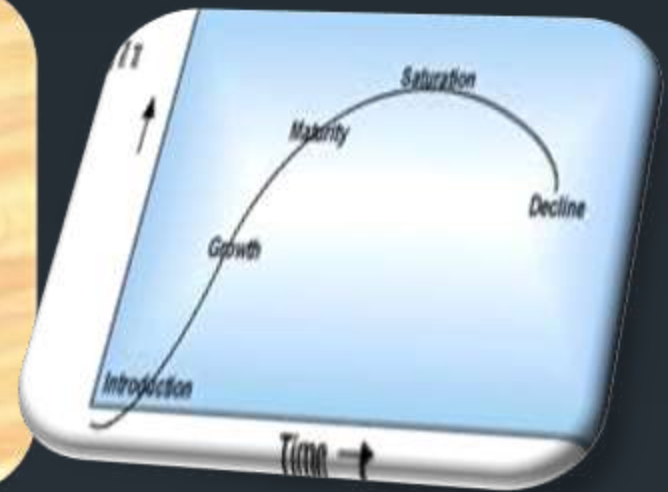
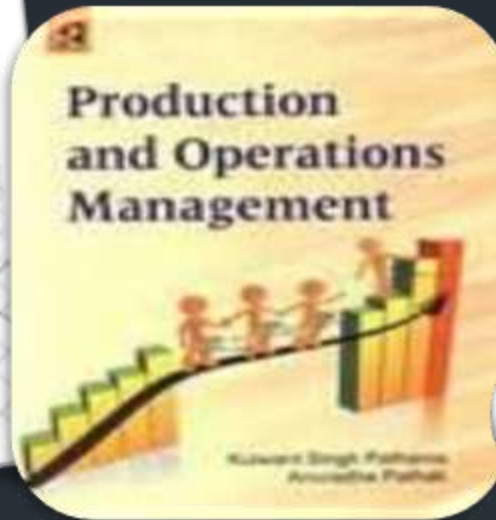


PRODUCTION & OPERATION MANAGEMENT



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ME 201 Strategic Management of an
Engineering Enterprise



Introduction

Production/operations management is the process, which combines and transforms various resources used in the production/operations subsystem of the organization into value added product/services in a controlled manner as per the policies of the organization. Therefore, it is that part of an organization, which is concerned with the transformation of a range of inputs into the required (products/services) having the requisite quality level.

The set of interrelated management activities, which are involved in manufacturing certain products, is called as **production management**. If the same concept is extended to services management, then the corresponding set of management activities is called as **operations management**.

Historical Evolution of Production and Operations Management


For over two centuries operations and production management has been recognised as an important factor in a country's economic growth.

The traditional view of manufacturing management began in eighteenth century when **Adam Smith** recognised the economic benefits of specialisation of labour. He recommended breaking of jobs down into subtasks and recognises workers to specialised tasks in which they would become highly skilled and efficient. In the early twentieth century, F.W. Taylor implemented Smith's theories and developed scientific management. From then till 1930, many techniques were developed prevailing the traditional view. Brief information about the contributions to manufacturing management is shown in the Table 1.1.

Table 1.1 Historical summary of operational management

Date	Contribution	Contributor
1776	Specialization of labour in manufacturing	Adam Smith
1799	Interchangeable parts, cost accounting	Eli Whitney and others
1832	Division of labour by skill; assignment of jobs by skill; basics of time study	Charles Babbage
1900	Scientific management time study and work study developed; dividing planning and doing of work	Frederick W. Taylor
1900	Motion of study of jobs	Frank B. Gilbreth
1901	Scheduling techniques for employees, machines jobs in manufacturing	Henry L. Gantt
1915	Economic lot sizes for inventory control	F. W. Harris

Date	Contribution	Contributor
1927	Human relations; the Hawthorne studies	Elton Mayo
1931	Statistical inference applied to product quality: quality control charts	W. A. Shewart
1935	Statistical sampling applied to quality control: inspection sampling plans	H. F. Dodge and H. G. Roming
1940	Operations research applications in World War II	P. M. Blacker and Others.
1946	Digital Computer	John Mauchlly and J. P. Eckert
1947	Linear Programming	G. B. Dantzig, William & others.
1950	Mathematical programming, on-linear and stochastic processes	A. Charnes, W. W. Cooper & others
1951	Commercial digital computer: large-scale computations available.	Sperry Univac



Date	Contribution	Contributor
1960	Organizational behaviour: continued study of people at work	L. Cummings, L. Porter
1970	Integrating operations into overall strategy and policy, Computer applications to manufacturing, Scheduling and control, Material requirement planning (MRP)	W. Skinner J. Orlicky and G. Wright
1980	Quality and productivity applications from Japan: robotics, CAD-CAM	W. E. Deming and J. Juran



Concept of Production

Production is defined as *“the step-by-step conversion of one form of material into another form through chemical or mechanical process to create or enhance the utility of the product to the user.”* Thus production is a value addition process. At each stage of processing, there will be value addition.

