasts on the average over time and to keep forecast errors as low as possible.

2.Forecasts are more accurate for groups or families of items rather than for individual items. When items are grouped together, their individual high and low values can cancel each other out. The data for a group of items can be stable even when individual items in the group are very unstable. Consequently, one can obtain a higher degree of accuracy when forecasting for a group of items rather than for individual items. For example, you cannot expect the same degree of accuracy if you are forecasting sales of long-sleeved hunter green polo shirts that you can expect when forecasting sales of all polo shirts.

3.Forecasts are more accurate for shorter than longer time horizons. The shorter the time horizon of the forecast, the lower the degree of uncertainty. Data do not change very much in the short run.

DECOMPOSITION OF A TIME SERIES

Patterns that may be present in a time series

Trend: Data exhibit a steady growth or decline over time.

Seasonality: Data exhibit upward and downward swings in a short to intermediate time frame (mostnotably during a year).

Cycles: Data exhibit upward and downward swings in over a very long time frame.

Random variations: Erratic and unpredictable variation in the data over time with no discernablepattern.

ILLUSTRATION OF TIME SERIES DECOMPOSITION

Hypothetical Pattern of Historical Demand

Dependent versus Independent Demand

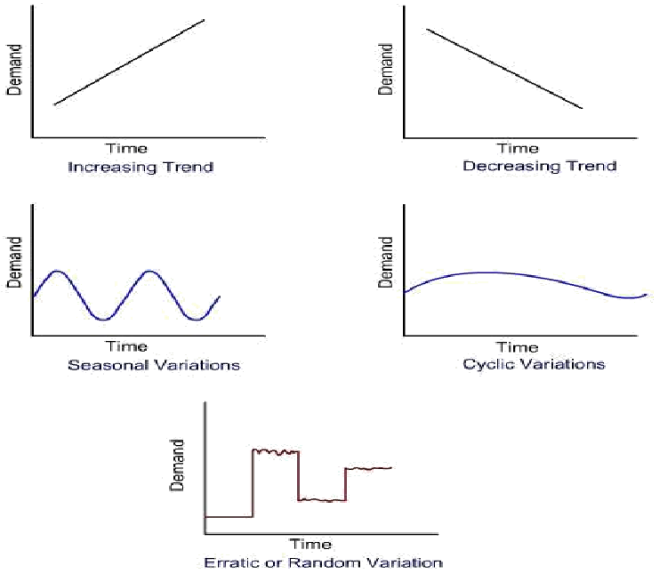
Demand of an item is termed as independent when it remains unaffected by the demand for any other item. On the other hand, when the demand of one item is linked to the demand for another

item, demand is termed as dependent. It is important to mention that only independent demand needs forecasting. Dependent demand can be derived from the demand of independent item to which it is linked.

Business Time Series

The first step in making a forecast consists of gathering information from the past. One should collect statistical data recorded at successive intervals of time. Such a data is usually referred to as time series. Analysts plot demand data on a time scale, study the plot and look for consistent shapes and patterns. A time series of demand may have constant, trend, or seasonal pattern (Figure 1)

Figure 1: Business Time Series



or some combination of these patterns. The forecaster tries to understand the reasons for such changes, such as,

- Changes that have occurred as a result of general tendency of the data to increase ordecrease, known as secular movements.
- Changes that have taken place during a period of 12 months as a result in changes in climate, weather conditions, festivals etc. are called as seasonal changes.
- Changes that have taken place as a result of booms and depressions are called as cyclical variations.
- Changes that have taken place as a result of such forces that could not be predicted (like flood, earthquake etc.) are called as irregular or erratic variations.

Quantitative Approaches of Forecasting

Most of the quantitative techniques calculate demand forecast as an average from the past demand. The following are the important demand forecasting techniques.

- Simple average method: A simple average of demands occurring in all previous time periods is taken as the demand forecast for the next time period in this method. (Example 1)

Example 1

Simple Average :

A XYZ television supplier found a demand of 200 sets in July, 225 sets in August & 245 sets in September. Find the demand forecast for the month of october using simple average method.

The average demand for the month of October is

$$SA = \left(\frac{D1+D2+D3}{3}\right)$$
$$= \left(\frac{200+225+245}{3}\right)$$
$$= 223.33$$
$$\approx 224 \text{ units}$$

- Simple moving average method: In this method, the average of the demands from several of the most recent periods is taken as the demand forecast for the next time period. The number of past periods to be used in calculations is selected in the beginning and is kept constant (such as 3-period moving average). (Example 2)

-

Simple Moving Average :

A XYZ refrigerator supplier has experienced the following demand for refrigerator during past five months.

Month	Demand
February	20
March	30
April	40
May	60
June	45

Find out the demand forecast for the month of July using five-period moving average & three-period moving average using simple moving average method.

$$MA_n = \frac{\sum_{i=1}^{n} Di}{n}$$

For five period average (i.e. n = 5)

$$MA_5 = \frac{20+30+40+60+45}{5}$$
$$= 29 \text{ units}$$

For three period average (i.e. n = 3)

$$MA_3 = \frac{40+60+45}{3}$$
$$= 48.33$$
$$\approx 49 \text{ units}$$

- Weighted moving average method: In this method, unequal weights are assigned to the past demand data while calculating simple moving average as the demand forecast for next time period. Usually most recent data is assigned the highest weight factor. (Example 3)

Example 3

Weighted Moving Average Method :

The manager of a restaurant wants to make decision on inventory and overall cost. He wants to forecast demand for some of the items based on weighted moving average method. For the past three months he exprienced a demand for pizzas as follows:

Month	Demand
October	400
November	480
December	550

Find the demand for the month of January by assuming suitable weights to demand data.

$$WMA = \sum_{i=1}^{n} CiDi$$

Ci = Weights for Periods

Di = Demand for Periods

Let $C1 = 0.25, C2 = 0.3, C3 = 0.5$

$\therefore WMA = C1D1 + C2D2 + C3D3$

$= 0.25 * 400 + 0.3 * 480 + 0.5 * 550$

$= 100 + 144 + 275$

$= 519$ units

- Exponential smoothing method: In this method, weights are assigned in exponential order. The weights decrease exponentially from most recent demand data to older demand data. (Example 4)

Example 4

Exponential Smoothing :

One of the two wheeler manufacturing company exprienced irregular but usually increasing demand for three products. The demand was found to be 420 bikes for June and 440 bikes for July. They use a forecasting method which takes average of past year to forecast future demand. Using the simple average method demand forecast for June is found as 320 bikes (Use a smoothing coefficient 0.7 to weight the recent demand most heavily) and find the demand forecast for August.

$$F_t = \alpha D_{t-1} + (1 - \alpha) F_{t-1}$$

where α = Smoothig Coefficient

D_{t-1} = Actual Demand for Recent Period

F_{t-1} = Demand Forecast for Recent Period

F_t = Forecast of Next Period Demand

- Regression analysis method: In this method, past demand data is used to establish a functional relationship between two variables. One variable is known or assumed to be known; and used to forecast the value of other unknown variable (i.e. demand). (Example 5)

Example 5

Regression Analysis :

Farewell Corporation manufactures Integrated Circuit boards(I.C board) for electronics devices. The planning department knows that the sales of their client goods depends on how much they spend on advertising, on account of which they receive in advance of expenditure. The planning department wish to find out the relationship between their clients advertising and sales, so as to find demand for I.C board.

The money spend by the client on advertising and sales (in dollar) is given for different periods in following table :

Period(t)	Advertising (X_t)	Sales (D_t)	D_t^2	X_t^2	X_tD_t
	$(1,00,000)	**$(1,000.000)**			
1	20	6	36	400	120
2	25	8	64	625	200
3	15	7	49	225	105
4	18	7	49	324	126
5	22	8	64	484	176
6 $\sum$	25	9	81	625	225
7	27	10	100	729	270
8	23	7	49	529	161
9	16	6	36	256	96
10	20	8	64	400	120
	211	**76**	**592**	**4597**	**1599**

$$b = \frac{n(\sum X_t D_t) - (\sum X_t)(\sum D_t)}{n(\sum X_t^2) - (\sum X_t)^2}$$

$$= \frac{10(1599) - (211)(76)}{10(4597) - (211)^2}$$

$$= \frac{15990 - 16036}{45970 - 44521}$$

$$= \frac{-46}{1449} = -0.0317$$

$$a = \sum D_t - b \sum X_t$$

$$= \frac{76 - (-0.0317)211}{10}$$

$$= 8.268$$

Relationship between future sales F_t and advertising cost X_t is

$$F_t = a + bX_t$$

$$= 8.268 - 0.0317X_t$$

Error in Forecasting

Error in forecasting is nothing but the numeric difference in the forecasted demand and actual demand. MAD (Mean Absolute Deviation) and Bias are two measures that are used to assess the accuracy of the forecasted demand. It may be noted that MAD expresses the magnitude but not the direction of the error.

$$MAD = \frac{\text{sum of the absolute value of forecast error for all periods}}{\text{number of periods}}$$

$$= \frac{\sum_{i=1}^{n} \left| \text{forecast error}_i \right|}{n}$$

$$= \frac{\sum_{i=1}^{n} \left| (\text{forecasted demand} - \text{actual demand})_i \right|}{n}$$

where n is the number of periods.

$$Bias = \frac{\text{sum of all forecast errors for all periods}}{\text{number of periods}}$$

$$= \frac{\sum_{i=1}^{n} (\text{forecast demand} - \text{actual demand})_i}{n}$$

where n is the number of periods.

SHORT QUESTIONS

1. Define forecasting?
2. Explain types of forecasting?
3. List quantitative methods of forecasting?
4. Describe various steps involved in forecasting?
5. Explain regression method?
6. Differentiate between the production planning and production control.
7. How the "controlling" can be done to regulate the progress of work?
8. Give the step by step Forecasting procedure for using time series
9. List out the various functions of production planning and control
10. What are the needs for PPC?
11. What is the importance of forecasting?
12. What are the differences between short term and long term forecasting?
13. What are the functions of PPC
14. What kind of pre-requisite data is a must to actually begin with the activities of PPC?
15. Explain the different types of production system and their characteristics.
16. State the objectives and Inputs of an MRP system
17. Explain computer aided process planning.

LONG QUESTIONS

1. State the objectives of long term and short term forecasting?
2. What are the advantages of forecasting?
3. Describe moving average method?
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14. Describe 'Least Square Method' of sales forecasting with its advantages and limitations.
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UNIT 2

POWER POINT PRESENTATION

FORECASTING

DEPARTMENT OF MECHANICAL ENGINEERING

DECISIONS THAT NEED FORECASTS

- Which markets to pursue?
- What products to produce?
- How many people to hire?
- How many units to purchase?
- How many units to produce?
- And so on

COMMON CHARACTERISTICS OF FORECASTING

- Forecasts are rarely perfect
- Forecasts are more accurate for aggregated data than for individual items
- Forecast are more accurate for shorter than longer time periods

FORECASTING STEPS

- What needs to be forecast?
  - Level of detail, units of analysis & time horizon required
- What data is available to evaluate?
  - Identify needed data & whether it's available
- Select and test the forecasting model
  - Cost, ease of use & accuracy
- Generate the forecast
- Monitor forecast accuracy over time

TYPES OF FORECASTING MODELS

- Qualitative (technological) methods:
  - Forecasts generated subjectively by the forecaster
- Quantitative (statistical) methods:
  - Forecasts generated through mathematical modeling

QUALITATIVE METHODS

Type	Characteristics	Strengths	Weaknesses
Executive opinion	A group of managers meet & come up with a forecast	Good for strategic or new-product forecasting	One person's opinion can dominate the forecast
Market research	Uses surveys & interviews to identify customer preferences	Good determinant of customer preferences	It can be difficult to develop a good questionnaire
Delphi method	Seeks to develop a consensus among a group of experts	Excellent for forecasting long-term product demand, technological	Time consuming to develop

STATISTICAL FORECASTING

- **Time Series Models:**
  - Assumes the future will follow same patterns as the past

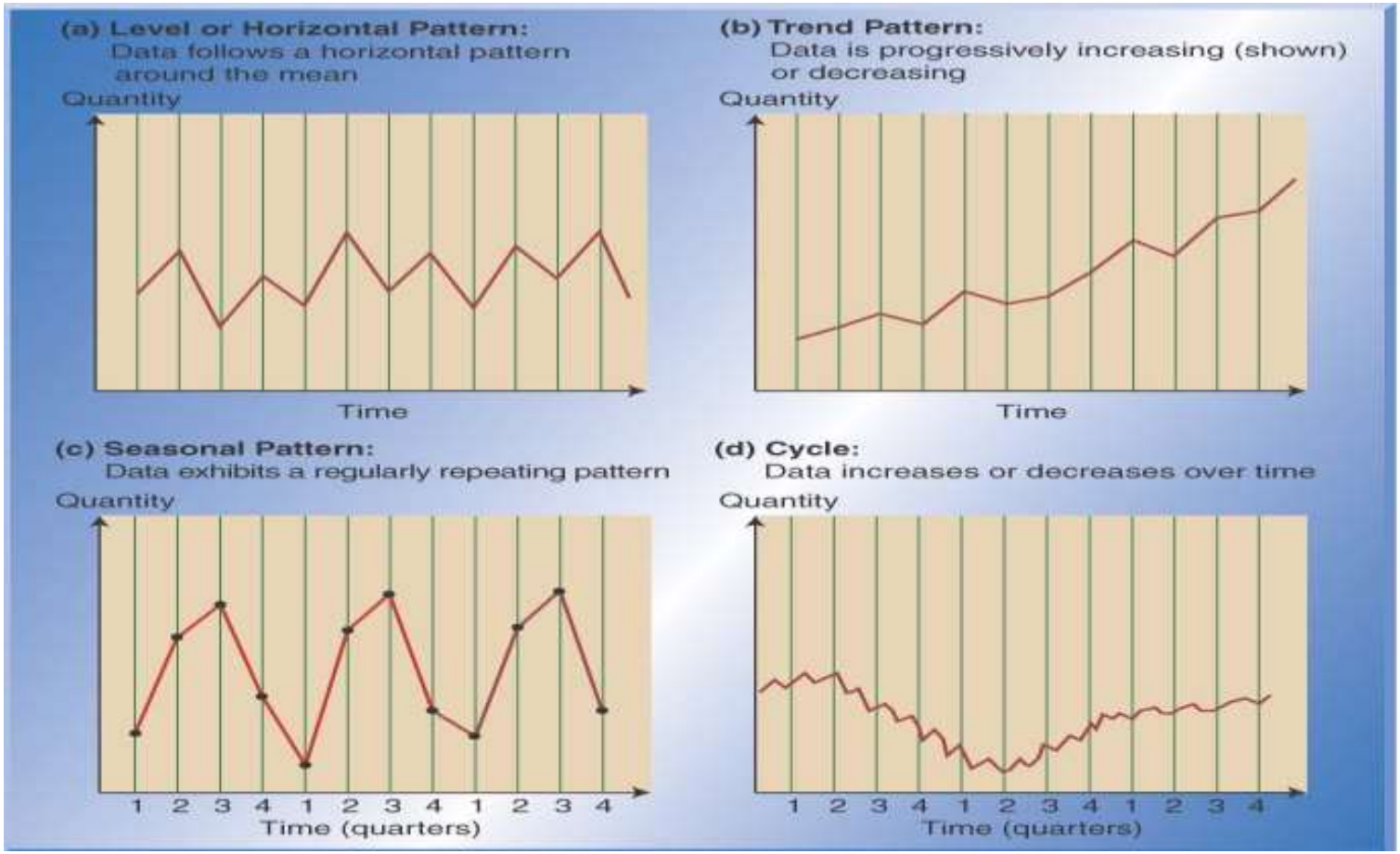
- **Causal Models:**
  - Explores cause-and-effect relationships
  - Uses leading indicators to predict the future
  - E.g. housing starts and appliance sales

- Trend-adjusted exponential smoothing
- Three step process:
  - Smooth the level of the series:
  - Smooth the trend:
  - Calculate the forecast including trend:

COMPOSITION OF TIME SERIES DATA

- Data = historic pattern + random variation
- Historic pattern may include:
  - Level (long-term average)
  - Trend
  - Seasonality
  - Cycle

TIME SERIES PATTERNS



METHODS OF FORECASTING THE LEVEL

- Naïve Forecasting
- Simple Mean
- Moving Average
- Weighted Moving Average
- Exponential Smoothing

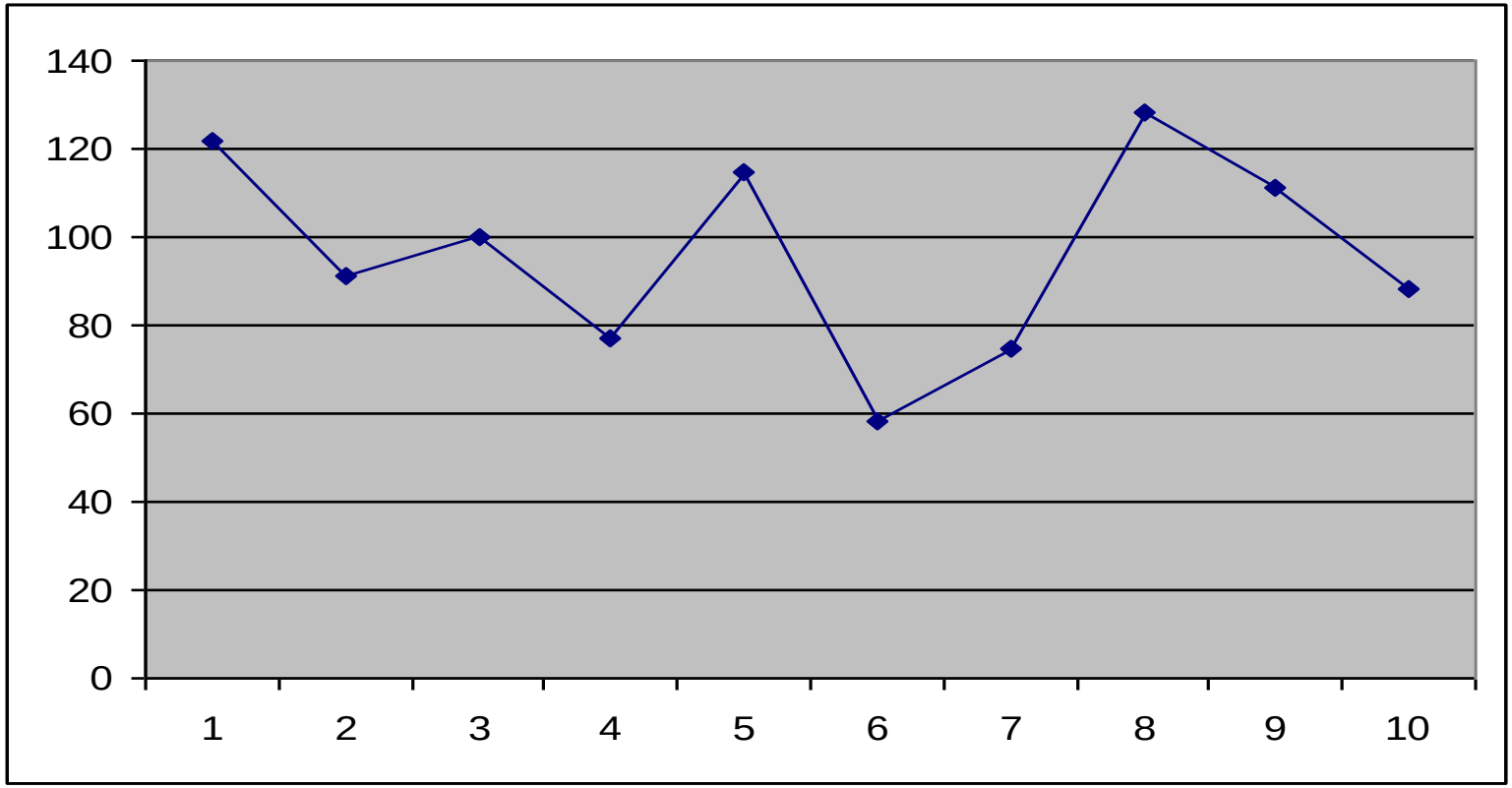
TIME SERIES PROBLEM

Determine forecast for periods 11

- Naïve forecast
- Simple average
- 3- and 5-period moving average
- 3-period weighted moving average with weights 0.5, 0.3, and 0.2
- Exponential smoothing with alpha=0.2 and 0.5

Period	Orders
1	122
2	91
3	100
4	77
5	115
6	58
7	75
8	128
9	111
10	88
11	

TIME CHART OF ORDERS DATA



THE EFFECT OF THE PARAMETER N

- A smaller N makes the forecast more

responsive

- A larger N makes the forecast more

stable

WEIGHTED MOVING AVERAGE

$$F_{t+1} = C_1 A_t + C_2 A_{t-1} + \ldots\ldots\ldots + C_N A_{t-N+1}$$

where

$$C_1 + C_2 + \ldots\ldots\ldots C_N = 1$$

EXPONENTIAL SMOOTHING

$$F_{t+1} = \alpha A_t + (1-\alpha) F_t$$

where

$$0 \leq \alpha \leq 1$$

THE EFFECT OF THE PARAMETER α

- A smaller α makes the forecast more

stable

- A larger α makes the forecast more

responsive

TIME SERIES PROBLEM SOLUTION

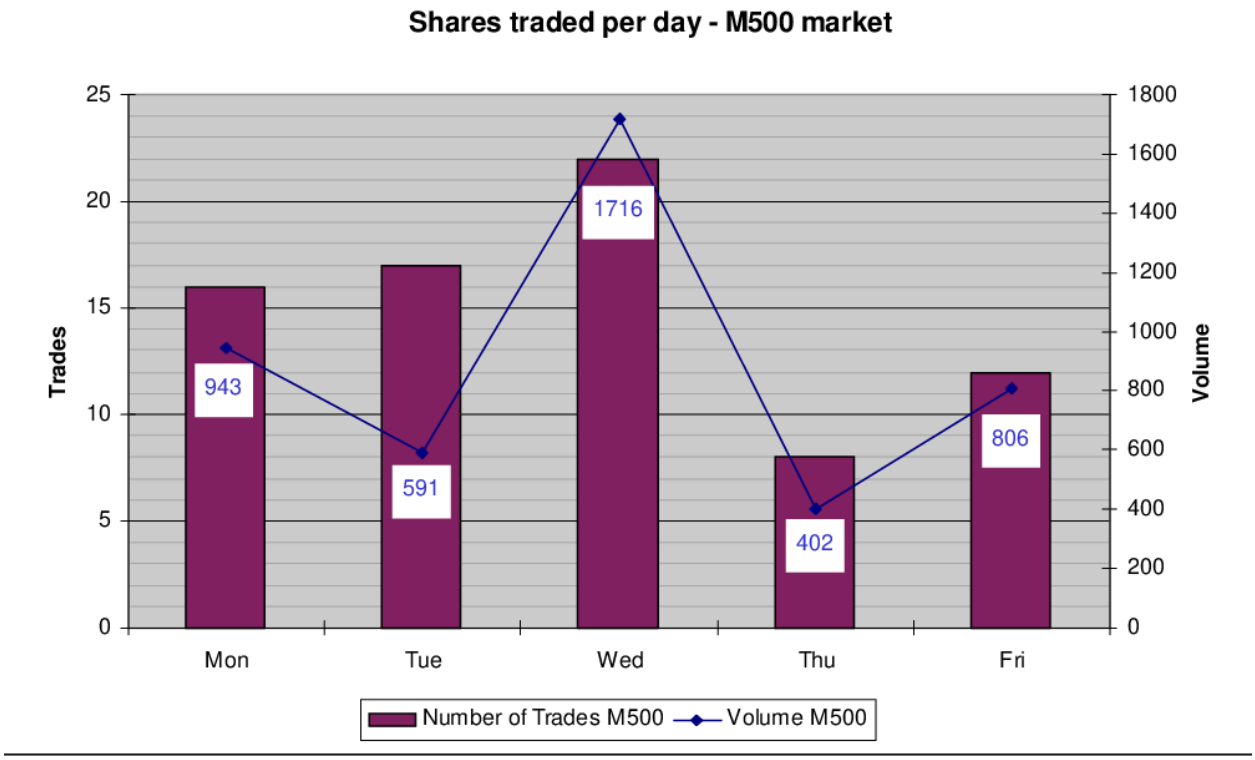
				Simple	Simple	Weighted	Exponential	Exponential
		Naïve	Simple	Moving	Moving	Moving	Smoothing	Smoothing
Period	Orders (A)	Forecast	Average	Average (N=3)	Average(N=5)	Average (N=3)	(α = 0.2)	(α = 0.5)
1	122						122	122
2	91	122	122				122	122
3	100	91	107				116	107
4	77	100	104	104		102	113	104
5	115	77	98	89		87	106	91
6	58	115	101	97	101	101	108	103
7	75	58	94	83	88	79	98	81
8	128	75	91	83	85	78	93	78
9	111	128	96	87	91	98	100	103
10	88	111	97	105	97	109	102	107
11		88	97	109	92	103	99	98

