Branch :OPERATION MANAGEMENT

Semester : 3rd semester

Subject Name: PRODUCTION AND OPERATION MANAGEMENT

Subject Code : MOM-2

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Topic-1

Subtopic- Nature and scope of operation management

Heading- Facility location

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Reference Books

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UNIT1

NATUREANDSCOPEOFPRODUCTIONANDOPERATIONS MANAGEMENT

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'.* Theproductionsystemofanorganisationisthatpart,whichproducesproductsofan organisation.Itisthatactivitywherebyresources,flowingwithinadefinedsystem,are combinedandtransformedinacontrolledmannertoaddvalueinaccordancewiththe policiescommunicatedbymanagement.Asimplifiedproductionsystemisshownin diagram.

Theproductionsystemhasthefollowing**characteristics**:

1. Productionisanorganisedactivity,soeveryproductionsystemhasanobjective.
2. Thesystemtransformsthevariousinputsto usefuloutputs.
3. Itdoesnotoperateinisolationfromtheotherorganisationsystem.
4. Thereexistsafeedbackabouttheactivities,whichisessentialtocontrolandimprove system performance.

ClassificationofProductionFunction

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

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.

A jobshop comprises ofgeneralpurpose machines arranged into different departments. Each job demands unique technological requirements, demands processing on machines in acertain sequence.

Characteristics

TheJob-shopproductionsystemisfollowedwhenthereis:
1. Highvarietyofproductsandlowvolume.
2. Useofgeneralpurposemachinesandfacilities.
3. Highlyskilled operatorswho cantake upeach jobasachallenge becauseofuniqueness.
4. Largeinventoryofmaterials, tools, parts.
5. Detailed planning is essential for sequencing the requirements of each product, capacities for each work centre and order priorities.

Advantages

Followingarethe advantagesofjobshopproduction:
1. Becauseofgeneralpurposemachinesandfacilitiesvarietyofproductscanbe produced.
2. Operatorswillbecomemoreskilledandcompetent,aseachjobgivesthemlearning opportunities.
3. Fullpotentialofoperatorscanbeutilised.
4. Opportunityexistsforcreative methodsand innovative ideas.

Limitations

Followingarethelimitationsofjobshopproduction:

Advantages

Followingarethe advantagesofjobshopproduction:
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7. Fullpotentialofoperatorscanbeutilised.
8. Opportunityexistsforcreative methodsand innovative ideas.

Limitations

Followingarethelimitationsofjobshopproduction:
1. Highercostduetofrequentsetupchanges.
2. Higherlevelofinventoryatalllevelsandhencehigherinventorycost.
3. Productionplanningiscomplicated.
4. Largerspacerequirements.

BATCHPRODUCTION

BatchproductionisdefinedbyAmericanProductionandInventory 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

Batchproductionsystemisused under thefollowing circumstances:
1. Whenthereisshorterproductionruns.
2. Whenplantand machineryareflexible.
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. Whenmanufacturingleadtimeandcostarelowerascomparedtojoborderproduction.

Advantages

Followingarethe advantages ofbatchproduction:

1. Betterutilisationofplantandmachinery.
2. Promotesfunctionalspecialisation.
3. Costperunitislowerascomparedtojoborderproduction.
4. Lowerinvestmentinplantand machinery.
5. Flexibilitytoaccommodateandprocessnumberofproducts.
6. Jobsatisfactionexistsforoperators.

Limitations

Followingarethelimitationsofbatchproduction:
1. Materialhandlingiscomplexbecauseofirregularand longerflows.
2. Productionplanningandcontroliscomplex.

Workinprocess inventoryishighercomparedtocontinuous production.

1. Highersetupcostsduetofrequentchangesinsetup.

MASSPRODUCTION

Manufacture of discrete parts or assemblies using a continuous process are called mass production.Thisproductionsystemisjustifiedbyverylargevolumeofproduction.The

machines are arranged in a line or product layout. Product and process standardisation exists and all outputs follow the same path.

Characteristics

Massproductionisusedunderthe following circumstances:\
1. Standardisationofproductandprocesssequence.
2. Dedicatedspecialpurposemachineshaving higher productioncapacitiesandoutput rates.
3. Largevolumeofproducts.
4. Shortercycletimeofproduction.
5. Lowerinprocessinventory.
6. Perfectlybalancedproductionlines.
7. Flowofmaterials, componentsandpartsiscontinuousandwithoutanybacktracking.
8. Productionplanningandcontrolis easy.
9. Materialhandlingcanbecompletelyautomatic.