Edwood Buffa defines production as *‘a process by which goods and services are created’*.

Some examples of production are: manufacturing custom-made products like, boilers with a specific capacity, constructing flats, some structural fabrication works for selected customers, etc., and manufacturing standardized products like, car, bus, motor cycle, radio, television, etc.

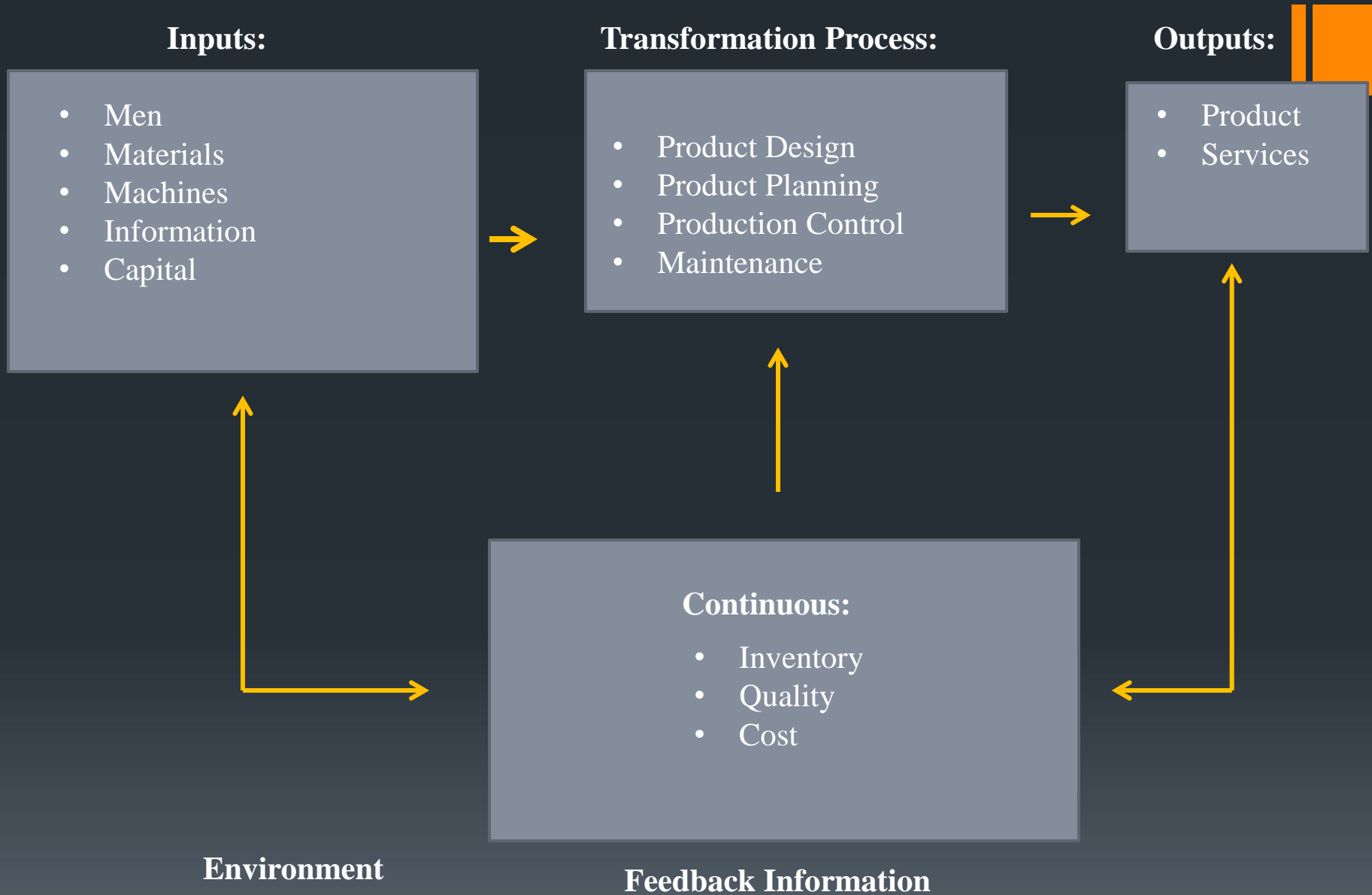


Fig. 1.1 *Schematic Production System*



Production System

The production system of an organization is that part, which produces products of an organization. It is that activity whereby resources, flowing within a defined system, are combined and transformed in a controlled manner to add value in accordance with the policies communicated by management. A simplified production system is shown above.