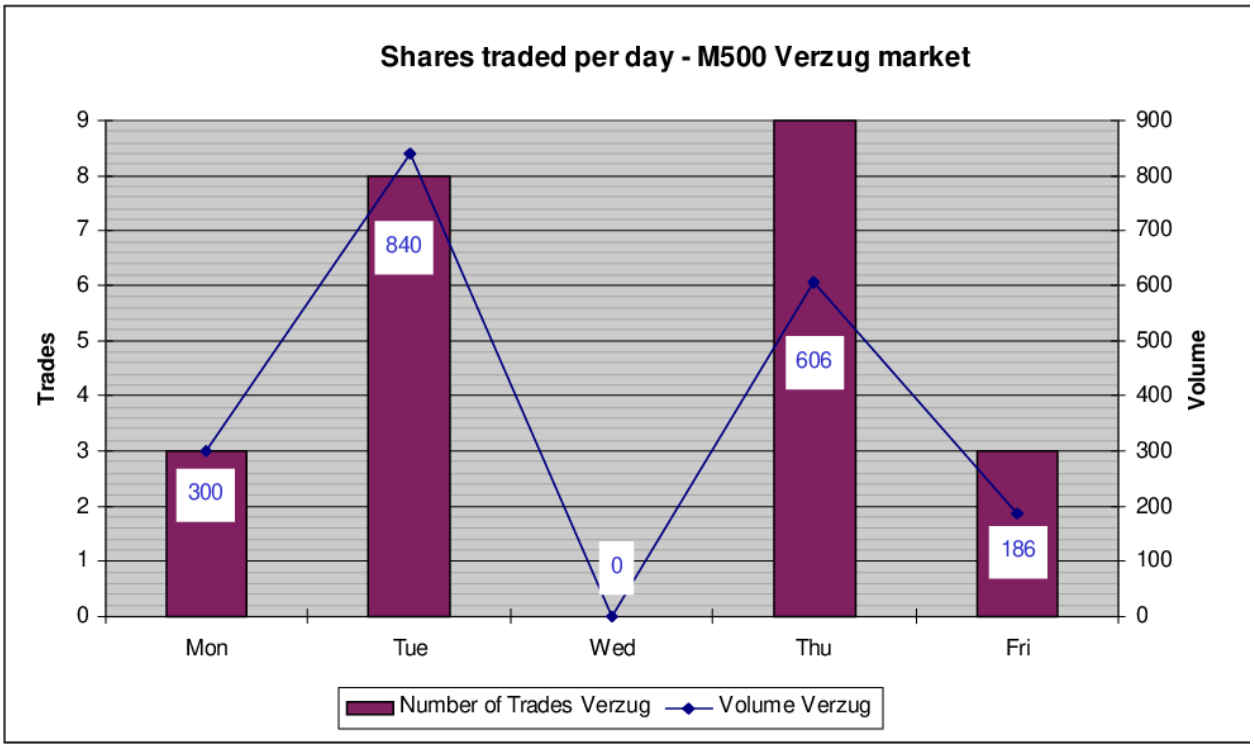
UNIT II

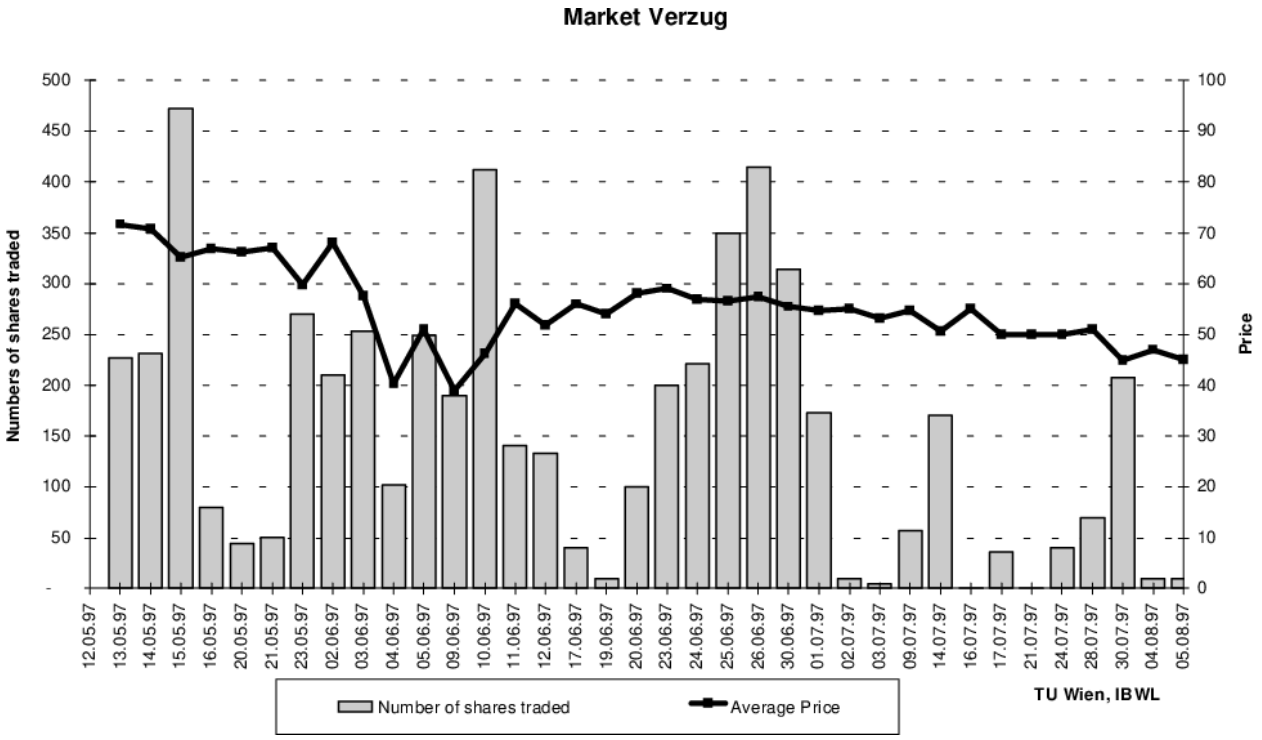
INDUSTRIAL APPLICATIONS

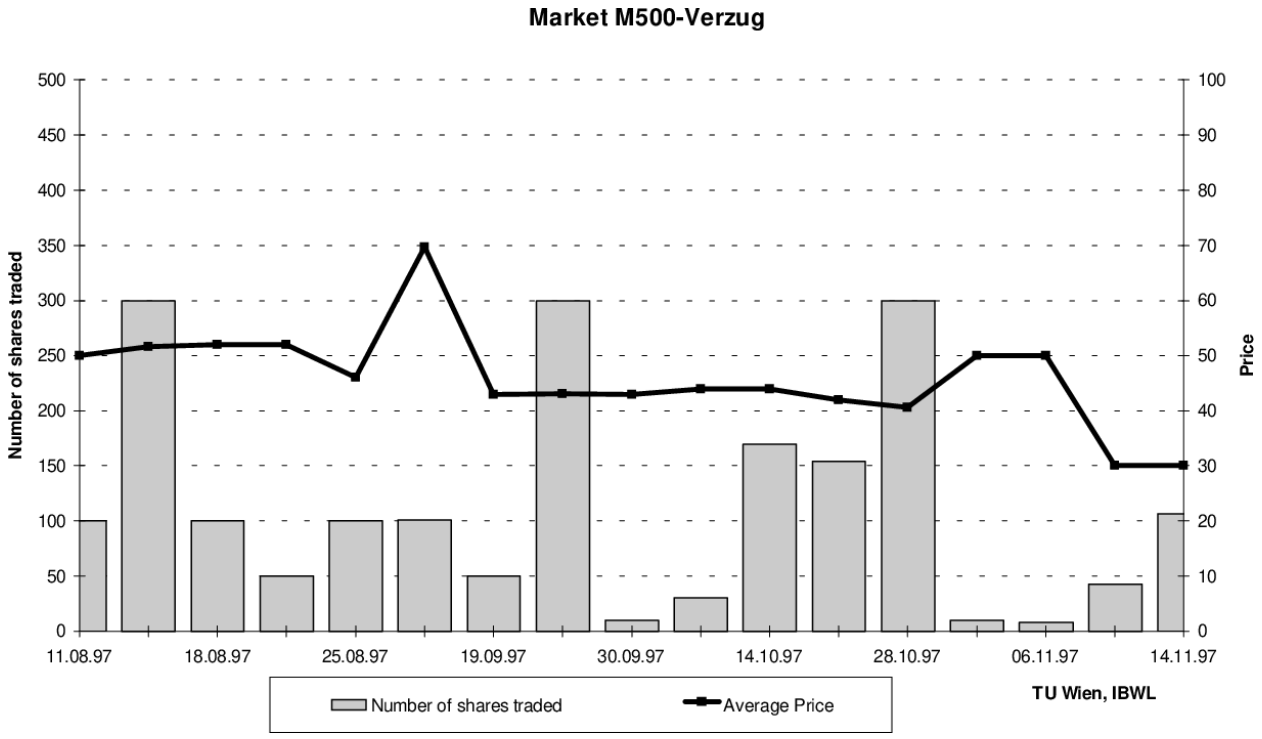
Forecasting Markets-An Industrial Application

Industrial application of an experimental stock market, which was designed to support project management decisions. People who work in a software development project were motivated to trade in simple real money double auction markets. The design of these markets was focused on the date the project should be finished and should help to aggregate privat and semi-public information on the progress of the project more quickly than conventional management




Shares traded per day - M500 Verzug market
Trades
Volume
9
8
7
6
5
4
3
2
1
0
900
800
700
600
500
400
300
200
100
0
300
840
0
606
186
Mon
Tue
Wed
Thu
Fri
Number of Trades Verzug
Volume Verzug


Market Verzug
Numbers of shares traded
Price
Number of shares traded
Average Price
TU Wien, IBWL


Market M500-Verzug
Number of shares traded
Price
Number of shares traded
Average Price
TU Wien, IBWL

UNIT II

ASSIGNMENT

UNIT II

SHORT QUESTIONS

1. Define forecasting?
2. Explain types of forecasting?
3. List quantitative methods of forecasting?
4. Describe various steps involved in forecasting?
5. Explain regression method?
6. Differentiate between the production planning and production control.
7. How the "controlling" can be done to regulate the progress of work?
8. Give the step by step Forecasting procedure for using time series
9. List out the various functions of production planning and control
10. What are the needs for PPC?
11. What is the importance of forecasting?
12. What are the differences between short term and long term forecasting?
13. What are the functions of PPC
14. What kind of pre-requisite data is a must to actually begin with the activities of PPC?
15. Explain the different types of production system and their characteristics.
16. State the objectives and Inputs of an MRP system
17. Explain computer aided process planning.

LONG QUESTIONS

1. State the objectives of long term and short term forecasting?
2. What are the advantages of forecasting?
3. Describe moving average method?
4. Explain types of forecasting?
5. Explain Delphi method?
6. Explain different types of production systems and differentiate between them.
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UNIT 3

INVENTORY MANAGEMENT

Course objective

Student will be able learn about Inventory Management..

Course Outcome

Student should be able to understand about the inventory management , various costs involved and control systems.

Inventory management: Functions of inventories – relevant inventory costs – ABC analysis – VED analysis – EOQ model – Inventory control systems – P–Systems and Q Systems, Introduction to MRP & ERP, LOB (Line of Balance), JIT inventory, and Japanese concepts.

Introduction:

Inventory :

The amount of material, a company has in stock at a specific time is known as inventory or in terms of money it can be defined as the total capital investment over all the materials stocked in the company at any specific time. Inventory may be in the form of,

- Raw material inventory
- In process inventory
- Finished goods inventory
- Spare parts inventory
- Office stationary etc.

As a lot of money is engaged in the inventories along with their high carrying costs, companies cannot afford to have any money tied in excess inventories. Any excessive investment in inventories may prove to be a serious drag on the successful working of an organization. Thus there is a need to manage our inventories more effectively to free the excessive amount of capital engaged in the materials.

Inventory Management:

In any business or organization, all functions are interlinked and connected to each other and are often overlapping. Some key aspects like supply chain management, logistics and inventory form the backbone of the business delivery function. Therefore these functions are extremely important to marketing managers as well as finance controllers.

Inventory management is a very important function that determines the health of the supply chain as well as the impacts the financial health of the balance sheet. Every organization constantly strives to maintain optimum inventory to be able to meet its requirements and avoid over or under inventory that can impact the financial figures.

Inventory is always dynamic. Inventory management requires constant and careful evaluation of external and internal factors and control through planning and review. Most of the organizations have a separate department or job function called inventory planners who continuously monitor, control and review inventory and interface with production, procurement and finance departments.

Different Types of Inventory:

Inventory of materials occurs at various stages and departments of an organization. A manufacturing organization holds inventory of raw materials and consumables required for production. It also holds inventory of semi-finished goods at various stages in the plant with various departments. Finished goods inventory is held at plant, FG Stores, distribution centers etc. Further both raw materials and finished goods those that are in transit at various locations also form a part of inventory depending upon who owns the inventory at the particular juncture. Finished goods inventory is held by the organization at various stocking points or with dealers and stockiest until it reaches the market and end customers.

Besides Raw materials and finished goods, organizations also hold inventories of spare parts to service the products. Defective products, defective parts and scrap also forms a part of inventory as long as these items are inventoried in the books of the company and have economic value.

Types of Inventory by Function:

INPUT	PROCESS	OUTPUT
Raw Materials	Work In Process	Finished Goods
Consumables required for processing. Eg : Fuel, Stationary, Bolts & Nuts etc. required in manufacturing	Semi Finished Production in various stages, lying with various departments like Production, WIP Stores, QC, Final Assembly, Paint Shop, Packing, Outbound Store etc.	Finished Goods at Distribution Centers through out Supply Chain
Maintenance Items/Consumables	Production Waste and Scrap	Finished Goods in transit
Packing Materials	Rejections and Defectives	Finished Goods with Stockiest and Dealers
Local purchased Items required for production		Spare Parts Stocks & Bought Out items
		Defectives, Rejects and Sales Returns
		Repaired Stock and Parts,
		salels promotion & sample stocks

Functions of Inventories:

The basic purpose of inventories is to balance supply and demand.

Inventory serves as a link between:

1. Supply and demand

2. Customer demand and finished goods

3. Finished goods and component availability.

4. Requirements for an operation and the output from the preceding operation.

5. Parts and materials to begin production and the suppliers of materials.

Why Inventories?

Inventories are needed because demand and supply can not be matched for physical and economical reasons. There are several other reasons for carrying inventories in any organization.

- To safe guard against the uncertainties in price fluctuations, supply conditions, demand conditions, lead times, transport contingencies etc.
- To reduce machine idle times by providing enough in-process inventories at appropriate locations.
- To take advantages of quantity discounts, economy of scale in transportation etc.
- To decouple operations i.e. to make one operation's supply independent of another's supply. This helps in minimizing the impact of break downs, shortages etc. on the performance of the downstream operations. Moreover operations can be scheduled independent of each other if operations are decoupled.
- To reduce the material handling cost of semi-finished products by moving them in large quantities between operations.
- To reduce clerical cost associated with order preparation, order procurement etc.

Relevant Inventory Costs:

In order to control inventories appropriately, one has to consider all cost elements that are associated with the inventories. There are four such cost elements, which do affect cost of inventory.

- Unit cost: it is usually the purchase price of the item under consideration. If unit cost is related with the purchase quantity, it is called as discount price.
- Procurement costs: This includes the cost of order preparation, tender placement, cost of postages, telephone costs, receiving costs, set up cost etc.

- Carrying costs: This represents the cost of maintaining inventories in the plant. It includes the cost of insurance, security, warehouse rent, taxes, interest on capital engaged, spoilage, breakage etc.
- Stock out costs: This represents the cost of loss of demand due to shortage in supplies. This includes cost of loss of profit, loss of customer, loss of goodwill, penalty etc.

If one year planning horizon is used, the total annual cost of inventory can be expressed as:

Total annual inventory cost = Cost of items + Annual procurement cost + Annual carrying cost + Stock out cost

Variables in Inventory Models

D = Total annual demand (in units) Q = Quantity ordered (in units)

Q* = Optimal order quantity (in units) R = Reorder point (in units)

R* = Optimal reorder point (in units) L = Lead time

S = Procurement cost (per order)

C = Cost of the individual item (cost per unit)

I = Carrying cost per unit carried (as a percentage of unit cost C) K = Stock out cost per unit out of stock

P = Production rate or delivery rate

d_l = Demand per unit time during lead time

D_l = Total demand during lead time

TC = Total annual inventory costs

TC* = Minimum total annual inventory costs

Number of orders per year = $= \frac{\text{AnnualDemand}}{\text{OrderQuantity}} = \frac{D}{Q}$

Total procurement cost per year = S.D / Q

Total carrying cost per year = Carrying cost per unit * unit cost * average inventory per cycle

$$= I.C.\left(\frac{0+Q}{2}\right)$$

$$= I.C.\frac{Q}{2}$$

Cost of items per year = Annual demand * unit cost

$$= D.C$$

$$\text{Total annual inventory cost (TC)} = D.C + \frac{S.D}{Q} + \frac{I.C.Q}{2}$$

The objective of inventory management team is to minimize the total annual inventory cost. A simplified graphical presentation in which cost of items, procurement cost and carrying cost are depicted is shown in Figure 1 . It can be seen that large values of order quantity Q result in large carrying cost. Similarly, when order quantity Q is large, fewer orders will be placed and procurement cost will decrease accordingly. The total cost curve indicates that the minimum cost point lies at the intersection of carrying cost and procurement cost curves.

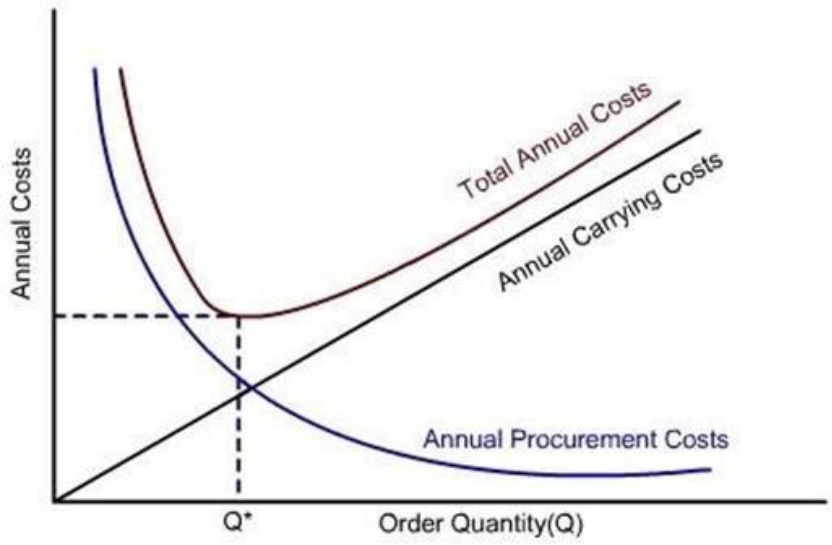


Figure 1: Inventory Related Costs

Inventory Operating Doctrine

When managing inventories, operations manager has to make two important decisions:

- When to reorder the stock (i.e. time to reorder or reorder point)
- How much stock to reorder (i.e. order quantity)

Reorder point is usually a predetermined inventory level, which signals the operations manager to start the procurement process for the next order. Order quantity is the order size.

ABC Analysis:

Inventory is a necessary evil in any organization engaged in production, sale or trading of products. Inventory is held in various forms including Raw Materials, Semi Finished Goods, Finished Goods and Spares.

Every unit of inventory has an economic value and is considered an asset of the organization irrespective of where the inventory is located or in which form it is available. Even scrap has residual economic value attached to it.

Depending upon the nature of business, the inventory holding patterns may vary. While in some cases the inventory may be very high in value, in some other cases inventory may be very high in volumes and number of SKU. Inventory may be help physically at the manufacturing locations or in a third party warehouse location.

Inventory Controllers are engaged in managing Inventory. Inventory management involves several critical areas. Primary focus of inventory controllers is to maintain optimum inventory levels and determine order/replenishment schedules and quantities. They try to balance inventory all the time and maintain optimum levels to avoid excess inventory or lower inventory, which can cause damage to the business.

ABC Classification:

Inventory in any organization can run in thousands of part numbers or classifications and millions of part numbers in quantity. Therefore inventory is required to be classified with some logic to be able to manage the same.

In most of the organizations inventory is categorized according to ABC Classification Method, which is based on pare to principle. Here the inventory is classified based on the value of the units. The principle applied here is based on 80/20 principles. Accordingly the classification can be as under:

A Category Items Comprise 20% of SKU & Contribute to 80% of $ spend.
B Category Items Comprise 30% of SKU & Contribute to 15% of $ spend.
C Category Items Comprise 50% of SKU & Contribute to 5% of $ spend.

Advantages of ABC Classification:

- This kind of categorization of inventory helps one manage the entire volume and assign relative priority to the right category. For Example A Class items are the high value items. Hence one is able to monitor the inventory of this category closely to ensure the inventory level is maintained at optimum levels for any excess inventory can have huge adverse impact in terms of overall value.
- **A Category Items:** Helps one identify these stocks as high value items and ensure tight control in terms of process control, physical security as well as audit frequency.
- It helps the managers and inventory planners to maintain accurate records and draw management's attention to the issue on hand to facilitate instant decision-making.

- **B Category Items:** These can be given second priority with lesser frequency of review and less tightly controls with adequate documentation, audit controls in place.

- **C Category Items:** Can be managed with basic and simple records. Inventory quantities can be larger with very few periodic reviews.

VED Analysis:

VED stands for vital, essential and desirable. This analysis relates to the classification of maintenance spare parts and denotes the essentiality of stocking spares.

The spares are split into three categories in order of importance. From the view-points of functional utility, the effects of non-availability at the time of requirement or the operation, process, production, plant or equipment and the urgency of replacement in case of breakdown.

Some spares are so important that their non-availability renders the equipment or a number of equipment in a process line completely inoperative, or even causes extreme damage to plant, equipment or human life.

On the other hand some spares are non-functional, serving relatively unimportant purposes and their replacement can be postponed or alternative methods of repair found. All these factors will have direct effects on the stocks of spares to be maintained.

V: Vital

Vital items which render the equipment or the whole line operation in a process totally and immediately inoperative or unsafe; and if these items go out of stock or are not readily available, there is loss of production for the whole period.

E: Essential

Essential items which reduce the equipment's performance but do not render it inoperative or unsafe; non-availability of these items may result in temporary loss of production or dislocation of production work; replacement can be delayed without affecting the equipment's performance seriously; temporary repairs are sometimes possible.

D: Desirable

Desirable items which are mostly non-functional and do not affect the performance of the equipment.

As the common saying goes "Vital Few — trivial many", the number of vital spares in a plant or a particular equipment will only be a few while most of the spares will fall in 'the desirable and essential' category.

However, the decision regarding the stock of spares to be maintained will depend not only on how critical the spares are from the functional point of view (VED analysis) but also

on the annual consumption (user) cost of spares (ABC — analysis) and, therefore, for control of spare parts both VED and ABC analyses are to be combined.