The production system has the following characteristics:

1. Production is an organized activity, so every production system has an objective.
2. The system transforms the various inputs to useful outputs.
3. It does not operate in isolation from the other organization system.
4. There exists a feedback about the activities, which is essential to control and improve system performance.

Production systems can be classified as Job Shop, Batch, Mass and Continuous Production systems.

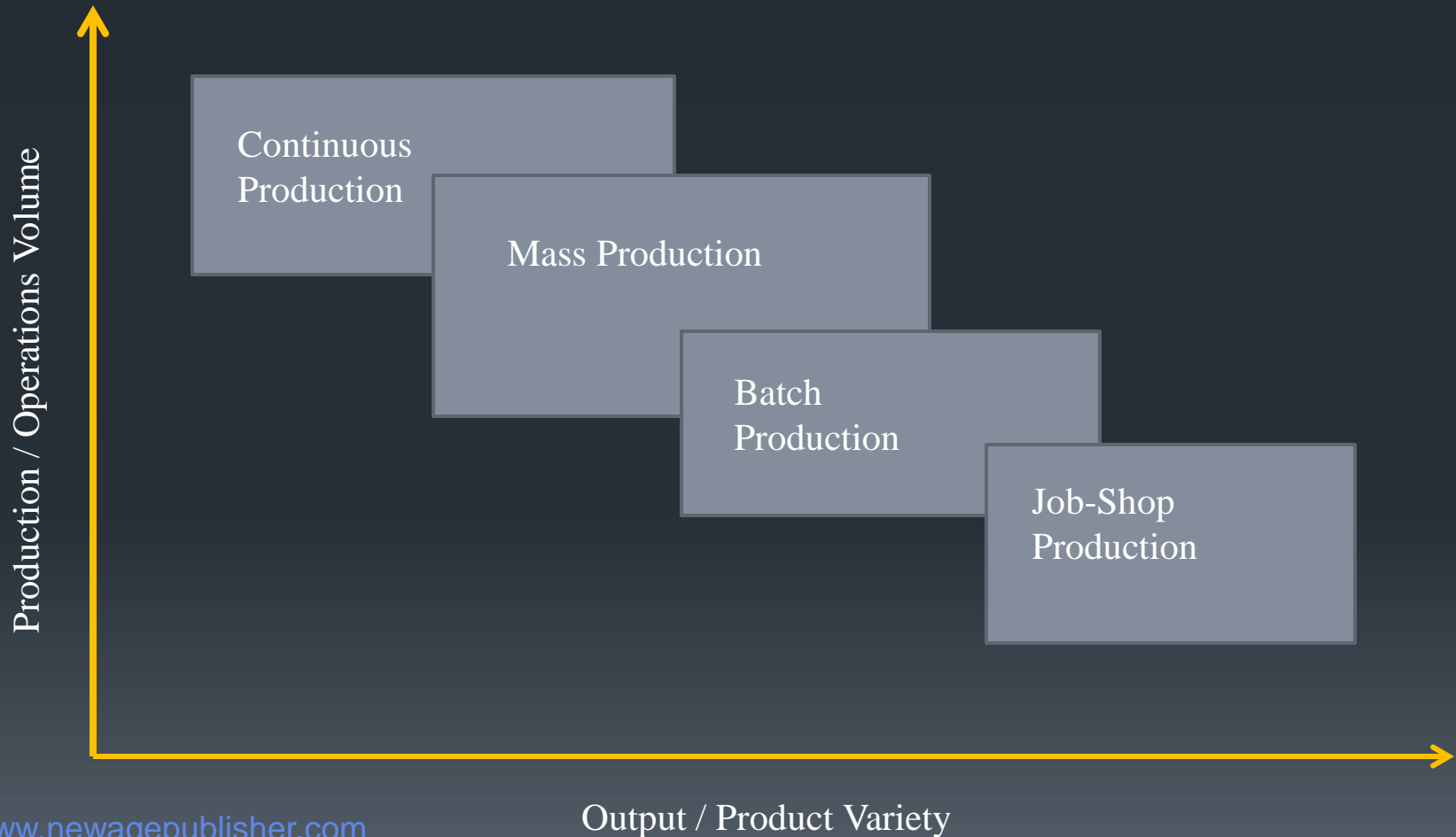


Fig. 1.2 *Classification of Production Systems*

Job Shop Production

Job shop production are characterised by manufacturing of one or few quantity of products designed and produced as per the specification of customers within prefixed time and cost. The distinguishing feature of this is low volume and high variety of products.