Inventory Modeling:

This is a quantitative approach for deriving the minimum cost model for the inventory problem in hand.

Economic Order Quantity (EOQ) Model

This model is applied when objective is to minimize the total annual cost of inventory in the organization. Economic order quantity is that size of the order which helps in attaining the above set objective. EOQ model is applicable under the following conditions.

- Demand per year is deterministic in nature
- Planning period is one year
- Lead time is zero or constant and deterministic in nature
- Replenishment of items is instantaneous
- Demand/consumption rate is uniform and known in advance
- No stock out condition exist in the organization

The total annual cost of the inventory (TC) is given by the following equation in EOQ model.

$$TC = C\,D + S.\frac{D}{Q} + I.C.\frac{Q}{2}$$

By taking the first partial derivative of T C w.r.t Q

$$\frac{\delta(TC)}{\delta Q} = 0 + \left(-SD/Q^2\right) + \left(IC/2\right)$$

Setting the $\frac{\delta(TC)}{\delta Q} = 0$ and solveing for Q

$$Q^* = \sqrt{\frac{2DS}{IC}}$$

where Q* is the optimal order quantity.

The graphical representation of the EOQ model is shown in following Figure.

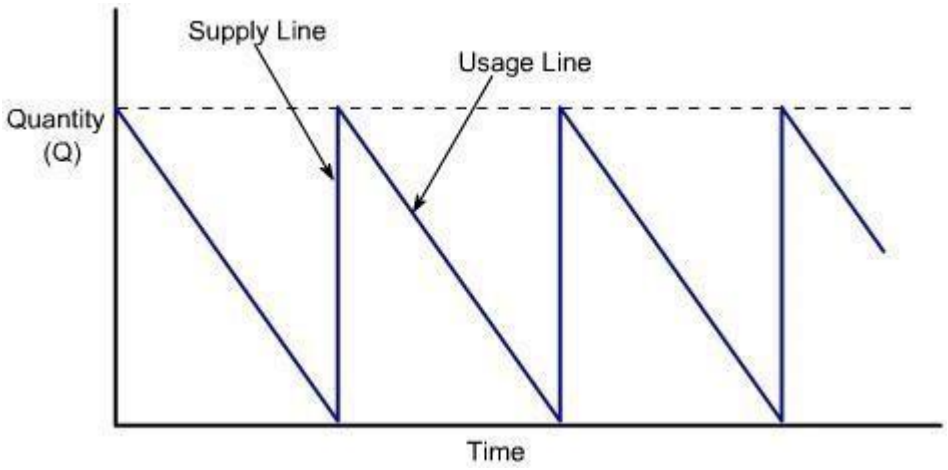


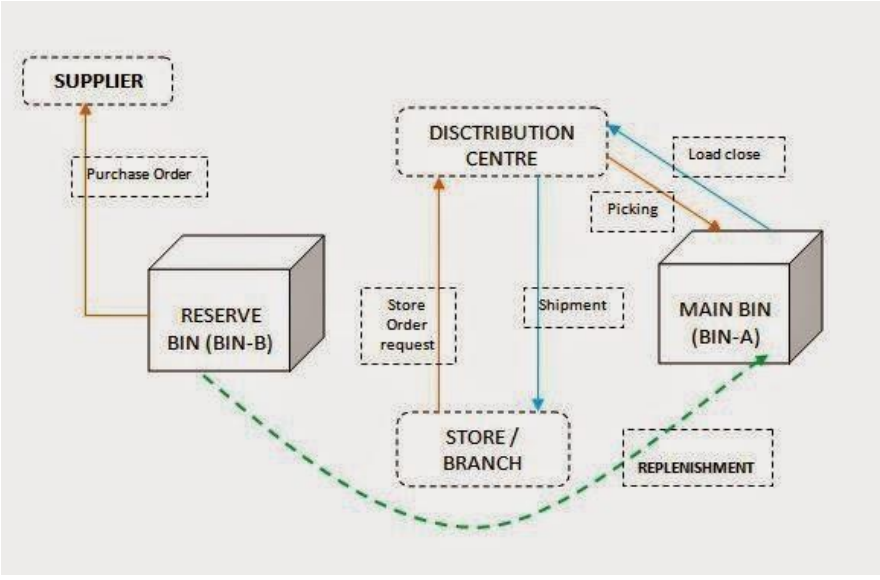
Figure: Economic Order Quantity Model (EOQ Model)

Inventory Control system:

1. **Two Bin System , Fixed order quantity system or Q-System**
2. **Periodic inventory ordering system, or P-System**

Managing our inventory as a retailer is a humongous task. Inventory management grows more and more complicated with increase in sales volume and diversification of product assortments.

Two Bin Systems:



In a **continuous inventory system** (also referred to as a *perpetual system* and a **fixed- order-quantity system**), a continual record of the inventory level for every item is maintained. Whenever the inventory on hand decreases to a predetermined level, referred to as the *reorder point,* a new order is placed to replenish the stock of inventory. The order that is placed is for a fixed amount that minimizes the total inventory costs. This amount, called the *economic order quantity,* is discussed in greater detail later.

A positive feature of a continuous system is that the inventory level is continuously monitored, so management always knows the inventory status. This is advantageous for critical items such as replacement parts or raw materials and supplies. However, maintaining a continual record of the amount of inventory on hand can also be costly.

This is a simple method used usually in warehousing where in an item is stored in two locations or bins in a warehouse and the stock is replenished in the first bin from the second bin once the first bin is consumed completely. The required quantity to be filled in the second bin is placed for ordering.

The availability of stock in each bin is calculated based on reorder lead time to ensure enough stock is made available till the new stock arrives.

Periodic Inventory System

For any business that carries **inventory**, or products stored for future sale, it is necessary to keep track of what is currently on hand. Some businesses keep track of inventory using a periodic inventory system. A **periodic inventory system** is an inventory system that updates inventory at the end of a specified period of time. This may mean that they update their inventory records at the end of each month, quarter, or year. Whenever the period ends, it generally coincides with the end of a **reporting period**, or a timeframe for which a report is drawn on all financial activities that occurred during that time. Common reporting periods conclude on a quarterly or annual basis.

Since a periodic inventory system only keeps track of inventory periodically throughout the year and not as inventory is purchased or sold, a physical count of the inventory must be conducted. A **physical count** is a complete and exact count of each item in the inventory done by hand. Some businesses carry hundreds or thousands of products, so physical counts can be extremely time-consuming. Even for businesses that carry few products, physical counts can be tedious and may take a lot of time to complete if problems, such as missing parts or wrong counts, arise.

MRP:

It was discussed in demand forecasting that in the dependent demand situation, if the demand for an item is known, the demand for other related items can be deduced. For example, if the demand of an automobile is known, the demand of its sub assemblies and sub components can easily be deduced. For dependent demand situations, normal reactive inventory control systems (i.e. EOQ etc.) are not suitable because they result in high inventory costs and unreliable delivery schedules. More recently, managers have realized that inventory planning systems (such as materials requirements planning) are better suited for dependent demand items. MRP is a simple system of calculating arithmetically the requirements of the input materials at different points of time based on actual production plan.

MRP can also be defined as a planning and scheduling system to meet time-phased materials requirements for production operations. MRP always tries to meet the delivery schedule of end products as specified in the master production schedule.

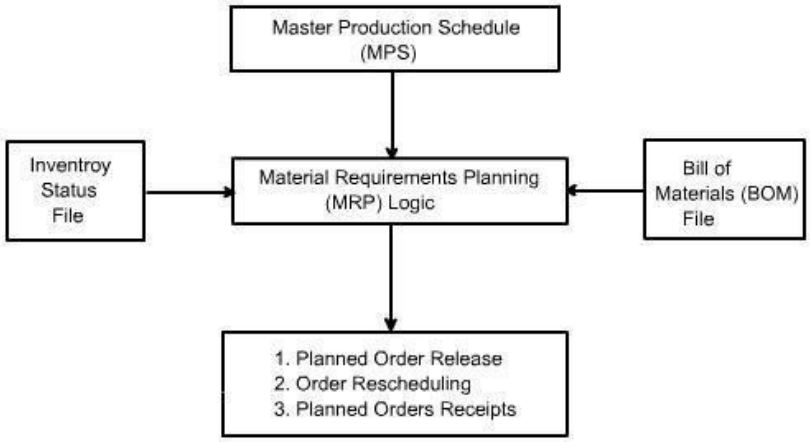
MRP Objectives

MRP has several objectives, such as:

- **Reduction in Inventory Cost**: By providing the right quantity of material at right time to meet master production schedule, MRP tries to avoid the cost of excessive inventory.
- **Meeting Delivery Schedule**: By minimizing the delays in materials procurement, production decision making, MRP helps avoid delays in production thereby meeting delivery schedules more consistently.
- **Improved Performance**: By stream lining the production operations and minimizing the unplanned interruptions, MRP focuses on having all components available at right place in right quantity at right time.

MRP System

A simple sketch of an MRP system is shown in following figure, it can be seen from the figure that an MRP system has three major input components:



Master Production Schedule (MPS):

MPS is designed to meet the market demand (both the firm orders and forecasted demand) in future in the taken planning horizon. MPS mainly depicts the detailed delivery schedule of the end products. However, orders for replacement components can also be included in it to make it more comprehensive.

Bill of Materials (BOM) File:

BOM represents the product structure. It encompasses information about all sub components needed, their quantity, and their sequence of buildup in the end product. Information about the work centers performing buildup operations is also included in it.

Inventory Status File:

Inventory status file keeps an up-to-date record of each item in the inventory. Information such as, item identification number, quantity on hand, safety stock level, quantity already allocated and the procurement lead time of each item is recorded in this file.

After getting input from these sources, MRP logic processes the available information and gives information about the following:

- **Planned Orders Receipts**: This is the order quantity of an item that is planned to be ordered so that it is received at the beginning of the period under consideration to meet the net requirements of that period. This order has not yet been placed and will be placed in future.
- **Planned Order Release**: This is the order quantity of an item that is planned to be ordered in the planned time period for this order that will ensure that the item is received when needed. Planned order release is determined by offsetting the planned order receipt by procurement lead time of that item.
- **Order Rescheduling**: This highlight the need of any expediting, de-expediting, and cancellation of open orders etc. in case of unexpected situations.

ERP:

Inventory management is critical component in ERP Systems that helps to manage retail locations and warehouses. For example: A wholesale super market has loads of products and collection of stock items. With ERP systems it is very easy to organize the number of items with specific identification number which can be confirmed easily. Also you can check the inventory levels for a particular category of item.

ERP systems provide a proper reporting mechanism of inventory in stores and in ware houses. This helps the manufacturing department in planning their future production schedules accordingly. It helps to track the payments and flow of finances into the Accounts. Inventory management in an ERP systems helps to avoid mistakes and take quick decisions. ERP system enables the most efficient stocking methods for inventory and helps improve all the internal operations. ERP system today has advanced features like double-entry inventory with no stock input, output or transformation. Other important features like Drop-shipping, Cross-docking, and Multi-warehouse etc are also taken care of by ERP systems.

Many small organization and retails stores are using ERP software to manage their warehouse and stocks which calculates surpluses, rejections, repairs and other important planning metrics for the entire inventory.

Line of Balance (LOB)

Line of Balance (LOB) is a management control process for collecting, measuring and presenting facts relating to time (see Schedule Control), cost and accomplishment – all measured against a specific plan. It shows the process, status, background, timing and phasing of the project activities, thus providing management with measuring tools that help:

- Comparing actual progress with a formal objective plan.
- Examining only the deviations from established plans, and gauging their degree of severity with respect to the remainder of the project.
- Receiving timely information concerning trouble areas and indicating areas where appropriate corrective action is required.
- Forecasting future performance.

The LOB itself is a graphic device that enables a manager to see at a single glance which activities of an operation are "in balance" – i.e., whether those which should have been completed at the time of the review actually are completed and whether any activities scheduled for future completion are lagging behind schedule. The LOB chart comprises only one feature of the whole philosophy which includes numerous danger signal controls for all the various levels of management concerned.

To do LOB, the following is needed:

- A contract schedule, or objective chart;
- A production plan or lead-time chart for the production process itself;
- Control points cumulative inventories; and
- A program status chart on which to plot LOB and the cumulative quantities of units that have passed through the control points of the assembly/production process.

Just-in-Time (JIT) Inventory Management:

Just-in-time (JIT) inventory management, also known as lean manufacturing and sometimes referred to as the Toyota production system (TPS), is the process of ordering and receiving inventory for production and customer sales only as it is needed and not before. This means that the company does not hold safety stock and operates with low inventory levels. This strategy helps companies lower their inventory carrying costs by increasing efficiency and decreasing waste.

This method requires producers to forecast demand accurately.

Just-in-time inventory management is a cost-cutting inventory management strategy though it can lead to stock outs. The goal of JIT is to improve return on investment by reducing non-essential costs.

Competing inventory management systems are short-cycle manufacturing (SCM), continuous-flow manufacturing (CFM) and demand-flow manufacturing (DFM).

This inventory system represents a shift away from the older just-in-case strategy, in which producers carried large inventories in case higher demand had to be met.

HISTORY:

The **management technique** originated in **Japan** and is often attributed to Toyota. However, many believe that Japan's shipyards were the first to develop and successful implement this approach. Its origins are seen as three-fold: Japan's post-war lack of cash, lack of space for big factories and inventory and Japan's lack of natural resources.

Thus the Japanese "leaned out" their processes. "

News about JIT/TPS reached western shores in 1977 with implementations in the US and other developed countries beginning in 1980.

Example of JIT:

Toyota started with just-in-time inventory controls in the 1970s and it took more than 15 years to perfect. Toyota sends off orders for parts only when it receives new orders from customers.

For Toyota and just-in-time manufacturing to succeed, the company must have steady production, high-quality workmanship, no machine breakdowns at the plant, reliable suppliers and quick ways to assemble machines that put together vehicles.

Japanese Concepts:

Japanese manufacturing techniques, as an area of influential practices and philosophies, emerged in the post-World War II era and reached the height of their prominence in the 1980s. Many adaptations of Japanese methods, and indeed, Japanese manufacturing vocabulary, have made their way into U.S. and worldwide manufacturing operations. Distinguishing characteristics associated with Japanese manufacturing include an emphasis on designing processes to optimize efficiency and a strong commitment to quality.

Perhaps the most widely recognized collection of Japanese manufacturing techniques is what is known as the Toyota Production System (TPS), the core of which is just-in-time (JIT) production or so-called lean manufacturing. The pioneers of these methods were Tahiti Ohno, a former Toyota executive, and Shigeo Shingo, an eminent engineer and consultant. In his 1989 book *The Study of the Toyota Production System from an Industrial Engineering Perspective,* Shingo identified these basic features of TPS:

1. It achieves cost reductions by eliminating waste, be it staff time, materials, or other resources.

2. It reduces the likelihood of overproduction by maintaining low inventories ("nonstock") and keeps labor costs low by using minimal manpower.
3. It reduces production cycle time drastically with innovations like the Single-Minute Exchange of Die (SMED) system, which cuts downtime and enables small-lot production.
4. It emphasizes that product orders should guide production decisions and processes, a practice known as order-based production.

These and other practices form a contrast to traditional (e.g., pre-1980s) Western manufacturing, which tended to emphasize mass production, full capacity utilization, and the economies of scale that were presumed to follow.

UNIT III

SHORT QUESTIONS

1. Define inventory?
2. What are the functions of inventory?
3. Explain shortage or penalty cost?
4. What is economic order quantity?
5. Define economic lot size?
6. Write the various types of inventory.
7. What is safety stock?
8. What is lead time?
9. What is reorder point?
10. What is order quantity?
11. What is economic order quantity?
12. What are the characteristics of two bin system?
13. What is purchase cost?
14. What is ordering cost?
15. What is carrying cost?
16. What is stock out cost?

LONG QUESTIONS

1. What are the types of inventory?
2. Explain direct inventories?
3. Describe the cost associated with inventories?
4. Explain carrying cost and ordering cost?
5. Derive the formula for determining EOQ?
6. Describe the various inputs to MRP system?
7. Differentiate between MRP/MRP-II and ERP?

8. What are the Japanese concepts used in JIT (Just in time)?
9. Explain the VED analysis
10. Write short notes on P-System
11. Write short notes on Q-System
12. Explain the procedure involved in carrying ABC analysis
13. Mention the control procedures are to be exercised on A class; B class and C class items?

UNIT 3

POWER POINT PRESENTATION

INVENTORY MANAGEMENT

DEPARTMENT OF MECHANICAL ENGINEERING

INVENTORY

➢ **MEANING**

- held for SALE
- Consumed in the PRODUCTION of goods/services

➢ **Forms** of Inventory for Manufacturing Comp.

Raw materials, Work in process, Finished goods and stores & spares

INVENTORY MANAGEMENT- OBJECTIVES

- minimize investments in inventory

- meet the demand for products by efficiently organizing the production & sales operations

COSTS OF HOLDING INVENTORIES

- Ordering costs
- Inventory Carrying costs
- Opportunity costs of funds blocked
- Shortage

RISK OF HOLDING INVENTORY

- Price decline
- Product Deterioration
- Product Obsolescence

TOOLS & TECHNIQUES OF INVENTORY MANAGEMENT/ CONTROL

- ABC Analysis
- Economic Ordering Quantity (EOQ)
- Order Point Problem
- Two Bin Technique
- VED Classification
- HML Classification
- SDE Classification
- FSN Classification
- Order Cycling System
- Just In Time (JIT)

ECONOMIC ORDERING QUANTITY (EOQ)

- Level of Inventory at which

- **Total Cost*** of Inventory is **MINIMUM**

  ***(Ordering and Carrying Cost)

EOQ MODEL

$$Q = \sqrt{\frac{2UP}{S}}$$

Q = *E*conomic Order Quantity

U = Annual usage/demand

P = Cost of Placing an order

S = Storage cost per unit per order

* Where Storage cost is given in % , it is always calculated by multiplying the % with the purchase price of raw material per unit, i.e Storage cost = % X Purchase price of raw material

EOQ- EXAMPLE

- **A firm's annual inventory is 1,600 units. The cost of placing an order is Rs 50, purchase price of raw material/unit is Rs.10 and the carrying costs is expected to be 10% per unit p.a. Calculate EOQ?**

U=1600, P= Rs. 50, S= .10 x Rs.10=Rs.1

$$EOQ = \frac{2 \times 1600 \times 50}{1}$$

= 400 units

ORDER POINT PROBLEM

- The **re-order point** is that level of inventory when a fresh order should be placed with suppliers. It is that inventory level which is equal to the consumption during the lead time or procurement time.
- **Re-order level** = (Daily usage × Lead time) + Safety stock.
- **Minimum level** = Re-order level – (Normal usage × Average delivery time).
- **Maximum level** = Reorder level – (Minimum usage × Maximum delivery time) + Re-order quantity.
- **Average stock level** = Minimum level + (Re-order quantity)/2.
- **Danger level** = (Average consumption per day × Lead time in days for emergency purchases).

TWO BIN TECHNIQUE

- Control of Category ‘C’ inventories
- Two Bins/Groups

First Bin- just enough to last from the date a new order is placed until it is received for inventory.

Second Bin- enough to meet current demand over the period of replenishment.

VED CLASSIFICATION

- Specifically used for Classification of **SPARE PARTS**

➢ **V-** part is VITAL(high stock level)

➢ **E-** part is *ESSENTIAL* (moderate stock level)

➢ **D-** part is DESIRABLE (minimum stock level)

HML CLASSIFICATION

- Material classified on the basis of **UNIT VALUE**

- **H**- HIGH VALUE
- **M**- MEDIUM VALUE
- **L** – LOW VALUE

FSN CLASSIFICATION

- Inventory is classified based on the MOVEMENT OF INVENTORIES from stores
- Inventory technique used to **AVOID OBSOLESCENCE**

➢ **F**- Fast moving

➢ **S**- Slow moving

➢ **N**- Non moving

ORDERING CYCLING SYSTEM

- Periodic reviews are made
- of each item of inventory
- & orders are placed
- to restore stock
- to a prescribed stock level

JUST-IN-TIME (JIT) INVENTORY CONTROL

- The JIT control system implies that the firm should maintain a minimal level of inventory and rely on suppliers to provide parts and components 'just-in-time' to meet its assembly requirements.

- JIT also known as Zero Inventory Production Systems**(ZIPS)**, Zero Inventories**(ZIN)**, Materials as Needed**(MAN)**, or Neck of Time**(N0T)**

JIT VS. JIC

- This may be contrasted with the traditional inventory management system which calls for maintaining a healthy level of safety stock to provide a reasonable protection against uncertainties of consumption and supply – the traditional system may be referred to as a **“just-in-case”** system.
- The **most commonly used tools** of inventory management in India are: **ABC analysis, FSN analysis and inventory turnover analysis.**

UNIT III

INDUSTRIAL APPLICATIONS

Inventory Management

Effectively managing inventory is crucial to your customers' experience; the only thing worse than not having a product in stock for customers to order is discovering you don't have it in stock after they've ordered it. It's equally crucial to your back office operations, since optimal inventory levels improve staff efficiency, help you make the best use of your warehouse space, and reduce the risk of getting stuck with spoiled, out-of-season, or obsolete products that have to be marked down or discarded.

Inventory management has three main components:

- **Product management** allows you to manage stock levels of individual products, keeping them up to date based on customer orders and incoming product.
- **Supplier management** allows you to manage suppliers, keeping track of which SKUs come from which suppliers and tracking shipments, POs, and payments by supplier.
- **Purchase order management** allows you to generate and send—based on real-time stock levels—purchase orders, then track order status and receive stock into inventory against the order.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UNIT III

ASSIGNMENT

UNIT III

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UNIT 4

ROUTING

Course objective

Student will be able learn various routing procedures and scheduling policies...

Course Outcome

Student should understand about the definition , routing sheets, scheduling.

Routing: Definition –Routing procedure –Route sheets – Bill of material – Factors affecting routing procedure.

Schedule –definition – Difference with loading, Scheduling Policies – Techniques, Standard scheduling methods.

Job shop, flow shop

ROUTING:

Routing may be defined as the selection of path which each part of the product will follow while being transformed from raw materials to finished products. Path of the product will also give sequence of operation to be adopted while being manufactured. In other way, routing means determination of most advantageous path to be followed from department to department and machine to machine till raw material gets its final shape, which involves the following steps:

Type of work to be done on product or its parts, Operation required to do the work, Sequence of operation required, where the work will be done, a proper classification about the personnel required and the machine for doing thework.
For effective production control of a well-managed industry with standard conditions, the routing plays an important role, i.e., to have the best results obtained from available plant capacity. Thus routing provides the basis for scheduling, dispatching and follow-up.

Techniques of Routing:

While converting raw material into required goods different operations are to be performed and the selection of a particular path of operations for each piece is termed as 'Routing'. This selection of a particular path, i.e. sequence of operations must be the best and cheapest to have the lowest cost of the final product. The various routing techniques are:

Route card:

This card always accompanies with the job throughout all operations. This indicates the material used during manufacturing and their progress from one operation to another. In addition to this the details of scrap and good work produced are also recorded

Worksheet: It contains Specifications to be followed while manufacturing. Instructions regarding routing of every part with identification number of machines and This sheet is made for manufacturing as well as for maintenance.