Characteristics

The Job-shop production system is followed when there is:

1. High variety of products and low volume.
2. Use of general purpose machines and facilities.
3. Highly skilled operators who can take up each job as a challenge because of uniqueness.
4. Large inventory of materials, tools, parts.
5. Detailed planning is essential for sequencing the requirements of each product, capacities for each work centre and order priorities.

Advantages

Following are the advantages of job shop production:

1. Because of general purpose machines and facilities variety of products can be produced.
2. Operators will become more skilled and competent, as each job gives them learning opportunities.
3. Full potential of operators can be utilised.
4. Opportunity exists for creative methods and innovative ideas.

Limitations

Following are the limitations of job shop production:

1. Higher cost due to frequent set up changes.
2. Higher level of inventory at all levels and hence higher inventory cost.
3. Production planning is complicated.
4. Larger space requirements.

Batch Production

Batch production is defined by American Production and Inventory Control Society (APICS) *“as a form of manufacturing in which the job passes through the functional departments in lots or batches and each lot may have a different routing.”* It is characterised by the manufacture of limited number of products produced at regular intervals and stocked awaiting sales.

Characteristics

Batch production system is used under the following circumstances:

1. When there is shorter production runs.
2. When plant and machinery are flexible.
3. When plant and machinery set up is used for the production of item in a batch and change of set up is required for processing the next batch.
4. When manufacturing lead time and cost are lower as compared to job order production.

Advantages

Following are the advantages of batch production:

1. Better utilisation of plant and machinery.
2. Promotes functional specialisation.
3. Cost per unit is lower as compared to job order production.
4. Lower investment in plant and machinery.
5. Flexibility to accommodate and process number of products.
6. Job satisfaction exists for operators.

Limitations

Following are the limitations of batch production:

1. Material handling is complex because of irregular and longer flows.
2. Production planning and control is complex.
3. Work in process inventory is higher compared to continuous production.
4. Higher set up costs due to frequent changes in set up.

Mass Production

Manufacture of discrete parts or assemblies using a continuous process are called mass production. This production system is justified by very large volume of production. The machines are arranged in a line or product layout. Product and process standardisation exists and all outputs follow the same path.

Characteristics

Mass production is used under the following circumstances:

1. Standardisation of product and process sequence.
2. Dedicated special purpose machines having higher production capacities and output rates.
3. Large volume of products.
4. Shorter cycle time of production.
5. Lower in process inventory.
6. Perfectly balanced production lines.
7. Flow of materials, components and parts is continuous and without any back tracking.
8. Production planning and control is easy.
9. Material handling can be completely automatic.

Advantages

Following are the advantages of mass production:

1. Higher rate of production with reduced cycle time.
2. Higher capacity utilisation due to line balancing.
3. Less skilled operators are required.
4. Low process inventory.
5. Manufacturing cost per unit is low.

Limitations

Following are the limitations of mass production:

1. Breakdown of one machine will stop an entire production line.
2. Line layout needs major change with the changes in the product design.
3. High investment in production facilities.
4. The cycle time is determined by the slowest operation.

Continuous Production

Production facilities are arranged as per the sequence of production operations from the first operations to the finished product. The items are made to flow through the sequence of operations through material handling devices such as conveyors, transfer devices, etc.

Characteristics

Continuous production is used under the following circumstances:

1. Dedicated plant and equipment with zero flexibility.
2. Material handling is fully automated.
3. Process follows a predetermined sequence of operations.
4. Component materials cannot be readily identified with final product.
5. Planning and scheduling is a routine action.

Advantages

Following are the advantages of continuous production:

1. Standardisation of product and process sequence.
2. Higher rate of production with reduced cycle time.
3. Higher capacity utilisation due to line balancing.
4. Manpower is not required for material handling as it is completely automatic.
5. Person with limited skills can be used on the production line.
6. Unit cost is lower due to high volume of production.

Limitations

Following are the limitations of continuous production:

1. Flexibility to accommodate and process number of products does not exist.
2. Very high investment for setting flow lines.
3. Product differentiation is limited.