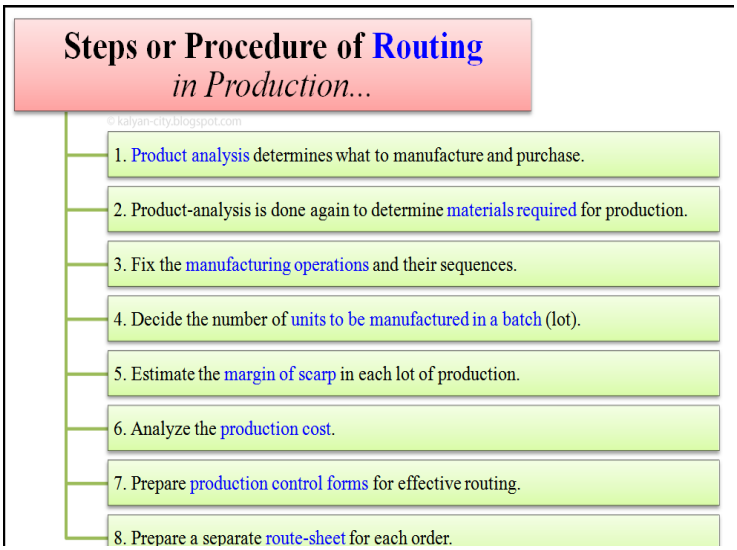
Route sheet: It deals with specific production order. Generally made from operation sheets. One sheet is required for each part or component of the order. This includes the following: Number and other identification of order. Symbol and identification of part, Number of pieces to be made, Number of pieces in each lot if put through in lots. Operation data which includes: List of operation on the part. Department in which operations are to be

performed, Machine to be used for each operation. Fixed sequence of operation, if any

Move order: Though this is document needed for production control, it is never used for routing system. Move order is prepared for each operation as per operation sheet. On this the quantity passed forward, scrapped and to be rectified are recorded. It is returned to planning office when the operation is completed.

Routing Procedure:

Steps or Procedure of Routing in procedure



Following important steps are involved in the procedure of routing:

1. Product analysis determines what to manufacture andpurchase.
2. Product-analysis is done again to determine materials required forproduction.
3. Fix the manufacturing operations and theirsequences.
4. Decide the number of units to be manufactured in a batch(lot).
5. Estimate the margin of scarp in each lot ofproduction.
6. Analyze the productioncost.
7. Prepare production control forms for effective routing.
8. Prepare a separate route-sheet for eachorder.

1. Product analysis

Product analysis is the first step in the routing procedure. This is done to find out what parts (goods) should be manufactured and what parts should be purchased. This depends mainly on the relative cost. It also depends on other factors such as technical consideration, purchase policies, availability of personnel, availability of equipment, etc. Generally, during less-busy periods; most of the parts are manufactured in the factory. However, during the busy period, many parts are purchased fromoutside.

2. Determine requiredmaterials

Product-analysis is done again to find out what materials are required for production and their quantity and quality.

3. Fix manufacturingoperations

The next step in the routing procedure is to fix (decide) the manufacturing operations and their sequences. The detailed production procedure is then scheduled (planned). Information required for this is derived from technical experience and by analyzing the machine capacity.

4. Determine size ofbatch

The number of units to be manufactured in any one lot (group or batch) should be decided. This is done concerning customers' orders. Necessary provision should also be made for rejections during the productionprocess

5. Estimate margin ofscrap

The amount of scrap in each lot, should be estimated. Generally, a scrap margin is between 2% to 5% ofproduction.

6. Analyze the production cost

Estimating the cost of manufactured goods is actually the function of costing department. However, the routing section provides necessary data to the costing department that enables it to analyze the production cost.

7. Prepare production controlforms

Production Control forms such as Job Cards, Inspection Cards, Tool Tickets, etc. should be prepared. These forms should contain complete information for effective routing.

8. Prepare routesheet

Route sheet is prepared on a production control form. It shows the part number, description of the part and the materials required. It is prepared by a route clerk. Separate route-sheet is required for each part of a customer's order.

Bill of material:

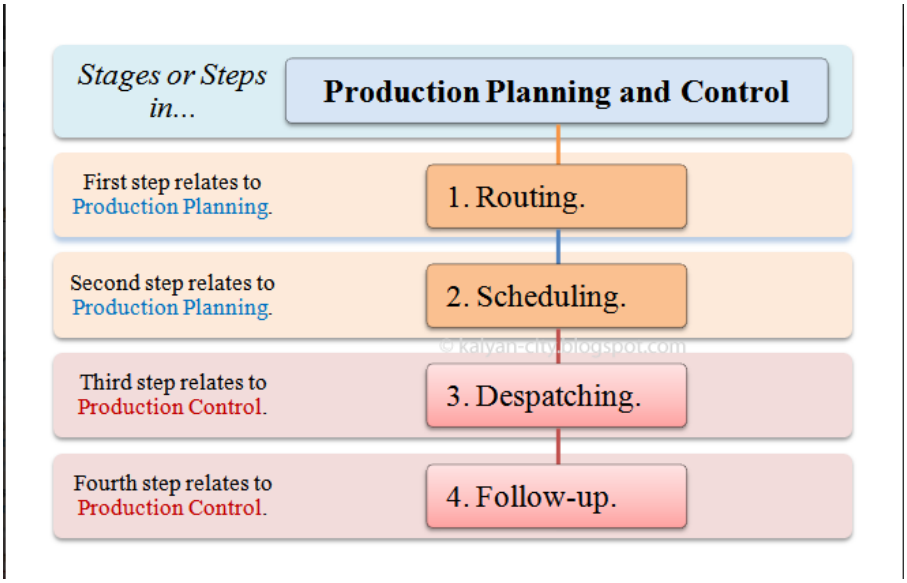
The bill-of-material BOM in the machine tool industry takes two different forms in design and manufacturing functions: Engineering BOM E BOM , which is used by the design engineer to represent designed product structure; and manufacturing BOM M BOM , which is used by MRPII system for MRP explosion. The designer constructs the E BOM after the product has been designed. Next, the E BOM is transformed into the M BOM by considering

assembly sequence and constraints. Constructing a M BOM simply involves compressing the E BOM into a three-level M BOM. Planning of a M BOM still depends primarily on the experience input of a manufacturing engineer and is performed manually. This trial and error and time consuming approach creates an inconsistent method for planning the M BOM. Therefore, in this study, a three-stage M BOM planning method is developed. Stage one plans the initial M BOM, stage two improves the M BOM and stage three tunes the M BOM. Concepts and algorithms of each stage are highlighted in this study. Moreover, an illustration is presented to demonstrate the feasibility of M BOMplanning

A bill of materials or product structure (sometimes bill of material, BOM or associated list) is a list of the raw materials, sub-assemblies, intermediate assemblies, sub-components, parts and the quantities of each needed to manufacture an end product. A BOM may be used for communication between manufacturing partners, or confined to a single manufacturing plant. A bill of materials is often tied to a production order whose issuance may generate reservations for components in the bill of materials that are in stock and requisitions for components that are not instock.

Factors affecting routing procedure

Steps in Production Planning and Control



The four stages or steps in production planning and control are:

1. Routing,
2. Scheduling,
3. Dispatching,and
4. Follow-up.

Initial two steps i.e. Routing and Scheduling, relate to production planning.Last two steps i.e. Dispatching and Follow-up, relate to production control.Now let's continue our discussion further to understand each step in detail.

1. Routing

Routing is the first step in production planning and control.

Routing can be defined as the process of deciding the path (route) of work and the sequence ofoperations.

Routing fixes in advance:

- The quantity and quality of theproduct.
- The men, machines, materials, etc. to beused.
- The type, number and sequence of manufacturing operations,and
- The place ofproduction.

In short, routing determines ‘What’, ‘How much’, ‘With which’, ‘How’ and ‘Where’ to produce.

Routing may be either very simple or complex. This depends upon the nature of production. In a continuous production, it is automatic, i.e. it is very simple. However, in a job order, it is verycomplex.

Routing is affected by the human factor. Therefore, it should recognize human needs, desires and expectations. It is also affected by plant-layout, characteristics of the equipment, etc.

The main objective of routing is to determine (fix) the best and cheapest sequence of operations and to ensure that this sequence is followed in the factory.

Routing gives a very systematic method of converting raw-materials into finished goods. It leads to smooth and efficient work. It leads to optimum utilization of resources; namely, men, machines, materials, etc. It leads to division of labor. It ensures a continuous flow of materials without any backtracking. It saves time and space. It makes the work easy for the production engineers and foremen. It has a great influence on design of factory's building and installedmachines.

So, routing is an important step in production planning and control. Production planning starts withit.

2. Scheduling

- Scheduling is the second step in production planning and control. It comes after routing.
- Scheduling meansto:
- Fix the amount of work todo.
- Arrange the different manufacturing operations in order ofpriority.
- Fix the starting and completing, date and time, for eachoperation.

- Scheduling is also done for materials, parts, machines, etc. So, it is like a time-table of production. It is similar to the time-table, prepared by therailways.
- Time element is given special importance in scheduling. There are different types of schedules; namely, Master schedule, Operation schedule and Dailyschedule.
- Scheduling helps to make optimum use of time. It sees that each piece of work is started and completed at a certain predetermined time. It helps to complete the job systematically and in time. It brings time coordination in production planning. All this helps to deliver the goods to the customers in time. It also eliminates the idle capacity. It keeps labor continuously employed.
- So, scheduling is an important step in production planning and control. It is essential in a factory, where many products are produced at the sametime.

3. Dispatching

Dispatching is the third step in production planning and control. It is the action, doing or implementation stage. It comes after routing and scheduling.

Dispatching means starting the process of production. It provides the necessary authority to start the work. It is based on route-sheets and schedule sheets.

Dispatching includes the following:

- Issue of materials, tools, fixtures, etc., which are necessary for actualproduction.
- Issue of orders, instructions, drawings, etc. for starting thework.
- Maintaining proper records of the starting and completing each job ontime.
- Moving the work from one process to another as per theschedule.
- Starting the controlprocedure.
- Recording the idle time ofmachines.
- Dispatching may be either centralized ordecentralized:
- Under centralized dispatching, orders are issued directly by a centralizedauthority.
- Under decentralized dispatching, orders are issued by the concerneddepartment.

4. Follow Up

Follow-up or Expediting is the last step in production planning and control. It is a controlling device. It is concerned with evaluation of the results.

Follow-up finds out and removes the defects, delays, limitations, bottlenecks, loopholes, etc. in the production process. It measures the actual performance and compares it to the expected performance. It maintains proper records of work, delays and bottlenecks. Such records are used in future to control production.

Follow-up is performed by 'Expediters' or 'Stock Chasers'.

Follow-up is necessary when production decreases even when there is proper routing and scheduling. Production may be disturbed due to break-downs of machinery, failure of power, shortage of materials, strikes, absenteeism, etc.

Follow-up removes these difficulties and allows a smooth production.

Scheduling

Scheduling can be defined as "prescribing of when and where each operation necessary to manufacture the product is to be performed." It is also defined as "establishing of times at which to begin and complete each event or operation comprising a procedure". The principle aim of scheduling is to plan the sequence of work so that production can be systematically arranged towards the end of completion of all products by duedate.

Principles of Scheduling:

The principle of optimum task size: Scheduling tends to achieve maximum efficiency when the task sizes are small, and all tasks of same order of magnitude.

Principle of optimum production plan: The planning should be such that it imposes an equal load on all plants.

Principle of optimum sequence: Scheduling tends to achieve the maximum efficiency when the work is planned so that work hours are normally used in the same sequence.

Inputs to Scheduling

Performance standards: The information regarding the performance standards (standard times for operations) helps to know the capacity in order to assign required machine hours to the facility. Units in which loading and scheduling is to be expressed. Effective capacity of the work centre. Demand pattern and extent of flexibility to be provided for rush orders. Overlapping of operations. Individual job schedules.

Scheduling Strategies Scheduling strategies vary widely among firms and range from 'no scheduling' to very sophisticated approaches. These strategies are grouped into four classes:

Detailed scheduling: Detailed scheduling for specific jobs that are arrived from customers is impracticable in actual manufacturing situation. Changes in orders, equipment breakdown, and unforeseen events deviate the plans.
Cumulative scheduling: Cumulative scheduling of total work load is useful especially for long range planning of capacity needs. This may load the current period excessively and under load future periods. It has some means to control thejobs.
Cumulative detailed: Cumulative detailed combination is both feasible and practical approach. If master schedule has fixed and flexible portions.
Priority decision rules: Priority decision rules are scheduling guides that are used independently and in conjunction with one of the above strategies, i.e., first come first serve.

These are useful in reducing Work-In-Process (WIP) inventory.

Types of Scheduling

Types of scheduling can be categorized as forward scheduling and backward scheduling.

Forward scheduling:

It is commonly used in job shops where customers place their orders on "needed as soon as possible" basis. Forward scheduling determines start and finish times of next priority job by assigning it the earliest available time slot and from that time, determines when the job will be finished in that work centre. Since the job and its components start as early as possible, they will typically be completed before they are due at the subsequent work centers in the routing. The forward method generates in the process inventory that are needed at subsequent work centers and higher inventory cost. Forward scheduling is simple to use and itgets jobs done in shorter lead times, compared to backwardscheduling.

Backward scheduling :

It is often used in assembly type industries and commit in advance to specific delivery dates. Backward scheduling determines the start and finish times for waiting jobs by assigning them to the latest available time slot that will enable each job to be completed just when it is due, but done before. By assigning jobs as late as possible, backward scheduling minimizes inventories since a job is not completed until it must go directly to the next work centre on its routing. Forward and backward scheduling methods are shown in the following figure.

Standard scheduling Methods

The scheduling methodology depends upon the type of industry, organization, product, and level of sophistication required. They are:

Charts and boards, Priority decision rules, and Mathematical programming methods, **Gantt Charts and Boards** Gantt charts and associated scheduling boards have been extensively used scheduling devices in the past, although many of the charts are now drawn by computer. Gantt charts are extremely easy to understand and can quickly reveal the current or planned situation to all concerned. They are used in several forms, namely, Scheduling or progress charts, which depicts the sequential schedule; Load charts, which show the work assigned to a group of workers or machines; and Record a chart, which are used to record the actual operating times and delays of workers and machines. **Priority Decision Rules** Priority decision rules are simplified guidelines for determining the sequence in which jobs will be done. In some firms these rules take the place of priority planning systems such as MRP systems. Following are some of the priority rules followed.

Symbol	*Priority rule*
FCFS	First come, first served
EDO	Earliest due date
LS	Least slack (that is, time due less processing time)
SPT	Shortest processing time
LPT	Longest processing time
PCO	Preferred customer order
RS	Random selection

Mathematical Programming Methods: Scheduling is a complex resource allocation problem. Firms process capacity, labor skills, materials and they seek to allocate their use so as to maximize a profit or service objective, or perhaps meet a demand while minimizing costs. The following are some of the models used in scheduling and production control.

Linear programming model: Here all the constraints and objective functions are formulated as a linear equation and then problem is solved for optimality. Simplex method, transportation methods and assignment method are major methods usedhere.

PERT/CPM network model: PERT/CPM network is the network showing the sequence of operations for a project and the precedence relation between the activities to be completed.
Note: Scheduling is done in all the activities of an organization i.e., production, maintenance etc. Therefore, all the methods and techniques of scheduling are used for maintenance management.

Line Balancing:

Production Line Balancing:

Line-balancing strategy is to make production lines flexible enough to absorb external and internal irregularities. There are two types of line balancing, which we have explained as –

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Labour Balancing and Assignments:

Strategy of production line stability is the tendency for labour assignments to be fixed. Labor feasibility is an important feature in the strategy of production line flexibility linked to individual skills and capabilities –

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- The management practice of deliberately pulling worker's of the line when the line is runningsmoothly.
- The movement of whole crews from one dedicated line to another as the model mix changes.
- Group Technology – In which one worker can handle variety of tasks (automation) in a single workcentre.

Equipment Balancing:

While balancing equipment, attempt to ensure that each piece of equipment in the work cell has the same amount of work. Now days every manufacturer is attempting to maximize the utilization of all available equipments. Such high utilization is often counterproductive and may be the wrong goal because; high utilization is usually accompanied by high inventory.

Equipment Failure:

An equipment failure is a major serious matter, with the potential to shut down a production line. To avoid such failures one should not overload the equipments, and workers should be trained to perform a daily machine checking (preventive maintenance) and following standard operating procedures. The advantage for Maintenance and Engineering Department does not lie in running late shifts, hence calculate the preventive maintenance time and schedule theactivity.

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Line Balancing Leadership:

Workmen should lead the production line balancing effort, so that they can react quickly when line imbalances (static and dynamic) crop up as a result of changeover to make a different item or changes in the outputrate.

Conclusion:

Production-line balancing study tends to employ thought and ingenuity to change conditions. Production-line design and operation is more art than science. Labour flexibility is the key to effective resource management. The idea of worker's checking and doing minor repair work on their own equipment possibly decreases the risk of equipment failure. Selecting an appropriate set of balancing mechanism is a part of work cell design and it must be linked with many other decisions for the system to function well.

Aggregate planning:

Aggregate planning is to determine the planned production quantity by period to meet forecast demand over a ***medium-range planning horizon***. The overall objective is to allocate all the resources in an efficient manner while satisfying the forecast demands over the planning horizon.

Aggregate planning is usually performed in broad and general terms at the ***productline (group)***level. A common unit of measurement (e.g., weight, volume, labor hours) is used to describe the output levels in a productionplan.

Aggregate planning is quite complicated with variable demand and/or supply. The demand pattern can be altered to some degree through pricing, promotion, backlogs and reservations, developing alternative products, and turning away customers. On the supply side, the major *variables* associated with aggregate planning include inventory level, work force size (hiring and layoff), extra shift, overtime or under-time, product mix, temporary/part-time employees, and subcontracting.

In aggregate planning, an organization attempts to satisfy demand by manipulation of the ***size*** and ***combination*** of the variables in control. Most organizations do not design aggregate plans that follow very closely the ups and downs of actual demands because it is usually too costly to vary output levels significantly from one period to the next period**.**

Aggregate Planning Procedure

1. Develop organizational policies regarding the use of aggregateplanning variables.
2. Establish the forecasting time period and the horizon of the aggregateplan.
3. Develop the demand forecastingsystem.
4. Select an appropriate unit of aggregatecapacity.
5. Determine the relevant coststructures.
6. Develop an aggregate planningmodel.
7. Develop alternative aggregate plans and select the bestplan.

Aggregate Planning Strategies

1. Pure chase strategy – match demand period byperiod
2. Pure level strategy – maintain a level workforce or a steady outputrate
3. Hybrid (mixed) strategy – use a combination of decisionvariables

Aggregate Planning Methods

1. Trial-and-errormethod
2. Mathematicalmethods

Expediting:

Expediting is a concept in purchasing and project management for securing the quality and timely delivery of goods and components. The procurement department or an external expeditor controls the progress of **manufacturing** at the supplier concerning quality, packing, conformity with standards and settimelines.

Expediting is especially needed in large scale projects, for example, when a power plant or a refinery is erected, because of a delay caused by late delivery or inferior quality willgetveryexpensiveandcouldleadtounsatisfiedclients,thusthelossofaproject.To

save these unnecessary costs and minimize potential risks, the supplier and customer may agree on the use of a third party expeditor. These are experts from companies specializing in this field who keep track of the deadlines, supervise progress on site and check whether the components are properly packed. After inspection they notify the involved parties and banks about their findings; if everything is as agreed the bank will initiate the transfer of the price of the goods to the supplier. In this way, the supplier secures his liquidity as he is paid immediately when the components leave his factory (letter of credit) and the customer/bank knows that the goods will be delivered correctly. Expediting is relevant for many industries, such as the oil and gas industry, the general energy industry and the infrastructure industry.

Control Aspects:

Expediting exists in several levels:

Production control: The expeditor inspects the factory whether the production is up to the standards of the country the goods are destined for. This is especially necessary for food or engineering equipment like power plant components. He or she controls as well whether the regular audits for ISO 9001 etc. have been made.

Quality control: The components are tested whether they function as required and whether they are made to the measurements and standards of the customer. A part of this quality control can be the testing for compliance with standards of the destination country, e.g. ASME.

Packing/transport survey: This is the lowest and most used level of expediting, as the goods are only counted and the packing is controlled whether it will withstand the adversities of transport (pre-shipmentinspection).

Project management: At a large-scale project, not only goods are controlled. The expeditor also keeps an eye on the deadlines and milestones of the project and whether the supplier will be on time. This way he or she monitors the crucial procurement parts of the project.

A **job shop** is a type of manufacturing process in which small batches of a variety of custom products are made. In the job shop process flow, most of the products produced require a unique set-up and sequencing of process steps. Job shops are usually businesses that perform custom parts manufacturing for other businesses. However, examples of job shops include a wide range of businesses—a machine tool shop, a machining center, a paint shop, a commercial printing shop, and other manufacturers that make custom products in small lot sizes. These businesses deal in customization and relatively small production runs, not volume and standardization.

CHARACTERISTICS OF A JOB SHOP

Layout

In the job shop, similar equipment or functions are grouped together, such as all drill presses in one area and grinding machines in another in a process layout. The layout is designed to minimize material handling, cost, and work in process inventories. Job shops use general purpose equipment rather than specialty, dedicated product-specific equipment. Digital numerically controlled equipment is often used to give job shops the flexibility to change set-ups on the various machines very quickly. Because economies of scale are usually not a part of a job shop's competitive edge, they compete on factors other than price. They compete on quality, speed of product delivery, customization, and new product introduction.

Routing

When an order arrives in the job shop, the part being worked on travels throughout the various areas according to a sequence of operations. Not all jobs will use every machine in the plant. Jobs often travel in a jumbled routing and may return to the same machine for processing several times. This type of layout is also seen in services like department stores or hospitals, where areas are dedicated to one particular product (men's clothing) or one type of service (maternity ward).

Employees

Employees in a job shop are typically highly skilled craft employees who can operate several different classes of machinery. These workers are paid higher wages for their skill levels. Due to their high skill level, job shop employees need less supervision. Workers may be paid a standard hourly wage or by an incentive system. The role of management is to bid on jobs and to establish prices for customer orders. The key activity in a job shop is processing information.

Information

Information is the most critical aspect of a job shop. Information is needed to quote a price, bid on a job, route an order through the shop, and specify the exact work to be done. Information begins with quoting, then a job sheet and blueprint are prepared before the job is released to the floor. Once on the production floor, employees complete job sheets and time cards for labor cost calculations and to update records for quoting future jobs when variances are present.

While it is often easy to bid on jobs the shop has manufactured before, new jobs require accurate costing of labor, materials, and equipment as well as accurate assigning of overhead to the job. Tickets follow each job through the shop, where time and activities are recorded. Because the job shop makes specialty, custom items, it competes on quality and customer service and not on price. The job shop has little if any raw materials inventory because customers bring in the parts and materials to be worked on. The job shop has work-in-process inventory while jobs are being completed, but typically the customer is waiting on the order and expects prompt delivery, so there is no finished goods inventory in this make-to-order environment. Some job shops, like many small businesses, thrive on managing cash flow. They may work on small jobs to complete them by the end of the month so they can bill

customers for the work.

Scheduling

A job is characterized by its route, its processing requirements, and its priority. In a job shop the mix of products is a key issue in deciding how and when to schedule jobs. Jobs may not be completed based on their arrival pattern in order to minimize costly machine set-ups and change-overs. Work may also be scheduled based on processing time, from shortest to longest.

Capacity is difficult to measure in the job shop and depends on lot sizes, the complexity of jobs, the mix of jobs already scheduled, the ability to schedule work well, the number of machines and their condition, the quantity and quality of labor input, and any process improvements.

Flow Shop :

Definition

A fabrication facility that uses fast and customized production machinery to manufacture one or more similar goods. A flow shop, such as an automobile assembly line, that is operated by a manufacturing business is typically optimized for the highest possible production speed and quality.

In a flow shop, the processes are arranged in the sequence that the parts are processed. The best known example is the assembly line, but there are many others.

This type of production system is usually the ultimate goal of any lean system. In fact, most of the writing in manufacturing and many of the lean methods concern the flow shop. The other methods, job shop and project shop, often feel even neglected to me. But then, it is just so much easier to perfect a flow shop than the other two.

The big advantage of the flow shop is its repeatability! All work steps are repeated (ideally in identical form) over and over again within a short time period. One example would be an automotive assembly line, where the work content of every station is around one to three minutes before the process is completed and the cycle starts anew. Machine tool makers and aircraft assembly lines may have a cycle of a few hours (see Trumpf for an example), which is longer than a car maker but still much faster than the job shop or project stop alternatives. This repeatability gives a lot of enormous benefits.