Production Management

E.S. Buffa defines production management as, “**Production management** deals with decision making related to production processes so that the resulting goods or services are produced according to specifications, in the amount and by the schedule demanded and out of minimum cost.”

Objectives of Production Management

The objective of the production management is ‘to produce goods services of right quality and quantity at the right time and right manufacturing cost’.

1. **Right Quality**
2. **Right Quantity**
3. **Right Time**
4. **Right Manufacturing Cost**

Operating System

Operating system converts inputs in order to provide outputs which are required by a customer. It converts physical resources into outputs, the function of which is to satisfy customer wants *i.e.*, to provide some utility for the customer. In some of the organization the product is a physical good (hotels) while in others it is a service (hospitals). Bus and taxi services, tailors, hospital and builders are the examples of an operating system.

Everett E. Adam & Ronald J. Ebert define operating system as, “An operating system (function) of an organization is the part of an organization that produces the organization’s physical goods and services.”

Ray Wild defines operating system as, “An operating system is a configuration of resources combined for the provision of goods or services.”


Concept of Operations

An operation is defined in terms of the mission it serves for the organization, technology it employs and the human and managerial processes it involves. Operations in an organization can be categorised into manufacturing operations and service operations. Manufacturing operations is a conversion process that includes manufacturing yields a tangible output: a product, whereas, a conversion process that includes service yields an intangible output: a deed, a performance, an effort.

Distribution between Manufacturing Operations and Service Operations

Following characteristics can be considered for distinguishing manufacturing operations with service operations:

1. Tangible/Intangible nature of output
2. Consumption of output
3. Nature of work (job)
4. Degree of customer contact
5. Customer participation in conversion
6. Measurement of performance.



Manufacturing is characterised by tangible outputs (products), outputs that customers consume overtime, jobs that use less labour and more equipment, little customer contact, no customer participation in the conversion process (in production), and sophisticated methods for measuring production activities and resource consumption as product are made.

Operations Management

A Framework for Managing Operations

PLANNING

Activities that establishes a course of action and guide future decision-making is planning. The operations manager defines the objectives for the operations subsystem of the organization, and the policies, and procedures for achieving the objectives. This stage includes clarifying the role and focus of operations in the organization's overall strategy. It also involves product planning, facility designing and using the conversion process.

ORGANIZING

Activities that establishes a structure of tasks and authority. Operation managers establish a structure of roles and the flow of information within the operations subsystem. They determine the activities required to achieve the goals and assign authority and responsibility for carrying them out.



CONTROLLING

Activities that assure the actual performance in accordance with planned performance. To ensure that the plans for the operations subsystems are accomplished, the operations manager must exercise control by measuring actual outputs and comparing them to planned operations management. Controlling costs, quality, and schedules are the important functions here.