Repetitive process cycles make optimization easier for humans! Human workers can learn one to three minutes of repeating work in an assembly line much easier than learn the always-different work in a job shop. For example, a lathe worker that is suited for job shops would need a long and costly education and years of practice to achieve mastery, and would command a higher salary. Teaching a worker a three-

minute work content is done in a few days to achieve mastery (or even hours, but you should not cut it too short – see Operator Training at Toyota and Scania for an example). Labor cost is usually lower too, although the workers would prefer the higher salary, of course. To prevent boredom, the worker can work at different tasks at different times.

Repetitive process cycles make optimization easier for machines! Optimization is also easier for machines. If a work cell or robot always handles the same parts, it is much easier to mechanize and automate. Since the work content is much smaller, it is a lot easier to program a multipurpose machine. In fact, since the work content is (nearly) identical each time, it is also much easier to adapt the hardware. Rather than a (slower) multipurpose machine, you have a faster dedicated machine exactly for this process.

Much easier logistics! The repeatability applies not only to the processes but also to the logistics. Since the steps are identical and always at the same spot, knowing what to bring where is so much easier. Part A always goes to process X, and Part B to process Y. Additionally, it is not only the same location but also the same frequency. Rather than a part per hour, day, or even less, the parts are needed by the minute or second. The material flow is not only with a clear source and destination, but also much higher frequency than job shops. This makes it much easier for human logistic workers to improve, be more efficient, and reduce errors. As above, this applies also to automation and mechanization. Since the material flow is now so constant, you can automate the material flow (for example, with a conveyor belt). In contrast, a conveyor belt usually makes no sense at all in a job shop.

Clarity

Another big benefit of flow shops is clarity. This is a direct result of the repeatability from above, but since it is host to so many other advantages, I want to give it its own heading. As repeatability helps in making a fast and efficient system in the first place, clarity helps in improving it.

Easier to create standards! Since the work repeats in short cycles, it is so much easier to create good standards. There are (ideally) no exceptions and decisions in the standard, and the standard covers only a short period of time that repeats frequently.

Easier to see problems and potentials! This is a big one! Due to the repeating identical work, it is much easier to see problems. These may be deviation from the standard, recurring problems, or just potentials for improvement. A chalk circle exercise is much easier in a flow shop than in a job shop. Related to this, **visual management** is also much easier in a flow shop. Since the sequence is always the same, it is much easier to, for example, see if there is a lot or little inventory at a certain spot.

Easier to improve! Since it is so much easier to see problems, it is also so much easier to improve them. The implementation is also helped by the repeatability.

Easier to predict! Due to its repeatability and clarity, the behavior of the flow shop

is also much easier to predict. Contrast this with the planning problems at the job shop. No matter which parameter, they are all much easier to estimate beforehand with much less fluctuations compared to a job shop or project shop. Take for example **Lead Time** (i.e., when the product will be ready for the customer), **Machine Utilization and Capacity** (i.e., do I have enough machine capacity to satisfy the customer?), **Worker Assignment** (i.e., which machine should be manned when), **WIP Inventory** (i.e., the stuff on the shop floor), and many more. Planning is, while still challenging, no longer a complete mess like in the job shop.

UNIT IV

SHORT QUESTIONS

1. Define scheduling.
2. Define production control.
3. Define master schedule.
4. What is expediting?
5. What is Gantt chart?
6. Define line balancing.
7. What do you mean by MRP?
8. Define routing.
9. Define bill of materials.
10. What is aggregate planning?
11. Explain line of balance?
12. What is Enterprise Resource planning?

LONG QUESTIONS

1. Explain Routing procedure?
2. What is the information required on the Bill of material form?
3. Explain expediting and follow up?
4. Name types of scheduling? Explain?
5. What are the objectives of aggregate production planning?
6. What are the factors affecting routing procedure
7. State the important factors that affecting routing procedure
8. Distinguish between loading and scheduling
9. a. What is route sheet?
   b. What is the information it contains
10. a. Write short notes on Job shop.
    b. Write short notes on Flow shop
11. List out various scheduling rules. Explain at least three of them

UNIT 4

POWER POINT PRESENTATION

PRODUCTION PLANNING AND CONTROL

DEPARTMENT OF MECHANICAL ENGINEERING

WHAT IS PPC?

- *"The highest efficiency in production is obtained by manufacturing the required quality of product , of required quantity ,at the required time by the best and cheapest method"* - *Hence,* **PPC is a tool to coordinate all manufacturing activities in a production system.**

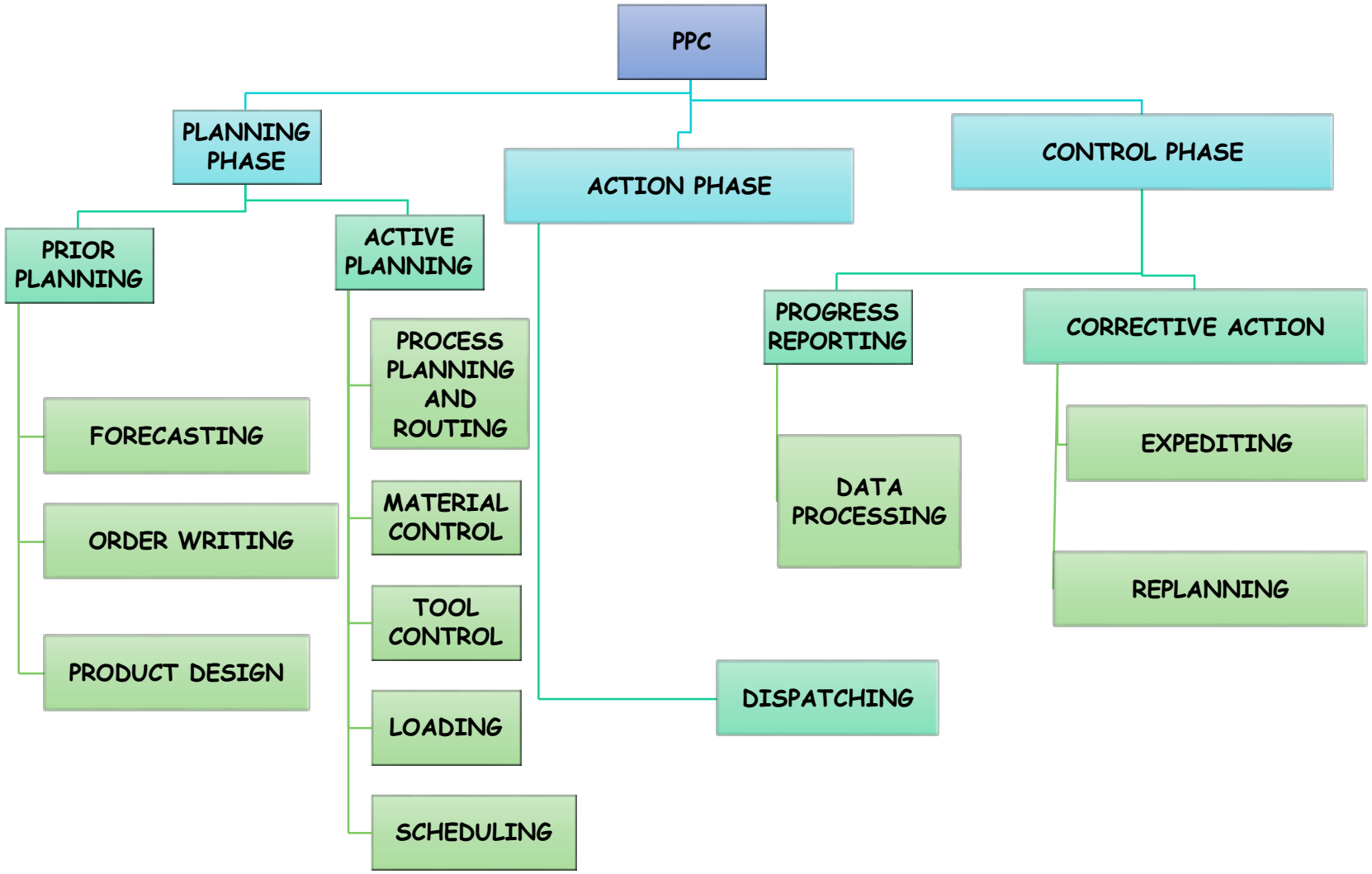
OBJECTIVES OF PPC

- To deliver required goods in required quantities to the customer in the required delivery schedule to achieve maximum customer satisfaction and minimum cost
- To ensure maximum utilization of the available resources
- To ensure production of quality products
- To minimize the manufacturing time

CONTINUED.....

- To maintain optimum inventory levels
- To maintain flexibility in manufacturing operation
- To coordinate between labor and machines and various supporting documents
- To plan for plant capacities for future requirements
- To remove bottle neck at all stages of production and to solve problems related to production
- To ensure effective cost reduction and cost control

FUNCTIONS OF PPC



1. ROUTING

- Routing is the first step in production planning and control.
- Routing can be defined as the process of deciding the path (route) of work and the sequence of operations.
- In short, routing determines ‘What’, ‘How much’, ‘With which’, ‘How’ and ‘Where’ to produce.

ADVANTAGES OF ROUTING

- Routing gives a very systematic method of converting raw-materials into finished goods.
- It leads to smooth and efficient work.
- It leads to optimum utilization of resources; namely, men, machines, materials, etc.
- It leads to division of labor.
- It ensures a continuous flow of materials without any backtracking

CONTINUED……

- It saves time and space.
- It makes the work easy for the production engineers and foremen.
- It has a great influence on design of factory's building and installed machines.

TECHNIQUES OF ROUTING

- Route card
- Work sheet
- Route sheet

1. ROUTE CARD

- This card always accompanies with the job throughout all operations.
- This indicates the material used during manufacturing and their progress from one operation to another.
- In addition to this the details of scrap and good work produced are also recorded.

ROUTE CARD

PRODUCTION ROUTE CARD

Customer Name

Product ID & Product Name

Quantity (Unit)

Generate Date

Customer Specific Requirement				Special Process / Characteristic			
Process	Start Date	End Date	Production Unit	Rejected Unit	Reason For Rejection	Accepted Unit	Remarks

2. WORKSHEET

It contains

- Specifications to be followed while manufacturing.
- Instructions regarding routing of every part with identification number of machines.
- This sheet is made for manufacturing as well as for maintenance.

3. ROUTE SHEET

- It is also called as route card
- It lists the manufacturing operations in the decided sequence along with the machines associated with each operation
- It also indicates the department in which the operation is to be done and the part will go for the next operation
- It also consists of the information such as part name, part number and product number
- It gives information about the material specification and cutting tools,jigs,fixtures and necessary devices for each operation.

2. SEQUENCING

- Defined as the order in which jobs pass through machines or work stations for processing
- The main aim is to find out such sequence out of the possible sequence that will complete the work in shortest time
- Sequencing problems becomes tedious as the number of jobs and machines increases

3. SCHEDULING

Scheduling means setting of starting and finishing dates for each operation, assembly and the finished product.

It also means to :

- Fix the amount of work to do.
- Arrange the different manufacturing operations in order of priority.
- Fix the starting and completing, date and time, for each operation

4. DISPATCHING

- It’s the next step after scheduling
- Also means starting the actual production of a particular work which has been planned in routing schedule.
- It provides the necessary authority to start the work.
- It is based on route-sheets and schedule sheets.

Dispatching includes the following:

Issue of materials, tools, fixtures, etc., which are necessary for actual production.
Issue of orders, instructions, drawings, etc. for starting the work.
Maintaining proper records of the starting and completing each job on time.
Moving the work from one process to another as per the schedule.
Starting the control procedure.
Recording the idle time of machines.

4. FOLLOW UP

- Follow-up or Expediting is the last step in production planning and control. It is a controlling device. It is concerned with evaluation of the results.
- Follow-up finds out and removes the defects, delays, limitations, bottlenecks, loopholes, etc. in the production process. It measures the actual performance and compares it to the expected performance. It maintains proper records of work, delays and bottlenecks. Such records are used in future to control production

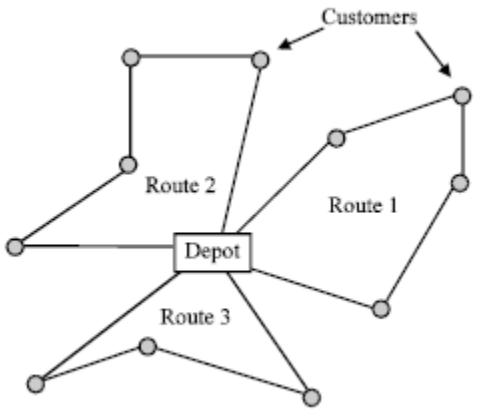
GANTT CHART

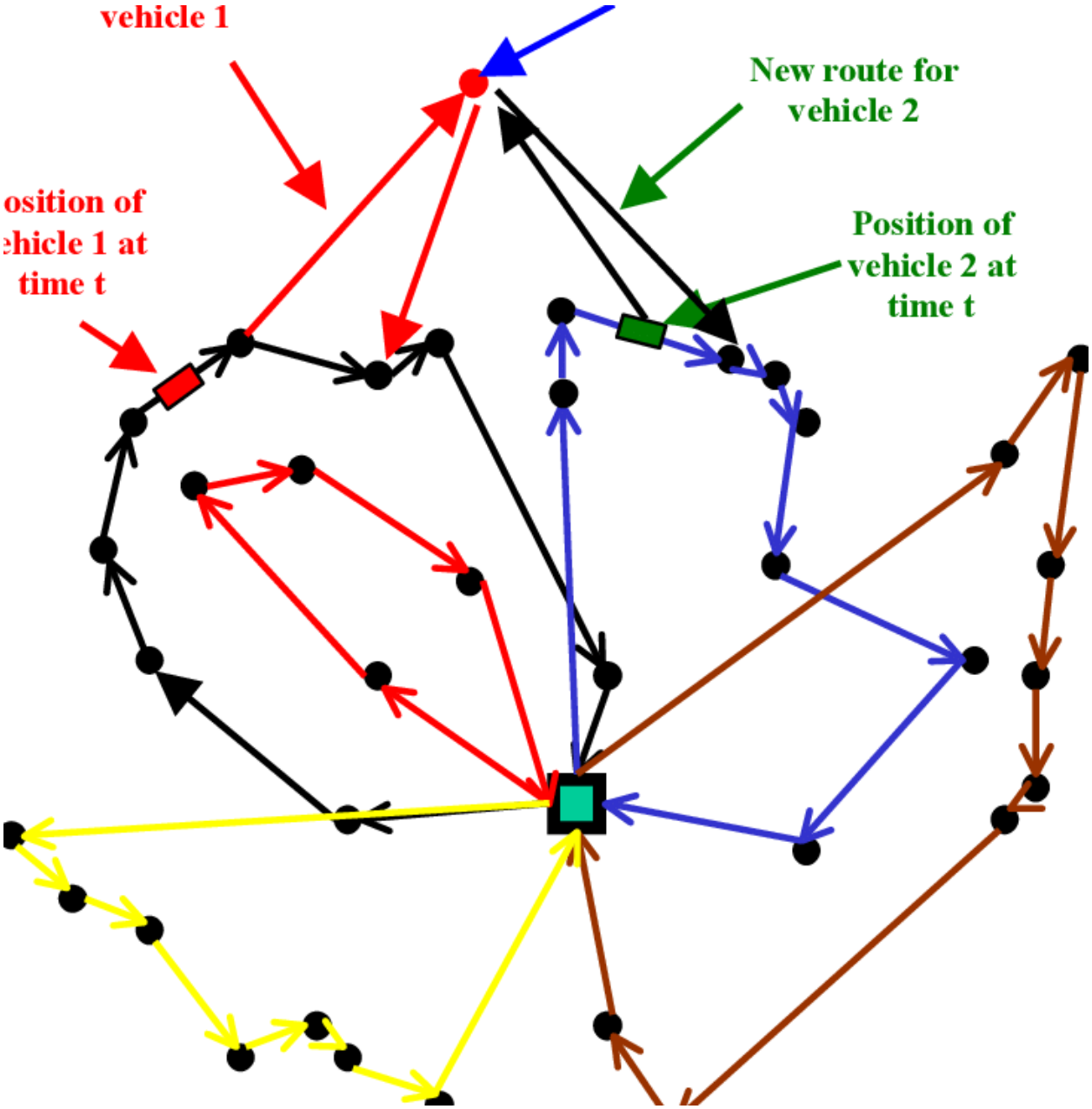
- It’s a type of bar chart that illustrates a project schedule.
- It is the graphical representation of the duration of tasks against the progression of time.
- Its shows the comparison between the planned and actual progress of job through several activities of departments.

UNIT IV

INDUSTRIAL APPLICATIONS

Routing is the process of selecting a path for traffic in a network or between or across multiple networks. Broadly, **routing** is performed in many types of networks, including circuit-switched networks, such as the public switched telephone network (PSTN), and computer networks, such as the Internet.

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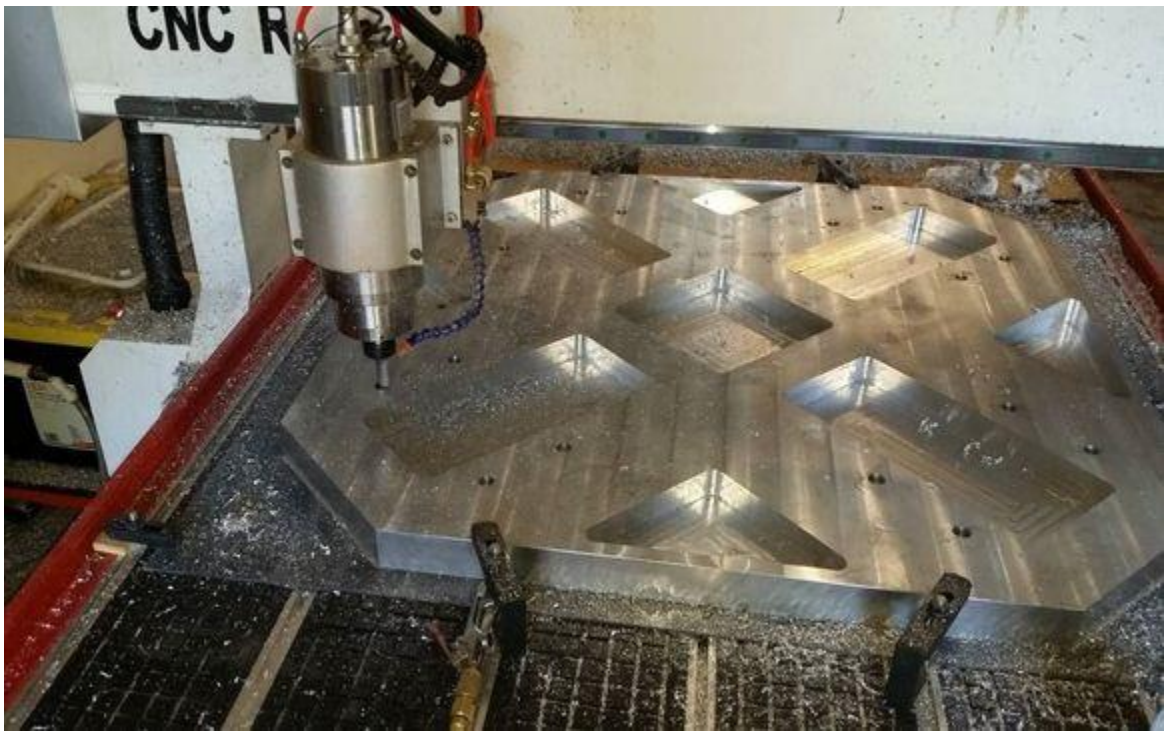
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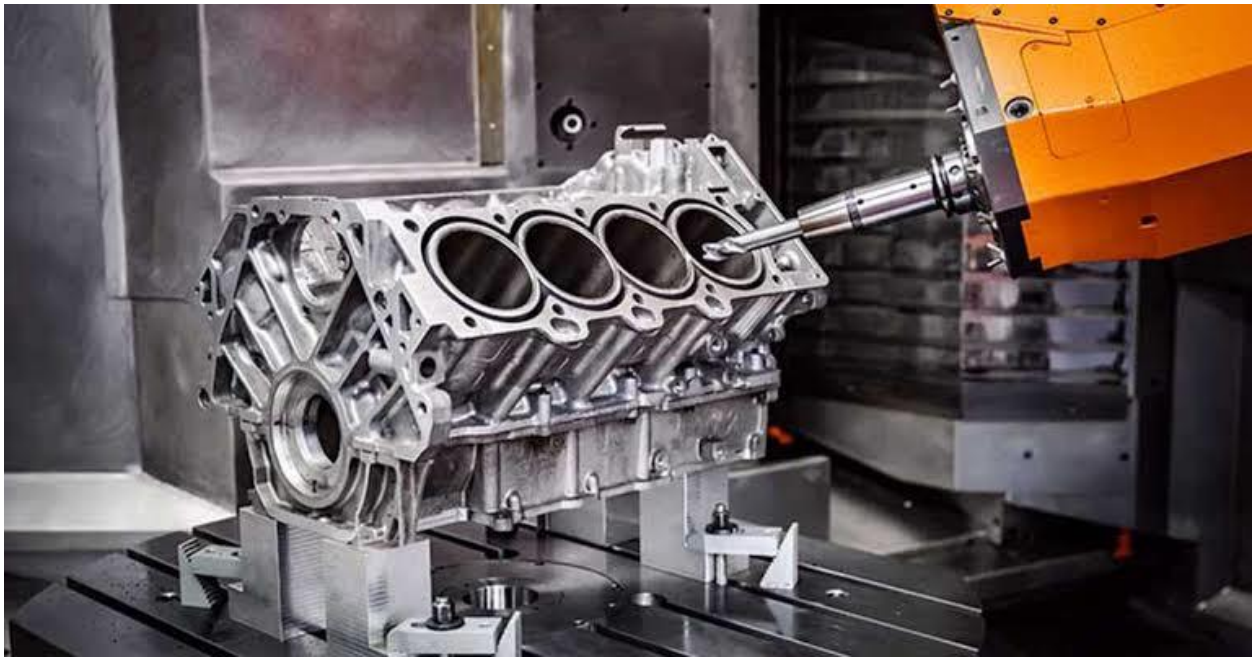

UNIT IV

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UNIT 5

LINE BALANCING & DISPATCHING

Course objective

Student will be able learn about Line balancing and Dispatching.

Course Outcome

Student should understand about the line balancing and dispatching and also types of job flows and work flows.

Line Balancing: Aggregate planning, Chase planning, Expediting, controlling aspects. Dispatching – Activities of dispatcher – Dispatching procedure – follow-up – definition – Reason for existence of functions – types of follow-up, applications of computer in production planning and control.

Line balancing is a manufacturing-engineering function in which whole collection of production-linetasks are divided into equal portions. Well-balancedlines avoid labour idealness and improve productivity.

Production Line Balancing

Line-balancing strategy is to make production lines flexible enough to absorb external and internal irregularities. There are two types of line balancing, which we have explained as –

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The movement of whole crews from one dedicated line to another as the model mix changes.

Group Technology – In which one worker can handle variety of tasks (automation) in a single work centre.

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Aggregate planning

Introduction

An organization can finalize its business plans on the recommendation of demand forecast. Once business plans are ready, an organization can do backward working from the final sales unit to raw materials required. Thus annual and quarterly plans are broken down into labor, raw material, working capital, etc. requirements over a medium-range period (6 months to 18 months). This process of working out production requirements for a medium range is called aggregate planning.

Factors Affecting Aggregate Planning

1. Aggregate planning is an operational activity critical to the organization as it looks to balance long-term strategic planning with short term production success. Following factors are critical before an aggregate planning process can actually start;
2. A complete information is required about available production facility and raw materials.
3. A solid demand forecast covering the medium-range period
4. Financial planning surrounding the production cost which includes raw material, labor, inventory planning, etc.
5. Organization policy around labor management, quality management, etc.
6. For aggregate planning to be a success, following inputs are required;
7. An aggregate demand forecast for the relevant period
8. Evaluation of all the available means to manage capacity planning like sub-contracting, outsourcing, etc.
9. Existing operational status of workforce (number, skill set, etc.), inventory level and production efficiency
10. Aggregate planning will ensure that organization can plan for workforce level, inventory level and production rate in line with its strategic goal and objective.