BEHAVIOUR

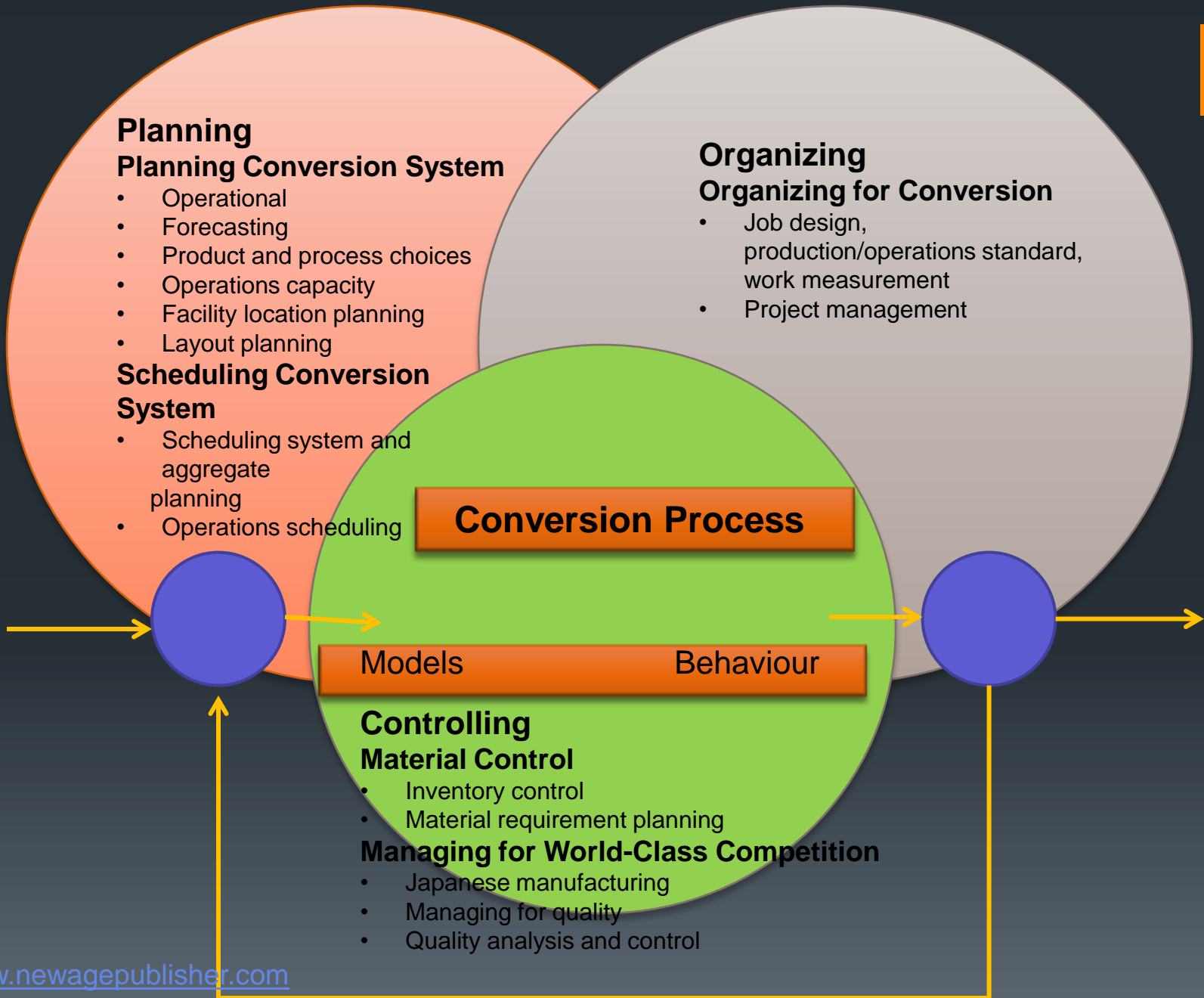
Operation managers are concerned with how their efforts to plan, organize, and control affect human behaviour. They also want to know how the behaviour of subordinates can affect management's planning, organizing, and controlling actions. Their interest lies in decision-making behaviour.



MODELS

As operation managers plan, organise, and control the conversion process, they encounter many problems and must make many decisions. They can simplify their difficulties using models like *aggregate planning models* for examining how best to use existing capacity in short-term, *break even analysis* to identify break even volumes, *linear programming and computer simulation* for capacity utilisation, *decision tree analysis* for long-term capacity problem of facility expansion, *simple median model* for determining best locations of facilities etc.

Fig. 1.3 *General model for managing operations*





Objectives of Operations Management

Objectives of operations management can be categorised into customer service and resource utilisation.

Customer Service

The first objective of operating systems is the customer service to the satisfaction of customer wants. Therefore, customer service is a key objective of operations management. The operating system must provide something to a specification which can satisfy the customer in terms of cost and timing. Thus, primary objective can be satisfied by providing the ‘right thing at a right price at the right time’.

These aspects of customer service—specification, cost and timing—are described for four functions in Table 1.2. They are the principal sources of customer satisfaction and must, therefore, be the principal dimension of the customer service objective for operations managers.

TABLE 1.2 Aspects of customer service

Principal Function	Principal customer wants	
	Primary Considerations	Other Considerations
Manufacture	Goods of a given, requested or acceptable specification	Cost, i.e., purchase price or cost of obtaining goods. Timing, i.e., delivery delay from order or request to receipt of goods.
Transport	Management of a given, requested or acceptable specification	Cost, i.e., cost of movements. Timing, i.e., 1. Duration or time to move. 2. Wait or delay from requesting to its commencement.



Principal Function	Principal customer wants	
	Primary Considerations	Other Considerations
Supply	Goods of a given, requested or acceptable specification	Cost, i.e., purchase price or cost of obtaining goods. Timing, i.e., delivery delay from order or request to receipt of goods.
Service	Treatment of a given, requested or acceptable specification	Cost, i.e., cost of movements. Timing, i.e., <ol style="list-style-type: none">1. Duration or time required for treatment2. Wait or delay from requesting treatment to its commencement.