Aggregate planning as an Operational Tool

Aggregate planning helps achieve balance between operation goal, financial goal and overall strategic objective of the organization. It serves as a platform to manage capacity and demand planning.

In a scenario where demand is not matching the capacity, an organization can try to balance both by pricing, promotion, order management and new demand creation.

In scenario where capacity is not matching demand, an organization can try to balance the

both by various alternatives such as.

- Laying off/hiring excess/inadequate excess/inadequate excess/inadequate workforce until demand decrease/increase.
- Including overtime as part of scheduling there by creating additional capacity.
- Hiring a temporary workforce for a fix period or outsourcing activity to a sub-contrator.

Importance of Aggregate Planning

Aggregate planning plays an important part in achieving long-term objectives of the organization. Aggregate planning helps in:

- Achieving financial goals by reducing overall variable cost and improving the bottom line
- Maximum utilization of the available production facility
- Provide customer delight by matching demand and reducing wait time for customers
- Reduce investment in inventory stocking
- Able to meet scheduling goals there by creating a happy and satisfied work force

Aggregate Planning Strategies

There are three types of aggregate planning strategies available for organization to choose from. They are as follows.

Level Strategy

As the name suggests, level strategy looks to maintain a steady production rate and workforce level. In this strategy, organization requires a robust forecast demand as to increase or decrease production in anticipation of lower or higher customer demand. Advantage of level strategy is steady workforce. Disadvantage of level strategy is high inventory and increase back logs.

Chase Strategy

As the name suggests, chase strategy looks to dynamically match demand with production. Advantage of chase strategy is lower inventory levels and back logs. Disadvantage is lower productivity, quality and depressed work force.

Hybrid Strategy

As the name suggests, hybrid strategy looks to balance between level strategy and chase strategy.

PRODUCTION CONTROL FUNCTIONS

Dispatching

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

Dispatching also provides a means for comparing actual progress with planned production progress. Dispatching functions include;

1. Providing for movement of raw materials from stores to the first operation and from one operation to the next operation till all the operations are carried out.
2. Collecting tools, jigs and fixtures from tool stores and issuing them to the user department or worker.
3. Issuing job orders authorizing operations in accordance with dates and times as indicated in schedules or machine loading charts.
4. Issue of drawings, specifications, route cards ,material requisitions and tool requisitions to the user department.
5. Obtaining inspection schedules and issuing them to the inspection section.
6. Internal materials handling and movement of materials to the inspection area after completing the operation, moving the materials to the next operation center after inspection,

and movement of completed parts to holding stores.
7. Returning jigs and fixtures and tools to stores after use.

Expediting/follow-up /Progressing
Expediting or progressing ensures that, the work is carried out as per the plan and delivery schedules are met.

Progressing includes activities such as status reporting, attending to bottlenecks or holdups in production and removing the same ,controlling variations or deviations from planned performance levels following up and monitoring progress of work through all stages of production, co-ordinating with purchase, stores, tool room and maintenance departments and modifying the production plans and re plan if necessary.

Need for expediting may arise due to the following reasons

Delay in supply of materials.
Excessive absenteeism.. Changes in design specifications.
Changes in delivery schedules initiated by customers.
Break down of machines or tools, jigs and fixtures.
Errors in design drawings and process plans.

DISPATCHING

Dispatching is the routine of setting productive activities in motion through the release of orders and necessary instructions according to pre-planned times and sequence of operations embodied in route sheets and loading schedules.

In other words, once a job is in an area where an operation is to be performed, it has to be determined when and by whom the job will be processed and also the sequence of waiting orders to be processed. The decision of assigning the various jobs to different machines and equipment is called Dispatching.

Functions of Dispatching:

- To check the availability ofinput materials and ensure the movement of material from store to first process and then from process toprocess.
- To ensure the availability of all production and inspectionaids.
- To obtain the requisite drawings, specifications and materiallists.
- To assign the work appropriate machine, workplace andmen.
- The issue of job orders authorizing operations in accordance with dates and times previously planned and entered on load charts and routesheets.
- The issue of time tickets, instruction cards and other required items to the workers who are to perform the variousactivities.
- The issue of inspection orders after each operation in order to determine result

regarding the quality of products if excessive spoilage occurs, to find out itscauses.

- Clean up on jobs, collection of time tickets, blueprints and instruction cards and their return to appropriate section of production controldeptt.
- To ensure that the work is forwarded to next deptt. or storeroometc.
- To record the beginning and completion times of jobs on time tickets forcalculation of time interval. To forward time ticket to accounts deptt for preparingwages.
- To record and report idle time of men and machines and request for corrective action required.

Dispatching Procedure:

In the decentralized dispatching, the manufacturing orders are issued in blanket way to the Engineer/Foreman/Supervisor. He must then determine the relative sequence in which these orders will be taken up within thedepartment.

It is the duty of the person (may be Foreman/Supervisor) concerned to dispatch these orders and to ensure that the required material is available at each machine and operator. In such cases the dispatch of material must be completed in the department on or before the prescribed date.

Chart in Fig. illustrates the sequence of dispatching operation for intermittent manufacturing system from the issue of manufacturing orders to the end of dispatching operation.

From the manufacturing order list of assemblies, sub-assemblies and parts is prepared. Route sheets are prepared for various components/parts and assemblies etc.

These route sheets indicate the input materials operation to be performed and their sequence. Further the time allowances are entered against each operation along with the date when it should start and finish. Along-with details of tools, jigs and fixtures required.

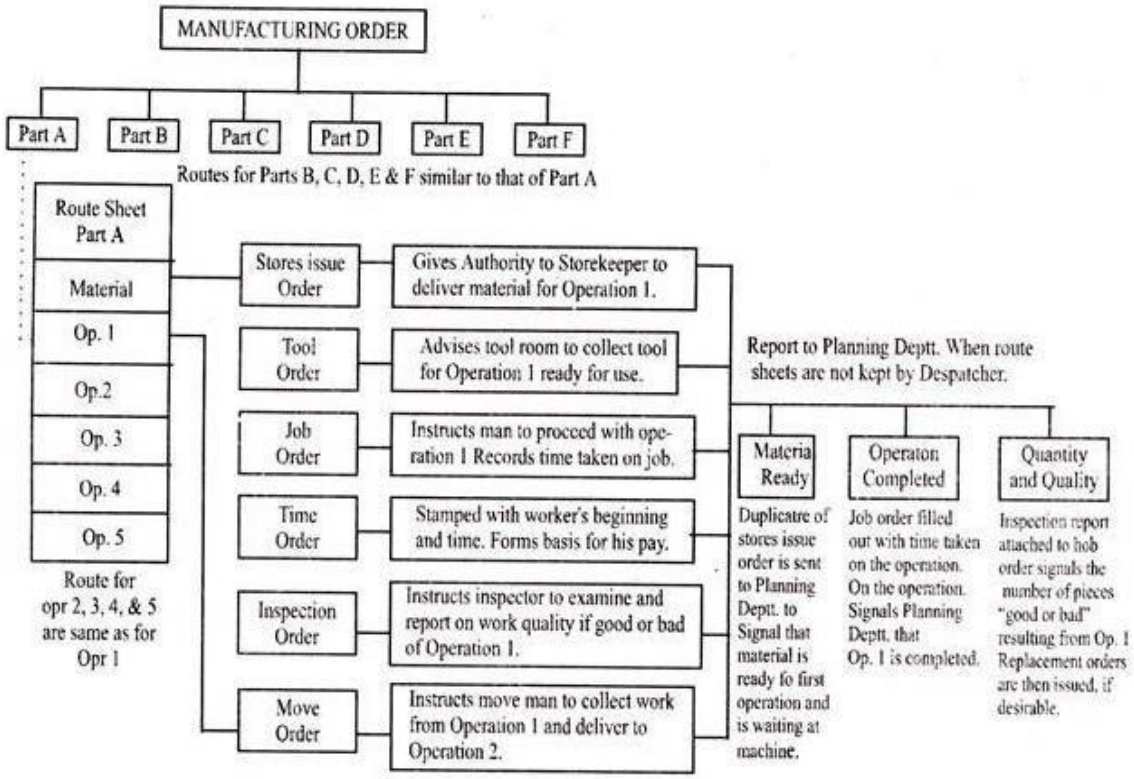


Fig. 7.14. Chart showing the sequence of dispatching operaton for intermittent manufacture.

The blue prints supplies the limits and tolerances for the purpose of inspection. In order to give effect to this information, required materials, tools, job orders, inspection tickets and move orders are prepared. So all working papers should be ready a day or two before the job should start.

These are further made available to the various persons concerned by the dispatcher. The material, tools and jigs & fixtures will be issued to the machine operators.

Inspection shall be performed after the first operation is over and the part shall move to next work station for second operation if it passesinspection.

The purpose of decentralized dispatching is to minimize the duplication of postings and elaborate reporting etc. In centralized dispatching which is applicable for continuous manufacturing system that involves a single standardized product and no assembly, dispatching requires that the concerned shops be informed about the decided rate of production.

The routine of dispatching under these circumstances shall be quite different from decentralized dispatching discussed earlier. This is called centralized control.

This system involves the dispatching orders from the central dispatching division directly to work stations. The working capacity & other characteristics of the machines/equipment as well as the back log and work ahead of it are known and recorded in the central dispatch office. In this case the whole dispatching is controlled from that point.

In both types of dispatching, it is traditional for the departmental supervisor or his clerk to keep themselves informed about the starting date and progress of each order by means of various dispatchingdisplays.

Meaning of Follow Up:

After the dispatching function is completed, processing of various operations has been authorized to begin in time as planned by scheduling department, the follow up is to check the progress of the order undertaken as it is being produced from the first operation until the order is converted into final product. Thus it regulates the progress of material and parts through the productionprocesses.

Follow up is checking the manufacturing activities systematically so that production may be carried out according to plan. It is the measurement of output against plan, analysis of the performance for shortcomings if any and following up the management in order to apply corrective action to prevent excessive shortfall.

Thus Progress Reporting is the function by which one can give an early warning when the actual production deviates from planned production thus making it possible to apply corrective action.

Follow up is the most important part of production control. This step is to ascertain from time to time that the production operations are going on according to the plan. The expeditor or chaser is meant for observing that anything overlooked or not properly executed is set right.

This ensures proper coordination of production activities and plans in order to take corrective action if necessary. Follow up functioning checks and measure the effectiveness of previous production control functions like routing, scheduling and dispatching. Expediting is a special form of follow up or progressreporting.

Expeditors are Used:

a. To help to eliminate particular difficulties which are throwing production off theschedule.

b. To speed up the processing of certainorders.

In short the purpose of active functions of dispatching and expediting are:

(i) To release the production orders at the appropriate time and provide the flow of necessary information.

(ii) To record the flow of materials and tools and make adjustment ifneeded.

(iii) To record progress of production activities and make necessaryadjustments.

(iv) To compare and record amount of work in process withschedule.

(v) To record the amount of faulty work and rejections, issue orders for the production of replacements.

(vi) To record the machine and manpower idleness and investigate the reasons forit.

(vii) To record the breakdowns, held up or stoppage of production activities and classify them accordingto:

- Lack of instructions and blue printsetc.
- Lack of input materials andcomponents.
- Work held up due to stoppage at previousworkstations.
- Equipment breakdown.
- Non availability ofmanpower.

Functions and Purpose of FollowUp:

Its main function is to bring up together all the variables of production activities and thus to show progress or boost production. It is the duty of follow up people to see whether the production is being performed according to the schedule and to provide feedback on the production data.

Follow up is done for the following purposes:

(i) Follow Up forMaterials:

Logically it is the duty of the purchase department to ensure that the requisitioned material should reach the requisitioned on or before the date of delivery to meet the production schedule promises.

But in case of very important orders which must be met in time, the follow up section

of the production control department, takes steps for collection of the materials. In such cases

follow up is accomplished by filing one copy of the requisition slip in a daily follow up file according to the due date the material is to be received.

(ii) Follow Up of Work inProgress:

In case of serialized production, it consists of check on the required materials for specific process and recording the production output of the production deptt. to see whether it is in accordance with schedule. In this case follow up is very simple and can be trusted to daily production records as shown in Fig. 7.21.

Daily Production Record

Date..... From Deptt. No..... To Deptt. No.....

Part No.	Description	Quantity	Remarks

Fig. 7.21

In order to meet schedule promises, some priority may be given to the late jobs. In case of job order manufacture, where the different products are produced at the same time, the sequence of orders may be changed in order to meet certain specificsituations.

The section in charge or production engineer should be advised by the follow-up man regarding the best sequence in which orders should be taken up in order to provide the completion of the assembly at proper time and place. A time record of job or order showing the start and completion time, number of pieces produced and rejection is made.

(iii) Follow Up for Assembly andErection:

In such situations one follow up man is given the entire responsibility. The various parts and components being manufactured at various work stations may be temporarily stored at those very places so that the follow up man shall release them when the rest of the component parts forming the assembly are ready for final assembly purposes.

In case of very complex and large equipment/products, the work of installation erection and servicing is done at purchaser's place. The requirement will be that the follow up

man should be well acquainted with the engineering details, trouble shooting and servicing of the equipment/machine at the consumer's plant.

Follow up or Progress Reporting can do following tasks:

(I) Recording of actual production.

(ii) Compare the actual production with the plannedproduction.

(iii) Can measure the production variability.

(iv) Can report the excessive variance to the production planning department forcorrective action.

Application of computer in production planning & control

Over the last 40 years, the role of computers in the production planning process has changed dramatically. In the 1970's, a calculator was considered a high-priced luxury item, and business mainframe programs were stored on cards. Today, every production planner has a personal computer with more processing capability than the mainframes of the past. Advances in computer hardware and software have enabled production planning processes to operate more efficiently and effectively than ever before.

Some of the areas where computers are used in business and industry are as follows:

[a] InventoryControl,

[b] ProductionPlanning,

[c] Budgeting and VarianceAnalysis,

[d] Plant CapacityUtilization,

[e] QualityControl,

[f] MarketResearch,

[g] PurchaseAccounting,

[h] SalesAccounting,

[i] PayrollAccounting,

[j] Information Management, andso.

Role of Computer:

With the expansion of business activities, the volume of business transactions has increased. The manual method of maintaining books of accounts is found to be unmanageable and gradually computers have replaced the manual method of accounting.And finally the database technology has revolutionized the accounting departments of business organizations.

Computer is an electronic device that can perform a variety of operations in accordance with a set of instructions called program.It is fast electronic data processing machine, which can provide solutions to all complicated situations. It accepts data from the user, converts the data into information, and provides the desiredresults.

UNIT V

SHORT QUESTIONS

1. What is dispatching?
2. What are the activities of dispatcher?
3. Explain dispatching rule.
4. What is move order?
5. What is tool order?
6. What is job ticket?
7. What is inspection order?
8. What is store order?
9. What is finished product order?
10. What is machine load chart?

LONG QUESTIONS

1. Explain the functions of dispatching?
2. Explain dispatching procedure?
3. Explain centralised dispatching?
4. Explain the advantages of decentralised dispatching?
5. Describe briefly the application of computer in PPC?
6. Write short notes on Dispatching procedure.
7. Write short notes on Activities of dispatches
8. List out various forms raised by dispatcher?
9. Explain the applications of computer in Production Planning & Control
10. Write short notes on Applications of computer in PPC.
11. A. What is follow up
    B. Explain follow up significance in production
12. Describe the forms used in dispatching Move order
13. Discuss about a) issue of move orders.
    b) Issue of tool orders.

UNIT 5

POWER POINT PRESENTATION

MODEL OF SCHEDULING PROBLEM

DEPARTMENT OF MECHANICAL ENGINEERING

MODEL OF SCHEDULING PROBLEM

- Components of any model:

- Decision variables
  - What we can change to optimize the system, i.e., model output
- Parameters
  - model input values, i.e., values that cannot be changed
- Objective function
  - e.g. profit, quality to be maximized
  - e.g. costs, time to be minimized
- Constraints
  - determine which decision variable values are allowed

MODELING: DECISION VARIABLES

- Three basic types of decision variables:
- **Sequence**
  - permutation of the jobs
- **Schedule**
  - allocation of the jobs in a more complex environment
- **Scheduling policy**
  - determines the next job, given the current state of the system
- Other variables are regarded as dynamic data, or as auxiliary variables:
  - Completion time (C_{ij})
  - Lateness (L_j)

MODELING: PARAMETERS

- Typical scheduling parameters:

- Number of resources (*m* machines, operators)
- Configuration and layout
- Resource capabilities
- Number of jobs (*n*)
- Job processing times (p_{ij})
- Job release and due dates (resp. r_{ij} and d_{ij})
- Job weight (w_{ij}) or priority
- Setup times

MODELING: OBJECTIVE FUNCTION

- Objectives and performance measures:

- Throughput, makespan (C_{max}, *weighted sum*)
- Due date related objectives (L_{max}, T_{max}, $\Sigma w_j T_j$)
- Work-in-process (WIP), lead time (response time), finished inventory
- Total setup time
- Penalties due to lateness ($\Sigma w_j L_j$)
- Idle time
- Yield

- Multiple objectives may be used with weights

MODELING: CONSTRAINTS

- Precedence constraints (linear vs. network)
- Routing constraints
- Material handling constraints
- (Sequence dependent) Setup times
- Transport times
- Preemption
- Machine eligibility
- Tooling/resource constraints
- Personnel (capability) scheduling constraints
- Storage/waiting constraints
- Resource capacity constraints

GENERIC NOTATION OF SCHEDULING PROBLEM

- Machine characteristics
- Job characteristics
- Objective function

- for example:
- **Pm | r_j, prmp | $\Sigma w_j C_j$** (parallel machines)
- **1 | s_{jk} | C_{max}** (sequence dependent setup / traveling salesman)
- **Q2 | prec | $\Sigma w_j T_j$** (2 machines w. different speed, precedence rel., weighted tardiness)

SCHEDULING MODELS

- Deterministic models
  - input matches realization
- vs.

- Stochastic models
  - distributions of processing times, release and due dates, etc. known in advance
  - outcome/realization of distribution known at completion

GENERAL-PURPOSE SCHEDULING PROCEDURES

- Dispatching rules
- Composite dispatching rules
- Adaptive search (Handouts)
- Mathematical programming (Appendices A3, A4)
- Branch-and-bound
- Beam-Search

DISPATCHING RULES

- Static rules
  - not time-dependent
  - are function of job and/or machine data
- vs.
- Dynamic rules
  - time-dependent
  - e.g.: “minimum slack first”-priority rule

DISPATCHING RULES

- Local rules
  - e.g. only consider current job, machine
- vs.
- Global rules
  - “look ahead”-strategy

DISPATCHING RULES

- Schedule generation scheme:
- mechanism by which schedule is constructed

- serial scheme
- schedule job-for-job (n stages)
- vs.
- parallel scheme (at most T stages)
  - decision set (all candidates to be scheduled at stage *t*)
  - completed set of jobs (jobs that are completed at stage *t*)
  - remaining set of jobs (not allowed to be scheduled at *t*)
  - active set of jobs (scheduled, but not completed at stage *t*)

DISPATCHING RULES

- Service in random order (SIRO)
- Earliest release date (ERD)
- Earliest due date (EDD)
- Minimum slack (MS)
- Weighted shortest processing time (WSPT)
- Note: WSPT is optimal in single-machine setting (Smith's rule)
- Longest processing time (LPT)

DISPATCHING RULES, CONT.

- Shortest setup time (SST)
- Least flexible job (LFJ)
- Greatest resource demand (GRD)
- Critical path rule (CP)
- Largest number of successors (LNS)
- Shortest queue at the next operation (SQNO)

DISPATCHING RULES, OVERVIEW

- Dependent on release and due dates:
- ERD, EDD, MS
- Dependent on processing times:
- LPT, SPT, WSPT, CP, LNS
- Miscellaneous:
- SST, LFJ, SQNO

DISPATCHING IN MORE COMPLICATED SITUATIONS

- Dispatching+routing over non-identical machines
- Batch and dispatch
- Dispatching with preemption
- Dispatching with setups

MORE ADVANCED DISPATCHING RULES

- Look-ahead with multiple job planning (e.g. including jobs with future release dates, dispatching with a waiting option, worst case slack rule)
- Adaptive search techniques
- Composite rules

COMPOSITE PRIORITY RULE THAT IS MIXTURE OF 3 BASIC PRIORITY RULES:

- ATC (apparent tardiness rule) is comb. of:
- 1. Weighted Shortest Processing Time First
- 2. Earliest Due Date First
- 3. Minimal slack

- ATCS (ATC with setups)
- 4. Shortest Setup Time First

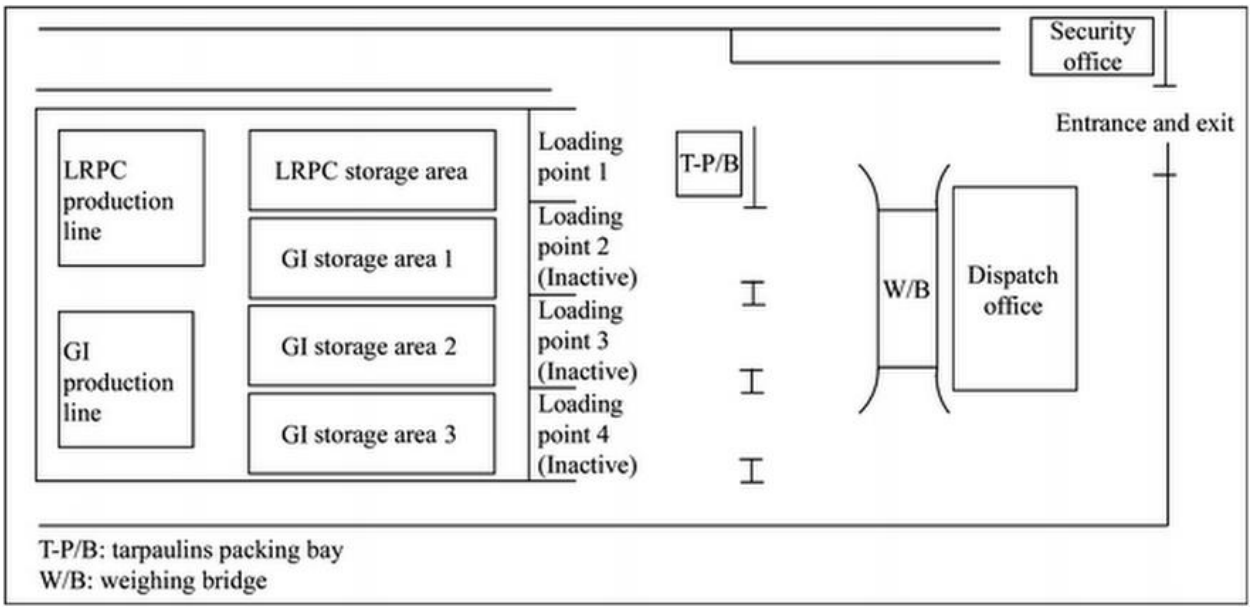
UNIT V

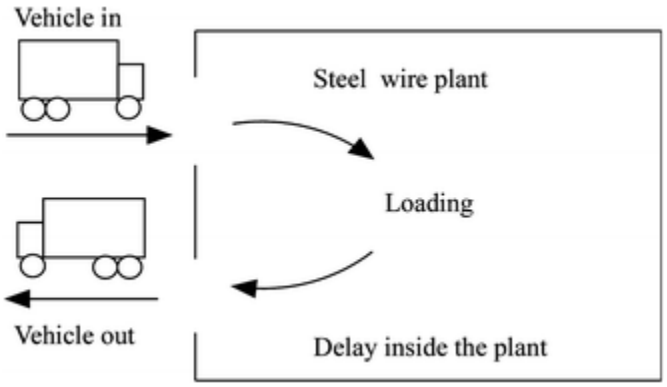
INDUSTRIAL APPLICATIONS

Dispatch is a procedure for assigning employees (workers) or vehicles to customers. Industries that dispatch include taxicabs, couriers, emergency services, as well as home and commercial services such as maid services, plumbing, HVAC, pest control and electricians.

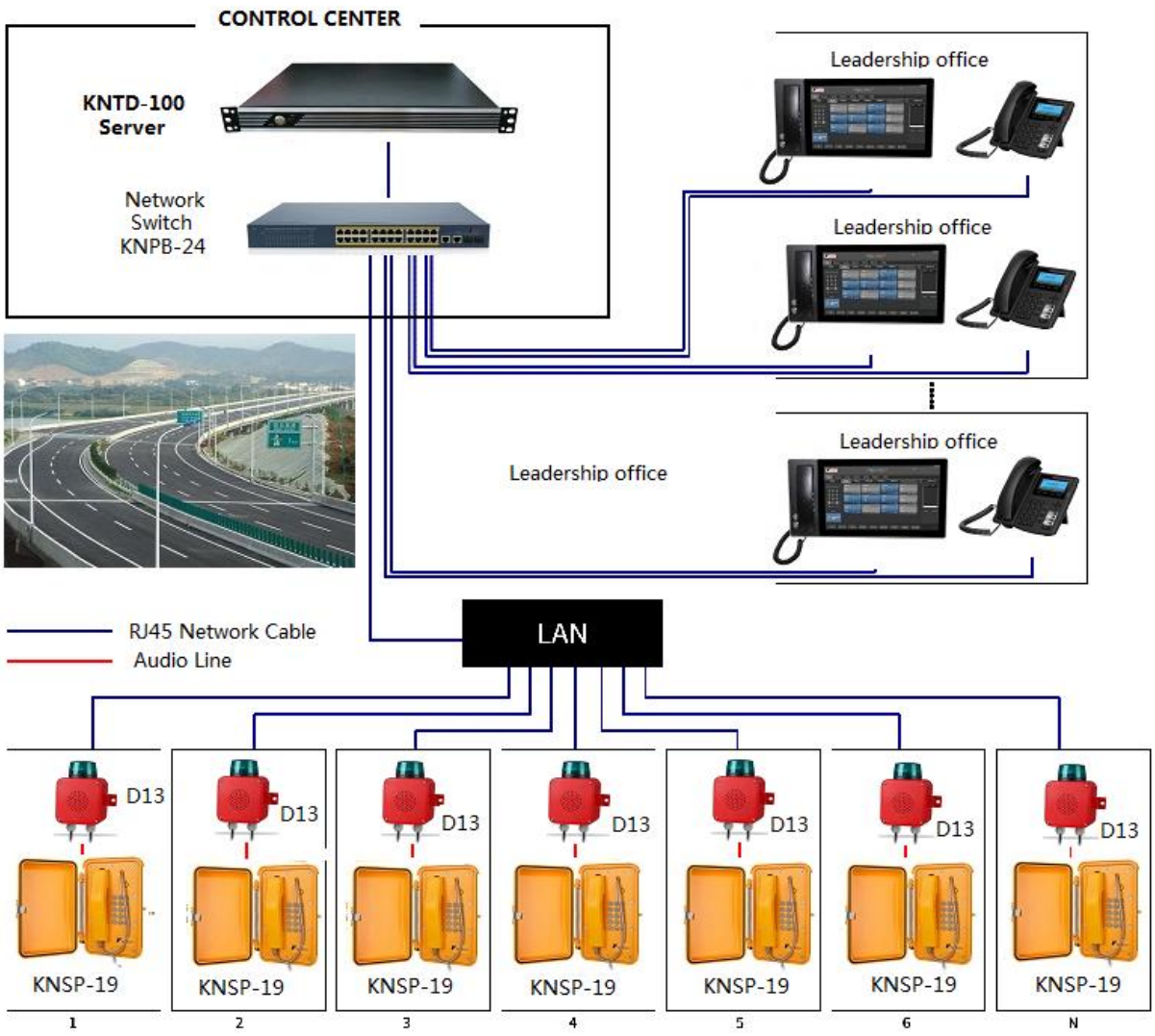
With vehicle dispatching, clients are matched to vehicles according to the order in which clients called and the proximity of vehicles to each client's pick-up location. Telephone operators take calls from clients, then either enter the client's information into a computer or write it down and give it to a dispatcher. In some cases, calls may be assigned a priority by the call-taker. Priority calls may jump the queue of pending calls. In the first scenario, a central computer then communicates with the mobile data terminal located in each vehicle (see computer assisted dispatch); in the second, the dispatcher communicates with the driver of each vehicle via two-way radio.

With home or commercial service dispatching, customers usually schedule services in advance and the dispatching occurs the morning of the scheduled service. Depending on the type of service, workers are dispatched individually or in teams of two or more. Dispatchers have to coordinate worker availability, skill, travel time and availability of parts. The skills required of a dispatcher are greatly enhanced with the use of computer dispatching software (see computer aided call handling).




Vehicle in
Steel wire plant
Loading
Vehicle out
Delay inside the plant

Highway IP Emergency Dispatching Scheme



UNIT V

ASSIGNMENT

UNIT V

SHORT QUESTIONS

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    B. Explain follow up significance in production
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13. Discuss about a) issue of move orders.
    b) Issue of tool orders.

ALL SHORT ANSWERS

UNIT I

PART – A (Short Answer Questions)

1 Define Planning?

In organizations, planning is a management process, concerned with defining goals for company's future direction and determining on the missions and resources to achieve those targets. To meet the goals, managers may develop plans such as a business plan or a marketing plan.

2 Define PPC?

Meaning and definition of production planning and control. Planning and controlgenerally involve the planning of manufacturingprocess. Especially it consists of the planning of routing, scheduling, dispatching, inspection, and coordination, control of materials, methods, machines, tools and operating times etc.

3 Define product Design?

Product design as a verb is to create a new product to be sold by a business to its customers. A very broad concept, it is essentially the efficient and effective generation and development of ideas through a process that leads to new products.

4 What are the requirements of good design?

- Function. The product must be designed in such a way that it optimally performs the main task or function for which it is purchased by a buyer.
- Reparability
- Reliability.
- Aesthetics
- Durability.
- Producibility.
- Simplicity.
- Compact.

5 Define production?

The processes and methods used to transform tangible inputs (raw materials, semi-finished goods, subassemblies) and intangible inputs (ideas, information, knowledge) into goods or services. Resources are used in this process to create an output that is suitable for use or has exchange value.

6 Define control?

Management control can be defined as a systematic effort by business management to compare performance to predetermined standards, plans, or objectives in order to determine whether performance is in line with these standards and presumably in order to take any remedial action required

7 Define scheduling?

Scheduling is the process of arranging, controlling and optimizing work and workloads in a production process or manufacturing process. Scheduling is used to allocate plant and machinery resources, plan human resources, plan production processes and purchase materials.

8 Define production budget?

The production budget calculates the number of units of products that must be manufactured, and is derived from a combination of the sales forecast and the planned amount of finished goods inventory to have on hand (usually as safety stock to cover for unexpected increases in demand)

9 What is Action Phase?

This is the execution phase of planning. It is the process of setting production activities in motion through release of orders and instructions. It authorizes the start of production activities by releasing materials, components, tools, fixtures and instruction sheets to the operator. The activities involved are:

- To assign definite work to definite machines, work centers and men.
- To issue required materials from stores.
- To issue jigs, fixtures and make them available at correct point of use.
- Release necessary work orders, time tickets, etc., to authorize timely start of operations.
- To record start and finish time of each job on each machine or by each man.

10 What is Control Phase?

Control phase is effected by dispatching, inspection and expediting materials control, analysis of work-in-process. Finally, evaluation makes the PPC cycle complete and corrective actions are taken through a feedback from analysis. A good communication, and feedback system is essential to enhance and ensure effectiveness of PPC.

UNIT II

PART A SHORT ANSWER QUESTIONS

1 Define sales forecasting

Sales forecasting is the process of estimating future sales. Accurate sales forecasts enable companies to make informed business decisions and predict short-term and long-term performance. Companies can base their forecasts on past sales data, industry-wide comparisons, and economic trends.

2 Define short term forecasting

The short term forecasting is usually used in short term objectives covering less than one year for example material requirement planning, scheduling, and budgeting

3 Define long term forecasting

The long term forecasting is usually used to predict the long termobjectives covering more than five years for example product diversification

4 What is least square method?

The least squares method is a form of mathematical regression analysis that finds the line of best fit for a dataset, providing a visual demonstration of the relationship between the data points. Each point of data is representative of the relationship between a known independent variable and an unknown dependent variable.

5 What is exponential smoothing method?

Exponential smoothing is a rule of thumb techniquefor smoothing time series data using the exponentialwindow function. Whereas in the simple moving average the past observations are weighted equally,exponential functions are used to assignexponentially decreasing weights over time.

6 What is analytical forecasting method?

Forecasting is the process of making predictions of the future based on past and present data and most commonly by analysis of trends. ... Both might refer to formal statistical methods employing time series, cross-sectional or longitudinal data, or alternatively to less formal judgmental methods.

7 What is the importance of sales forecasting?

Sales are the lifeblood of a business Sales forecasting is a crucial part of the financial planning of a business. It's a self-assessment tool that uses past and current sales statistics to intelligently predict future performance. With an accurate sales forecast in hand, you can plan for the future.

8 Write the objectives of forecasting.

The Objectives of Forecasting. In the narrow sense, the objective of forecasting is to produce better forecasts. But in the broader sense, the objective is to improve organizational performance—more revenue, more profit, increased customer satisfaction

- Formulation of suitable production policy
- Regulate the supply of raw materials
- Best utilization of machines
- Deciding plant capacity
- Manpower planning
- Determining dividend policy

9 What is market potential?

Market potential is the entire size of the market for a product at a specific time. It represents the upper limits of the market for a product. Market potential is usually measured either by sales value or sales volume

10 List the methods of sales forecasting.

- Jury method
- Survey of expert opinion method
- Sales force composite method
- Survey of buyers intention method
- Analytical and statistical methods

11 What are the different types of forecasting?

- Short term forecasting
- Long term forecasting

UNIT III

PART A SHORT ANSWER QUESTIONS

1 Define Inventory.

The amount of material, a company has in stock at a specific time is known as inventory or in terms of money it can be defined as the total capital investment over all the materials stocked in the company at any specific time.

2 Write the various types of inventory.

- Raw material inventory
- In process inventory
- Finished goods inventory
- Spare parts inventory
- Office stationary etc.

3 What is safety stock?

Safety stock term used by industries to describe a level of extra stock that is maintained to minimize risk of stock outs (shortfall in raw material or packaging) due to uncertainties in supply and demand. Adequate safety stock levels permit business operations to proceed according to their plans.

4 What is lead time?

The lead time between the placement of an order and delivery of a new ORDER from a Supplier

5 What is reorder point?

The reorder point (ROP) is the level of inventory which triggers an action to replenish that particular inventory stock. It is a minimum amount of an item which a firm holds in stock, such that, when stock falls to this amount, the item must be reordered.

6 What is order quantity?

It is the number of units ordered in each new order placed.

7 What is economic order quantity?

The Economic Order Quantity (EOQ) is the number of units that a company should add to inventory with each order to minimize the total costs of inventory—such as holding costs, order costs, and shortage costs.

8 What are the characteristics of two bin system?

Two-bin inventory control is an inventory control system used to determine when items or materials used in production should be replenished. The two-bin inventory control method is mainly used for small or low-value items. For example, when items in the first bin (working stock) have been depleted, an order is placed to refill or replace these items. The second bin is supposed to have enough items to last until the placed order arrives. The first bin has a minimum of working stock and the second bin keeps reserve stock or remaining material.

9 What is purchase cost?

A purchase price is the price an investor pays for an investment, and the price becomes the investor's cost basis for the calculation of a gain or loss when the investment is sold.

10 What is ordering cost?

Ordering costs are the expenses incurred to create and process an order to a supplier. These costs are included in the determination of the economic order quantity for an inventory item. Examples of ordering costs are: Cost to prepare a purchase requisition.Cost to prepare a purchase order.

11 What is carrying cost?

In marketing, carrying cost, carrying cost of inventory or holding cost refers to the total cost of holding inventory. This includes warehousing costs such as rent, utilities and salaries, financial costs such as opportunity cost, and inventory costs related to perishability, shrinkage (theft) and insurance.

12 What is stock out cost?

Economic consequences of not being able to meet an internal or external demand from the current inventory. Such costs consist of internal costs (delays, labor time wastage, lost production, etc.) and external costs (loss of profit from lost sales, and loss of future profit due to loss of goodwill)

UNIT – IV

PART A SHORT ANSWER QUESTIONS

1 Define scheduling.

Scheduling can be defined as "prescribing of when and where each operation necessary to manufacture the product is to be performed." It is also defined as "establishing of times at which to begin and complete each event or operation comprising a procedure". The principle aim of scheduling is to plan the sequence of work so that production can be systematically arranged towards the end of completion of all products by due date.

2 Define production control.

Systematic planning, coordinating, and directing of all **manufacturing** activities and influences to ensure having goods made on time, of adequate quality, and at reasonable cost.

3 Define master schedule.

A master production schedule (MPS) is a plan for individual commodities to be produced in each time period such as production, staffing, inventory, etc. It is usually linked to manufacturing where the plan indicates when and how much of each product will be demanded.

4 What is expediting?

Expediting is a concept in purchasing and project management for securing the qualityand timely delivery of goods and components

The procurement department or an external expeditor controls the progress of manufacturing at the supplier concerning quality, packing, conformity with standards and set timelines. Thus the expeditor makes sure that the required goods arrive at the appointed date in the agreed quality at the agreed location.

5 What is Gantt chart?

a chart in which a series of horizontal lines shows the amount of work done or production completed in certain periods of time in relation to the amount planned for those periods.

6 Define line balancing.

Line balancing is a manufacturing-engineering function in which whole collection of production-line tasks are divided into equal portions. Well-balanced lines avoid labour idealness and improve productivity.

Line-balancing strategy is to make production lines flexible enough to absorb

external and internal irregularities.

7 What do you mean by MRP?

Material requirements planning (MRP) is a production planning and inventory control system. An MRP integrates data from production schedules with that from inventory and the bill of materials (BOM) to calculate purchasing and shipping schedules for the parts or components required to build a product.

8 Define routing.

Routing may be defined as the selection of path which each part of the product will follow while being transformed from raw materials to finished products. Path of the product will also give sequence of operation to be adopted while being manufactured. In other way, routing means determination of most advantageous path to be followed from department to department and machine to machine till raw material gets its final shape

9 Define bill of materials.

A bill of materials or product structure (sometimes bill of material, BOM or associated list) is a list of the raw materials, sub-assemblies, intermediate assemblies, sub-components, parts and the quantities of each needed to manufacture an endproduct.

10 What is aggregate planning?

Aggregate planning is to determine the planned production quantity by period to meet forecast demand over a medium-range planning horizon. The overall objective is to allocate all the resources in an efficient manner while satisfying the forecast demands over the planning horizon.

UNIT – V

PART A SHORT ANSWER QUESTIONS

1 What is dispatching?

Dispatching is the routine of setting productive activities in motion through the release of orders and necessary instructions according to pre-planned times and sequence of operations embodied in route sheets and loading schedules.

2 What are the activities of dispatcher?

- Issue of move orders
- Issue of tool orders
- Issue of job order
- Issue of inspection order
- Issue of drawings, time tickets, instruction cards & other necessary
- Issue of store orders
- Issue of orders to finished product stores

3 Explain dispatching rule.

A dispatching ruleis a rule that prioritizes all the jobs that are awaiting for processing on a machine. Whenever a machine has been freed, a dispatching rule inspects the waiting jobs and selects the job with the highest priority.

4 What is move order?

Move Order is a request for a sub inventory transfer or an account issue. Move Orders allow planners to request the movement of material within the warehouse or facility for replenishment, material storage relocations and quality handling, etc.

5 What is tool order?

These are issued to tool department to collect and make ready tools, jigs and fixtures in advance of the time, at which the operation will commence.

6 What is job ticket?

An auxiliary printed form that may accompany a job order to a workshop to be used variously for recording worker's time, identifying material, giving brief instructions as to procedure, routing, tools, and destination.

7 What is inspection order?

Inspection orders are issued to the inspection personnel giving instructions regarding inspection centers, type of inspection requiredat different stages of operations, gauges to be used.

8 What is store order?

These orders are issued to the store to supply the raw materials against the proper authorization.

9 What is finished product order?

These orders instruct the finished product store for collecting the finished products on determined lines.

10 What is machine load chart?

In machine load chart time is marked along the horizontal axis and various machines are marked along the vertical axis. The orders by their numbers have been marked on the horizontal firm lines.

PREVIOUS QUESTION PAPERS

Code No: **RT42031** **R13** **Set No. 1**

IV B.Tech II Semester Regular/Supplementary Examinations, April - 2018

PRODUCTION PLANNING AND CONTROL

(Common to Mechanical Engineering and Mining Engineering)

Time: 3 hours **Max. Marks: 70**

Question paper consists of Part-A and Part-B

Answer ALL sub questions from Part-A

Answer any THREE questions from Part-B

*****

PART–A ***(22 Marks)***

1. a) Define production planning and control. [3]
   b) Write the types of forecasting. [4]
   c) What are the limitations of JIT? [4]
   d) Define scheduling. [3]
   e) Write about expediting. [4]
   f) Write the various activities of dispatcher. [4]

PART–B ***(3x16 = 48 Marks)***

2. a) Explain various elements of Production Control. [8]
   b) List out the planning functions and controlling functions separately, explain them briefly. [8]

3. a) Using the exponential smoothing technique, Compute the forecasts from the following data (time series) under the situations when $\alpha = 0.7$.Compute the forecast for the 11 th period?

Month	1	2	3	4	5	6	7	8	9	10
Demand	28	30	32	31	27	26	30	33	32	31

[8]

   b) A comparison of monthly sales of expensive item, against the total number of visits made by a salesman during the previous month, yields the following data. Is the correlation of the two variables good enough to enable the number of visits, to be adopted as an efficient indicator of future sales?

Sales	1	3	5	7	11
Visits	2	4	8	9	10

[8]

4. a) What are the advantages of inventory control? What are the symptoms of poor inventory control [8]
   b) Explain the scope of ERP and difficulties in implementation. [8]

5. a) Distinguish between loading and scheduling. [8]
   b) Describe different operation sheets and explain how routing procedure can be prepared from them. [8]

6. a) Explain the standard scheduling methods in detail. [8]
   b) What is the purpose of aggregate planning? Explain in detail. [8]

7. a) Describe dispatching control in intermittent production and continuous production. [8]
   b) Explain the role of computers in carrying various functions of PPC. [8]

Code No: **RT42031** **R13** **Set No. 2**

IV B.Tech II Semester Regular/Supplementary Examinations, April - 2018

PRODUCTION PLANNING AND CONTROL

(Common to Mechanical Engineering and Mining Engineering)

Time: 3 hours **Max. Marks: 70**

Question paper consists of Part-A and Part-B

Answer ALL sub questions from Part-A

Answer any THREE questions from Part-B

*****

PART–A ***(22 Marks)***

1. a) Write the scope of production planning and control. [4]
   b) Define forecasting. [3]
   c) What are the benefits of JIT? [4]
   d) Write the applications of routing. [4]
   e) Enumerate the main purpose of scheduling in brief. [4]
   f) Define the term follow up. [3]

PART–B ***(3x16 = 48 Marks)***

2. a) Describe the different types of production systems. [8]
   b) Explain about functions of production systems. [8]

3. a) Using the exponential smoothing technique, Compute the forecasts from the following data (time series) under the situations when **α = 0.3.**Compute the forecast for the 11 th period?

Month	1	2	3	4	5	6	7	8	9	10
Demand	28	30	32	31	27	26	30	33	32	31

   [10]

   b) Explain the general principles of forecasting techniques. [6]

4. a) Explain various costs associated with inventory. [8]
   b) Explain the inputs and outputs of the MRP system. [8]

5. a) Explain the concept of Bill of materials in detail. [8]
   b) Explain the general procedure involved in preparing route sheet. [8]

6. a) Compare and contrast different scheduling policies. [8]
   b) Explain the various controlling aspects of production in detail. [8]

7. a) Write the applications of computer in production planning and control. [8]
   b) What are typical advantages and disadvantages of dispatching with decentralized control? [8]

Code No: **RT42031** **R13** **Set No. 3**

IV B.Tech II Semester Regular/Supplementary Examinations, April - 2018

PRODUCTION PLANNING AND CONTROL

(Common to Mechanical Engineering and Mining Engineering)

Time: 3 hours **Max. Marks: 70**

Question paper consists of Part-A and Part-B

Answer ALL sub questions from Part-A

Answer any THREE questions from Part-B

*****

PART–A *(22 Marks)*

1. a) Write the applications and examples for mass production. [4]
   b) Write the uses of forecasting. [4]
   c) Write about MRP-II. [4]
   d) Define routing. [3]
   e) Why scheduling is essential? [4]
   f) Write the importance of dispatching on time. [3]

PART–B *(3x16 = 48 Marks)*

2. a) What are the activities in control phase of PPC? Explain in brief. [8]
   b) What are the objectives for which PPC department is established in a factory system? [8]

3. a) Find the MAD (Mean Absolute Deviation) and MSE (Mean Square Error) for the following forecast.

Period	1	2	3	4	5	6	7	8	9	10	11	12
Actual Demand	97	93	110	98	130	133	129	138	136	124	139	125
Forecasted Demand	100	100	100	100	102	104	106	108	110	112	114	116

   [8]
   b) Difference between qualitative and quantitative methods. [8]

4. a) Explain the various functions of inventory management. [8]
   b) Explain P and Q systems of controlling the inventories with neat diagrams. [8]

5. a) What are the important factors that affecting routing procedure. [8]
   b) Define route sheet? What is the information it contains? Explain it by drawing a route sheet. [8]

6. a) Explain about the scheduling techniques in detail. [8]
   b) Explain the concept of Line Balancing in detail. [8]

7. a) What is material follow up? What is the role of purchase department in material follow up. [8]
   b) Explain advantages & disadvantages of dispatching – centralized control. [8]

Code No: **RT42031** **R13** **Set No. 4**

IV B.Tech II Semester Regular/Supplementary Examinations, April - 2018

PRODUCTION PLANNING AND CONTROL

(Common to Mechanical Engineering and Mining Engineering)

Time: 3 hours **Max. Marks: 70**

Question paper consists of Part-A and Part-B

Answer ALL sub questions from Part-A

Answer any THREE questions from Part-B

*****

PART–A ***(22 Marks)***

1. a) Write the applications and examples for batch shop production. [4]
   b) Write the importance of forecasting. [3]
   c) Write about MRP-I. [4]
   d) Write the applications of scheduling. [4]
   e) Mention the significance of expediting for production planning. [4]
   f) Define dispatching. [3]

PART–B ***(3x16 = 48 Marks)***

2. a) With the help of an organization chart explain how PPC department can carry out its functions. [8]
   b) Explain the importance of PPC department in a typical production system. [8]

3. a) Fit the linear regression model for the following data and forecast the demand for the period 9.