TABLE 1.3 The twin objectives of operations management

<p>The customer service objective.</p> <p>To provide agreed/adequate levels of customer service (and hence customer satisfaction) by providing goods or services with the right specification, at the right cost and at the right time.</p>	<p>The resource utilisation objective.</p> <p>To achieve adequate levels of resource utilisation (or productivity) <i>e.g.</i>, to achieve agreed levels of utilisation of materials, machines and labour.</p>
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Scope of Production and Operations Management

Production and operations management concern with the conversion of inputs into outputs, using physical resources, so as to provide the desired utilities to the customer while meeting the other organizational objectives of effectiveness, efficiency and adoptability. It distinguishes itself from other functions such as personnel, marketing, finance, etc., by its primary concern for 'conversion by using physical resources.' Following are the activities which are listed under production and operations management functions:

1. Location of facilities
2. Plant layouts and material handling
3. Product design
4. Process design
5. Production and planning control
6. Quality control
7. Materials management
8. Maintenance management.



LOCATION OF FACILITIES

Location of facilities for operations is a long-term capacity decision which involves a long term commitment about the geographically static factors that affect a business organization. It is an important strategic level decision-making for an organization. It deals with the questions such as ‘where our main operations should be based?’

PLANT LAYOUT AND MATERIAL HANDLING

Plant layout refers to the physical arrangement of facilities. It is the configuration of departments, work centres and equipment in the conversion process. The overall objective of the plant layout is to design a physical arrangement that meets the required output quality and quantity most economically.

According to *James Moore*, “*Plant layout is a plan of an optimum arrangement of facilities including personnel, operating equipment, storage space, material handling equipments and all other supporting services along with the design of best structure to contain all these facilities*”.

‘Material Handling’ refers to the ‘moving of materials from the store room to the machine and from one machine to the next during the process of manufacture’. It is also defined as the ‘art and science of moving, packing and storing of products in any form’. It is a specialised activity for a modern manufacturing concern, with 50 to 75% of the cost of production.

PRODUCT DESIGN

Product design deals with conversion of ideas into reality. Every business organization have to design, develop and introduce new products as a survival and growth strategy. Developing the new products and launching them in the market is the biggest challenge faced by the organizations.

PROCESS DESIGN

Process design is a macroscopic decision-making of an overall process route for converting the raw material into finished goods. These decisions encompass the selection of a process, choice of technology, process flow analysis and layout of the facilities.

PRODUCTION PLANNING AND CONTROL

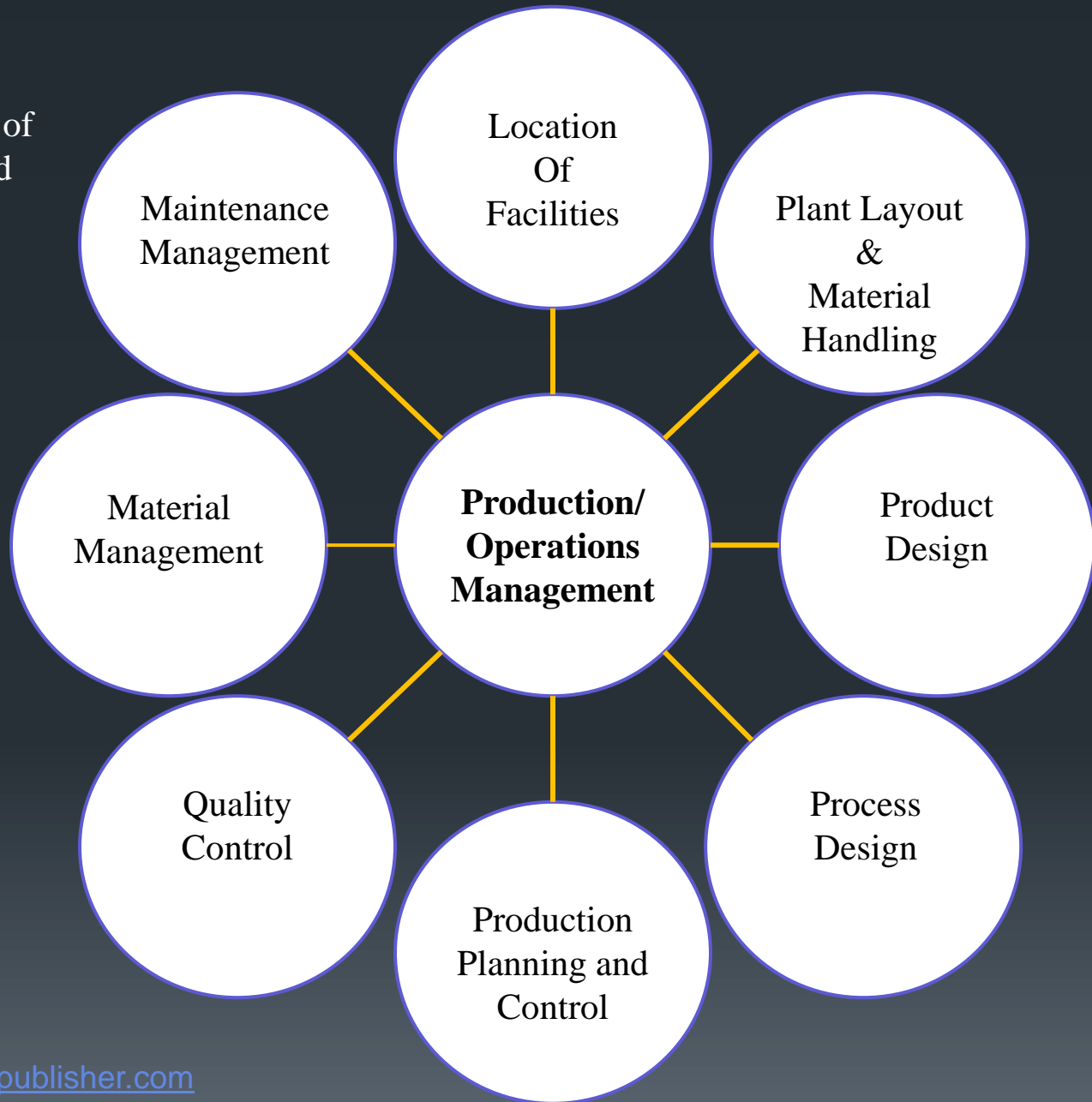
Production planning and control can be defined as the process of planning the production in advance, setting the exact route of each item, fixing the starting and finishing dates for each item, to give production orders to shops and to follow up the progress of products according to orders.