Period	1	2	3	4	5	6	7	8
Demand	750	820	840	820	840	755	785	750

   [8]

   b) For the given data, compute 3 month moving average

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct
Orders	120	90	100	l 75	110	50	75	130	110	90

   Compute the 3 month weighted moving average with a weight of 52% for the October data, a weight of 23% for the September data, and a weight of 18% for the August data. [8]

4. a) An electric housing has an annual usage rate of 75,000 units/year, an ordering cost Rs, 800 and annual carrying charge of 15.4% of the unit price. Delivery lead time is 2 weeks. Determine EOQ, Lead time consumption and the optimal operating doctrine. (Assuming the cost of one unit is Rs. 12). [8]
   b) Explain the various steps of Line of Balance technique. [8]

5. a) Explain about the Routing procedure. [8]
   b) What is the role of bills of materials? How demand affects the bill of material? [8]

6. a) Explain the various types of graphs used in scheduling and control related problems. [8]
   b) Explain about the concept of Chase planning. [8]

7. a) Explain how tool dispatching works in centralized control and decentralized control. [8]
   b) Explain the significance of follow up in production. [8]

R13

Code No: 118DZ

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech IV Year II Semester Examinations, April - 2018
PRODUCTION PLANNING AND CONTROL
(Mechanical Engineering)

Time: 3 hours **Max. Marks: 75**

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A. Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

PART - A

(25 Marks)

1.a)	List out the various functions of production planning and control	[2]
b)	What are the needs for PPC?	[3]
c)	What is the importance of forecasting?	[2]
d)	What are the differences between short term and long term forecasting?	[3]
e)	What is meant by inventory control?	[2]
f)	State the costs associated with inventory problems.	[3]
g)	Define line balancing.	[2]
h)	Explain routing procedure	[3]
i)	What is dispatching?	[2]
j)	State any three objectives of follow up	[3]

PART - B

(50 Marks)

2.a) Explain the scope of production planning and control.
b) Explain different types of production systems and differentiate between them. [5+5]

OR

3.a) Distinguish between production planning and production control and state their objectives.
b) Discuss organization of Production planning and control department. [5+5]

4.a) Discuss the factors which affects the choice of forecasting method..
b) Forecast the production for next two years when the production quantity for last ten years is as follows: 200, 225, 235, 240, 255, 260, 265, 275, 270, 271
Use the following methods and comment on results
i) Moving average (3 years and 5 years)
ii) Exponential smoothing for α=0.3 and 0.7. [5+5]

OR

5.a) Describe 'Least Square Method' of sales forecasting with its advantages and limitations.
b) Describe the Survey of buyers intention method of sales fore casting with its advantages and limitations. [5+5]

6.a) Derive the expression for EOQ when the demand of the item is uniform, the production rate is infinite and no stocks out are allowed.

b) Explain the various elements of JIT. [5+5]

OR

7.a) What is meant by VED analysis? What is its significance?

b) Alpha industry estimates that it will sell 12000 units of its product for the forthcoming year. The ordering cost is Rs. 100 per order and the carrying cost per unit per year is 20% of the purchase price per unit. The purchase price per unit is Rs.50.Find i) Economic Order quantity, ii) No. of orders per year and iii) Time between successive orders. [5+5]

8.a) Define routing and its significance. Explain about the important components of routing sheets?

b) What is aggregate planning? Write its functions, merits and demerits. [5+5]

OR

9.a) Explain various functions of Routing.

b) Bring out any four differences between scheduling and loading. [5+5]

10.a) Define follow up and explain different types of the follow up in detail.

b) Discuss in detail the sequential steps involved in dispatching. [5+5]

OR

11.a) Describe the following forms used in dispatching:
i) Move order
ii) Production ticket.

b) Explain the applications of computer in production planning and control. [5+5]

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Code No: **RT42031** **R13** **Set No. 1**

IV B.Tech II Semester Regular Examinations, April/May - 2017

PRODUCTION PLANNING AND CONTROL

(Common to Mechanical Engineering and Mining Engineering)

Time: 3 hours **Max. Marks: 70**

Question paper consists of Part-A and Part-B

Answer ALL sub questions from Part-A

Answer any THREE questions from Part-B

*****

PART–A ***(22 Marks)***

1. a) What is job order production? [3]
   b) State the objectives of short term forecasting. [4]
   c) Give a short note of ABC analysis. [3]
   d) Define routing. List out limitations of routing. [4]
   e) What is scheduling? What are its objectives? [4]
   f) Discuss any four applications of computer in PPC. [4]

PART–B ***(3x16 = 48 Marks)***

2. a) Describe the functions of Production planning and control. [8]
   b) State the purpose of a manufacturing organization in an industry. Give a typical organization structure of a manufacturing organization. [8]

3. a) Describe 'Exponential Smoothing Method' of sales forecasting. State its advantages and limitations. [8]
   b) Find the trend using least square method for the date below. Also estimate demand for 1984. [8]

Year	1975	1976	1977	1978	1979	1980	1981
Demand in 1000 units	85	75	80	72	65	60	55

4. a) Explain the significance of EOQ formula. What are its Limitations? [8]
   b) What is meant by VED analysis? What is its significance? [8]

5. a) Explain how the routing differs in job order, intermittent and continuous production systems. [8]
   b) List out and explain the objectives of routing. [8]

6. Following data is available for processing three orders: A, B and C. Order AJ712 was received two days after receipt of order AJ600 and AJ720 was received one day after receipt of order AJ712. One day is required for setting up and material handling between each operation. Prepare a Gantt schedule chart. There are no machine restrictions.

	Estimated time(days)		
Operation No.	Order No. AJ712	Order No. AJ 720	Order No. AJ 600
10	7	8	3
20	5	2	5
30	3	4	5
40	2	-	-
50	1	-	-
60	1	-	-

[16]

7. a) Explain about the dispatching procedure. [8]
   b) Explain the necessity of close control in dispatching activities? [8]

Code No: **RT42031** **R13** **Set No. 2**

IV B.Tech II Semester Regular Examinations, April/May - 2017

PRODUCTION PLANNING AND CONTROL

(Common to Mechanical Engineering and Mining Engineering)

Time: 3 hours **Max. Marks: 70**

Question paper consists of Part-A and Part-B
Answer ALL sub questions from Part-A
Answer any THREE questions from Part-B
*****

PART–A *(22 Marks)*

1. a) What is batch production? [3]
   b) State the objectives of long term forecasting. [4]
   c) Give a short note of KANBAN system. [3]
   d) What is the importance of route sheet? [4]
   e) Describe master scheduling. [4]
   f) Discuss the advantages of decentralized dispatching. [4]

PART–B *(3x16 = 48 Marks)*

2. a) Explain the relationship between 'Production planning' and 'control'. [8]
   b) Describe the activities in follow up or control phase of PPC. [8]

3. a) Forecast the demand for the following series by exponential smoothing method:

Period	1	2	3	4	5	6	7	8	9	10
Actual Demand	10	12	8	11	9	10	15	14	16	15

   [8]
   b) Name and describe the various factors affecting sales forecasting. [8]

4. a) How can load reports be used to develop material requirement plans? [8]
   b) Explain the factors affecting the inventory costs. [8]

5. a) Explain the bill of material with design specification chart. [8]
   b) Define routing. Explain the routing procedure in brief. [8]

Code No: **RT42031** **R13** **Set No. 2**

6. A machine operator processes five types of products and must choose sequence for them. The set-up cost per change (Rs.) depends on the products presently on the machine and the set-up be made according to the following table. Changeovers from A to D and C to E are not allowed. How should one sequence the products in order to have minimum total set-up cost?

From Product	To Product				
	A	B	C	D	E
A	-	4	7	-	4
B	4	-	6	3	4
C	7	6	-	7	-
D	3	3	7	-	6
E	4	6	4	5	-

[16]

7. a) What is meant by Dispatching? [4]
   b) Explain the different types of follow ups? [8]
   c) Give a list of records maintained by Dispatching Department? [4]

Code No: **RT42031** **R13** **Set No. 3**

IV B.Tech II Semester Regular Examinations, April/May - 2017
PRODUCTION PLANNING AND CONTROL
(Common to Mechanical Engineering and Mining Engineering)

Time: 3 hours **Max. Marks: 70**

Question paper consists of Part-A and Part-B
Answer ALL sub questions from Part-A
Answer any THREE questions from Part-B
*****

PART–A *(22 Marks)*

1. a) What is continuous production? [3]
   b) Describe moving average method. [4]
   c) Give a short note of JIT system. [3]
   d) What are the factors affecting routing procedure. [4]
   e) Describe production scheduling. [4]
   f) Discuss the advantages of centralized dispatching. [4]

PART–B *(3x16 = 48 Marks)*

2. a) Describe in brief, planning in manufacture organization. [8]
   b) Define production planning. State its objectives. List the information required for production planning. [8]

3. a) State the advantages and limitations of sales forecasting. [8]
   b) Project the trend of sales for the next four years.

Year	1983	1984	1985	1986	1987
Sales in Lakh	120	140	150	170	190

[8]

4. a) Explain the principles of MRP system. [8]
   b) Classify inventory models? Discuss briefly any one of them? [8]

5. a) What do you meant by bill of material? Explain in detail. [8]
   b) Discuss different routing procedure. [8]

6. For the following data, find the schedule that minimizes the mean flow time, if the number of parallel machines is 2.

Job	1	2	3	4	5	6	7	8
Processing Time (hr)	4	6	3	7	2	1	5	9

[16]

7. a) What is dispatching? State the various activities of dispatching in brief. [8]
   b) Name and describe the common forms used for dispatching. [8]

Code No: **RT42031** **R13** **Set No. 4**

IV B.Tech II Semester Regular Examinations, April/May - 2017
PRODUCTION PLANNING AND CONTROL
(Common to Mechanical Engineering and Mining Engineering)

Time: 3 hours **Max. Marks: 70**

Question paper consists of Part-A and Part-B
Answer ALL sub questions from Part-A
Answer any THREE questions from Part-B
*****

PART–A ***(22 Marks)***

1.	a)	What are the objectives of PPC.	[3]
	b)	Explain the objectives of forecasting.	[4]
	c)	Give a short note on Line of Balance.	[3]
	d)	What is the importance of loading?	[4]
	e)	What is the role of LOB in project scheduling?	[4]
	f)	Briefly explain dispatching rules.	[4]

PART–B ***(3x16 = 48 Marks)***

2.	a)	State the advantages of better Production planning and control.	[8]
	b)	Name the various types of production systems. Describe the production system suitable for job work.	[8]
3.	a)	Explain the importance of sales forecasting.	[8]
	b)	Describe 'Least square method' of sales forecasting with its advantages and limitations.	[8]
4.	a)	Compare VED analysis with ABC analysis.	[8]
	b)	Explain the terminology involved in MRP system.	[8]
5.	a)	Describe route sheet with a suitable example.	[8]
	b)	Explain the importance of bill of material in production line.	[8]

6. A bomb squad faces a terrible situation that the members wish had never happened. A terrorist has planted five bombs in an airport building, endangering lives and property. The squad has located all five bombs and must now proceed to dismantle them. Because of limited staffing, the bombs can be dismantled only sequentially. Unfortunately, there is not much time left and the squad must choose judiciously the order in which the bombs will be dismantled. The following data represents a reliable estimate by the squad. What sequence for dismantling the bombs would you recommend to the squad? What should be the criterion that the squad optimizes?

Bomb	1	2	3	4	5
Time to dismantle (hours)	3	1	2	4	1
Time remaining before the bomb will explode (hours)	9.0	11.25	11.0	6.0	5.0

[16]

7. a) List out and briefly explain the activities of dispatcher. [8]
   b) Explain the applications of computer in production planning and control. [8]

Code No: 118DZ **R13**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech IV Year II Semester Examinations, May - 2017
PRODUCTION PLANNING AND CONTROL
(Common to ME, MCT)

Time: 3 hours **Max. Marks: 75**

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A. Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

PART - A

(25 Marks)

1.a) Differentiate between the production planning and production control. [2]
b) How the "controlling" can be done to regulate the progress of work? [3]
c) Give the step by step Forecasting procedure for using time series [2]
d) A forecaster is using an exponential smoothing model with a = 0.4 and wishes to convert to a moving average. What length of moving average is approximately equivalent? [3]
e) What do you understand by the term operating doctrine in the inventory modelling? [2]
f) Do JIT enhance return on investment (ROI)? Explain. [3]
g) What are the assumptions in flow shop scheduling? [2]
h) Compare *infinite* loading and *finite* loading. [3]
i) What are the methods to take corrective action in follow-up? [2]
j) Differentiate between centralized and decentralized dispatching. [3]

PART - B

(50 Marks)

2.a) Briefly explain the prerequisites of PPC.
b) Explain the production lifecycle with the aid of a graph. [5+5]

OR

3.a) "PPC regulates and controls "how," "where," and "when" work is to be done." What do you understand by this statement?
b) State the principles of good production planning and control. [5+5]

4.a) What are the levels of aggregation in forecasting for a manufacturing organization? How should this hierarchy of forecasts be linked and used?
b) List out the advantages and disadvantages of short term long term forecasting. [5+5]

OR

5. A firm uses simple exponential smoothing with $\alpha = 0.1$ to forecast demand. The forecast for the week of February 1 was 500 units, whereas actual demand turned out to be 450 units.
a) Forecast the demand for the week of February 8.
b) Assume that the actual demand during the week of February 8 turned out to be 505 units. Forecast the demand for the week of February 15, Continue forecasting through March 15, assuming that subsequent demands were actually 516, 488, 467, 554 and 510 units. [10]

6.a) Explain the concept behind the two-dimensional and music 3-D models of inventory control.

b) What is MRP and MRP-II? How they are related? Explain. [5+5]

OR

7.a) *Inventory is waste!* Do you agree? Justify your answer.

b) Find the economic lot size, the associated total cost, and the length of time between two orders, given that the set- up cost is Rs.100, daily holding cost per unit of inventory is Rs. 0.05, and daily demand is approximately 30 units. [5+5]

8.a) Distinguish between the routing functions of continuous and intermittent productions.

b) Explain the use of Line of Balance (LOB) in Production control. Explain in detail the steps involved in LOB. [5+5]

OR

9.a) Describe the following costs in aggregate planning and explain the difficulties that arise in attempting to measure them in a real operation environment.
i) Smoothing costs (ii) Holding costs

b) What do you understand by Compensatory Off Policy? Explain its merits and demerits. [5+5]

10.a) "The PPC function 'dispatching' is often misunderstood." Explain the correct meaning and duties of the dispatching function.

b) What are the stages of follow up? Explain any two. [5+5]

OR

11.a) What are the functions of dispatching?

b) When do you prefer decentralized dispatching to centralized dispatching? Explain their features. [5+5]

--ooOoo---

Code No: **RT42031** **R13** **Set No. 1**

IV B.Tech II Semester Regular/Supplementary Examinations, April/May - 2019

PRODUCTION PLANNING AND CONTROL

(Common to Mechanical Engineering and Mining Engineering)

Time: 3 hours **Max. Marks: 70**

Question paper consists of Part-A and Part-B

Answer ALL sub questions from Part-A

Answer any THREE questions from Part-B

*****

PART–A *(22 Marks)*

1. a) What are the various types of production systems? [3]
   b) What is forecasting. List their uses. [4]
   c) Distinguish between MRP-II and ERP. [4]
   d) What is the importance of route sheet? [4]
   e) Name some scheduling methods. [3]
   f) What is dispatching? [4]

PART–B *(3x16 = 48 Marks)*

2. a) What is PPC? What is the need for PPC? [8]
   b) Discuss the objectives of production control. [8]

3. a) Discuss the factors which affect the choice of forecasting method. [8]
   b) A firm uses simple exponential smoothing with α =0.3 to forecast demand. The forecast for the first week of January was 500 units, whereas actual turned out to be 450 units. (i) Forecast the demand for the second week of January (ii) Assume that the actual demand during the second week of January turned out to be 550 units. Forecast the demand up to February third week, assuming the subsequent demands as 475, 450, 470, 525, and 470 units. [8]

4. a) Derive the expression for EOQ when the demand of the item is uniform. The production rate is infinite and no stocks out are allowed. [8]
   b) A company requires 10000 units of an item per annum. The cost of ordering is Rs. 150 per order. The inventory carrying cost is 30%. The unit price of the item is Rs. 12. Calculate (i) The economic order quantity (ii) Optimal total annual cost (iii) Time between the orders. [8]

5. a) Explain the steps involved in the preparation of route sheet. [4]
   b) Explain the difference between loading and scheduling. [12]

6. a) What is line balancing? What is its importance in PPC? Explain it with an example. [10]
   b) Explain about any one scheduling policy. [6]

7. a) Explain the reasons for existence of follow-up functions. [8]
   b) Explain how a computer can be used to prepare a schedule chart. [8]

Code No: **RT42031** **R13** **Set No. 2**

IV B.Tech II Semester Regular/Supplementary Examinations, April/May - 2019

PRODUCTION PLANNING AND CONTROL

(Common to Mechanical Engineering and Mining Engineering)

Time: 3 hours **Max. Marks: 70**

Question paper consists of Part-A and Part-B

Answer ALL sub questions from Part-A

Answer any THREE questions from Part-B

*****

PART–A *(22 Marks)*

1. a) Define PPC. [3]
   b) Explain the objectives of forecasting. [4]
   c) Give a short note on Line of Balance. [4]
   d) Distinguish between the route card and route sheet. [4]
   e) Name some line balancing methods. [4]
   f) What is follow up? [3]

PART–B *(3x16 = 48 Marks)*

2. a) Discuss the organization structure of Production planning and control department. [8]
   b) Discuss the objectives of production planning. [8]

3. a) Describe least square method with its advantages and limitations. [8]
   b) Using the method of least squares, find the trend values for each five years for the annual sales data given below. Also estimate the annual sales for the year 1985.

Year	1980	1981	1982	1983	1984
Sales in Rs.	50000	65000	750000	52000	72000

[8]

4. a) Explain the various elements of JIT and KANBAN system. [8]
   b) What are the characteristics of fixed order Quantity (Q) System? Illustrate with a figure. [8]

5. a) Enumerate any five differences between loading and scheduling. [8]
   b) Explain the factors affecting the routing procedure. [8]

6. A manufacturer has four orders on hand which he has to schedule on four different machines. How would you schedule his orders?

Order no	Oder size	Standard pieces per hour on machines			
		A	B	C	D
1	100	1	3/2	4/5	4/3
2	200	2	1	10/11	5/3
3	50	2	4/3	1	5/2
4	75	1	4/5	2/3	5/4
Machines hours available		80	150	250	100

[16]

7. a) Discuss in detail the sequential steps involved in dispatching [8]
   b) Discuss the applications of computers in PPC. [8]

Code No: **RT42031** **R13** **Set No. 3**

IV B.Tech II Semester Regular/Supplementary Examinations, April/May - 2019

PRODUCTION PLANNING AND CONTROL

(Common to Mechanical Engineering and Mining Engineering)

Time: 3 hours **Max. Marks: 70**

Question paper consists of Part-A and Part-B

Answer ALL sub questions from Part-A

Answer any THREE questions from Part-B

*****

PART–A *(22 Marks)*

1. a) List out different types of production [3]
   b) What is the importance of forecasting? [4]
   c) What is KANBAN System? Explain in brief. [4]
   d) What is meant by bill of material? [4]
   e) Why is aggregate planning important? [3]
   f) Define the following terms: (i) Dispatching (ii) Follow up. [4]

PART–B *(3x16 = 48 Marks)*

2. a) Discuss the benefits of Production planning and control. [8]
   b) Differentiate between production planning and production control. [8]

3. a) Explain the objectives of forecasting. [8]
   b) One of the two wheeler manufacturing company experienced irregular but usually increasing demand for three products. The demand was found to be 520 bikes for June and 540 bikes for July. They use a forecasting method which takes average of past year to forecast future demand. Using the simple average method demand forecast for June is found as 420 bikes (Use a smoothing coefficient 0.7 to weight the recent demand most heavily) and find the demand forecast for August. [8]

4. a) What is VED analysis? Explain its significance? [8]
   b) ABC manufacturer's produces 1, 25,000 oil seals each year to satisfy the requirement of their client. They order the metal for the bushing in lot of 30,000 units. It cost them $40 to place the order. The unit cost of bushing is $0.12 and the estimated carrying cost is 25% unit cost. Find out the economic order quantity. What percentage of increases or decrease in order quantity is required so that the ordered quantity is Economic order quantity? [8]

5. a) Define routing and explain what are the factors affecting the routing procedure in detail. [8]
   b) Write short note on bill of material with an example [8]

6. a) What is scheduling? What are the different scheduling methods? [8]
   b) What is aggregate planning? Explain the pure strategies of aggregate planning. [8]

7. a) Differentiate between centralized and decentralized dispatching procedures. [8]
   b) List out the applications of computers in PPC. [8]

Code No: **RT42031** **R13** **Set No. 4**

IV B.Tech II Semester Regular/Supplementary Examinations, April/May - 2019

PRODUCTION PLANNING AND CONTROL

(Common to Mechanical Engineering and Mining Engineering)

Time: 3 hours **Max. Marks: 70**

Question paper consists of Part-A and Part-B

Answer ALL sub questions from Part-A

Answer any THREE questions from Part-B

*****

PART–A *(22 Marks)*

1. a) List the objectives of planning and control. [3]
   b) Name some qualitative and quantitative methods of forecasting. [4]
   c) Define inventory control. [4]
   d) What is MRP? List the various inputs required for it. [4]
   e) What is meant by line balancing? [3]
   f) Write different types of follow up. [4]

PART–B *(3x16 = 48 Marks)*

2. a) Discuss about different elements of PPC. [8]
   b) Explain the functions of production planning and control. [8]

3. a) Describe exponential smoothing method with its advantages and limitations. [8]
   b) Forecast the production for next two years when the production quantity for last ten years is as follows: 200, 225, 235, 240, 255, 260, 265, 275, 270, 271 Use the following methods and comment on results (i) Moving average (3 Years and 5 Years) (ii) Exponential smoothing for $\alpha = 0.3$ and 0.7. [8]

4. a) What is meant by ABC analysis? What is its significance? [6]
   b) M/s. KOBO Bearing Ltd is committed to supply 24000 bearings per annum to M/s. Deluxe Fans on a steady daily basis. It is estimated that it costs 10 paise as inventory holding cost per bearing per month and the set up cost per run of bearing manufacture of Rs. = 324.(i) What should be the optimum run size for bearing manufacture? (ii) What should be the interval between two consecutive optimum runs? (iii) Find out the minimum inventory holding cost? [10]

5. a) Write short note on bill of material with an example. [8]
   b) Describe machine loading and scheduling with an example. [8]

6. a) What is aggregate planning and explain about it in detail. [8]
   b) Explain the terms forward scheduling and backward scheduling. [8]

7. a) Explain briefly the dispatching activities. [8]
   b) Discuss the role of computers in production planning and control. [8]

Code No: **RT42031** **R13** **Set No. 1**

IV B.Tech II Semester Supplementary Examinations, July/August - 2017

PRODUCTION PLANNING AND CONTROL

(Common to Mechanical Engineering and Mining Engineering)

Time: 3 hours **Max. Marks: 70**

Question paper consists of Part-A and Part-B

Answer ALL sub questions from Part-A

Answer any THREE questions from Part-B

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PART–A ***(22 Marks)***

1. a) Define continuous production system. Write any three differences between mass production and flow production. [4]
   b) Write about moving average method. [4]
   c) Write any four benefits of MRP. [4]
   d) Write a short note on BOM. [4]
   e) Write a brief note on production scheduling. [3]
   f) What is follow up? State any three objectives. [3]

PART–B ***(3x16 = 48 Marks)***

2. a) Describe the functions of production planning and control in detail. [8]
   b) What is internal organization of a department? Explain it briefly by taking an example. [8]

3. a) Describe 'Least Square Method' of sales forecasting with its advantages and limitations. [8]
   b) Forecast the demand for the following series by exponential smoothing method by taking $\alpha = 0.3$ and 0.6

Period	1	2	3	4	5	6	7	8	9	10
Actual demand	10	12	8	11	9	10	15	14	16	15

[8]

4. a) Define inventory. What are the various types of inventory? Why are they maintained? [8]
   b) A factory needs 36000 units annually of a component that cost Rs.2 per unit. Cost of each order placing is Rs.25 and inventory carrying cost is Rs.10 per year.
      (i) Find the economic lot size and the total inventory cost.
      (ii) What is the time between placing of orders?
      (iii) The supplier offers 2% discount if a single order is placed. Should the company accept it? [8]

5. a) Define routing and explain what are the factors affecting the routing procedure in detail. [8]
   b) Write any four differences between scheduling and loading. [8]

6. a) Describe briefly the line of balance technique of project scheduling. [8]
   b) What is aggregate planning? Write its functions, merits and demerits. [8]

7. a) What is dispatching? State various activities of a dispatcher. [8]
   b) Write any eight applications of computers in PPC. [8]