Planning is deciding in advance what to do, how to do it, when to do it and who is to do it. Planning bridges the gap from where we are, to where we want to go.

Routing may be defined as the selection of path which each part of the product will follow, which being transformed from raw material to finished products.

Scheduling determines the programme for the operations. Scheduling may be defined as 'the fixation of time and date for each operation' as well as it determines the sequence of operations to be followed.

Fig. 1.4 Scope of
Production and
Operations
Management





Dispatching is concerned with the starting the processes. It gives necessary authority so as to start a particular work, which has already been planned under ‘Routing’ and ‘Scheduling’.



QUALITY CONTROL

Quality Control (QC) may be defined as ‘a system that is used to maintain a desired level of quality in a product or service’. It is a systematic control of various factors that affect the quality of the product. Quality control aims at prevention of defects at the source, relies on effective feed back system and corrective action procedure.

Quality control can also be defined as ‘that industrial management technique by means of which product of uniform acceptable quality is manufactured’. It is the entire collection of activities which ensures that the operation will produce the optimum quality products at minimum cost.



The main objectives of quality control are:

- To improve the companies income by making the production more acceptable to the customers *i.e.*, by providing long life, greater usefulness, maintainability, etc.
- To reduce companies cost through reduction of losses due to defects.
- To achieve interchangeability of manufacture in large scale production.
- To produce optimal quality at reduced price.
- To ensure satisfaction of customers with productions or services or high quality level, to build customer goodwill, confidence and reputation of manufacturer.
- To make inspection prompt to ensure quality control.
- To check the variation during manufacturing.



MATERIAL MANAGEMENT

Materials management is that aspect of management function which is primarily concerned with the acquisition, control and use of materials needed and flow of goods and services connected with the production process having some predetermined objectives in view.

The main objectives of materials management are:

- To minimise material cost.
- To purchase, receive, transport and store materials efficiently and to reduce the related cost.
- To cut down costs through simplification, standardisation, value analysis, import substitution, etc.
- To trace new sources of supply and to develop cordial relations with them in order to ensure continuous supply at reasonable rates.
- To reduce investment tied in the inventories for use in other productive purposes and to develop high inventory turnover ratios.



MAINTENANCE MANAGEMENT

In modern industry, equipment and machinery are a very important part of the total productive effort. Therefore, their idleness or downtime becomes are very expensive. Hence, it is very important that the plant machinery should be properly maintained.

The main objectives of maintenance management are:

1. To achieve minimum breakdown and to keep the plant in good working condition at the lowest possible cost.
2. To keep the machines and other facilities in such a condition that permits them to be used at their optimal capacity without interruption.
3. To ensure the availability of the machines, buildings and services required by other sections of the factory for the performance of their functions at optimal return on investment.



END OF PRESENTATION



Reference:

- www.newagepublisher.com