Advantages

Followingaretheadvantagesofmass production:
1. Higher rateofproductionwithreducedcycletime.
2. Highercapacityutilisationduetoline balancing.
3. Lessskilledoperatorsare required.
4. Lowprocess inventory.
5. Manufacturingcostperunit islow.

Limitations

Followingarethelimitationsofmassproduction:

1. Breakdownofonemachinewillstop anentireproduction line.
2. Linelayoutneeds majorchangewiththechangesintheproduct design.
3. Highinvestmentinproductionfacilities.
4. Thecycletimeisdeterminedbytheslowest operation.

CONTINUOUSPRODUCTION

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

Continuousproductionisusedunderthe followingcircumstances:
1. Dedicatedplant andequipmentwithzero flexibility.
2. Materialhandlingisfullyautomated.
3. Processfollowsapredeterminedsequenceofoperations.
4. Componentmaterialscannotbereadilyidentifiedwithfinalproduct.
5. Planningandscheduling isaroutineaction.

Advantages

Following aretheadvantagesofcontinuousproduction:
1. Standardisationofproductandprocesssequence.
2. Higher rateofproductionwithreducedcycletime.
3. Highercapacityutilisationduetoline balancing.
4. Manpowerisnotrequired formaterialhandling asit iscompletelyautomatic.
5. Personwith limited skillscanbeusedontheproduction line.

6. Unitcostis lowerduetohighvolumeofproduction.

Limitations

Followingarethelimitationsofcontinuous production:
1. Flexibilitytoaccommodateandprocessnumber ofproductsdoesnotexist.
2. Veryhighinvestmentforsetting flow lines.
3. Productdifferentiationislimited.

Production Management

Production management is a process of planning, organising, directing and controlling the activitiesoftheproductionfunction. It combinesandtransformsvariousresourcesused inthe production subsystem of the organisation into value added product in a controlled manner as per the policies of the organisation.

E.S. Buffadefinesproduction 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 ofminimum cost."

ObjectivesofProductionManagement

The objective of the production management is 'to produce goods services of right qualityand quantity at the right time and right manufacturing cost'.

1. **RIGHTQUALITY**

The qualityofproduct is established based uponthe customers needs. The right qualityis not necessarily best quality. It is determined by the cost of the product and the technical characteristics as suited to the specific requirements.

2. **RIGHTQUANTITY**

The manufacturing organisation should produce the products in right number. If they are produced in excess of demand the capital will block up in the form of inventory and if the quantity is produced in short of demand, leads to shortage of products.

3. **RIGHTTIME**

Timeliness of delivery is one of the important parameter to judge the effectiveness of production department. So, the production department has to make the optimal utilisation of input resources to achieve its objective.

4. **RIGHTMANUFACTURINGCOST**

Manufacturing costs are established before the product is actually manufactured. Hence, all attempts should be made to produce the products at pre-established cost, so as to reduce the variation between actual and the standard (pre-established) cost.

OperationsManagement

OperationManagement is a wayormeans throughwhichthe listedobjectives ofanoperating system is achieved. There is always a confusion between the word Operations Management andProductionManagement.ItisacceptednormthatOperationsManagementincludes

techniques which are enabling the achievement of operational objectives in an operation system.

The operation system includes both manufacturing sector as well as service sector, but when you use the word Production Management, you should be careful to note that it refers to the manufacturing sector but not the service sector. Suppose, you are designing a layout for the hospital you should say that you are applying Operations Management Technique not the Production Management Technique.

When you design a layout for a manufacturing sector you can say that you are applying Production Management Technique or Operation Management Technique or vice versa.

ObjectivesofOperationsManagement

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

CUSTOMER SERVICE

The first objectiveofoperatingsystems isthecustomer servicetothesatisfactionofcustomer wants. Therefore, customer service is a key objective of operations management. The operating systemmust provide something to a specificationwhichcansatisfythe 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'.

Generally an organisation will aim reliably and consistently to achieve certain standards and operations manager will be influential in attempting to achieve these standards. Hence, this objective will influence the operations manager's decisions to achieve the required customer service.

RESOURCEUTILISATION

Another major objective of operating systems is to utilise resources for the satisfaction of customer wants effectively, i.e., customer service must be provided with the achievement of effective operations through efficient use of resources. Inefficient use of resources or inadequate customer service leads to commercial failure of an operating system.

Operations management is concerned essentially with the utilisation of resources, i.e., obtaining maximumeffect fromresourcesor minimisingtheir loss, under utilisationor waste. The extent of the utilisation of the resources' potential might be expressed in terms of the proportion of available time used or occupied, space utilisation, levels of activity, etc. Each measure indicates the extent to which the potential or capacity of such resources is utilised. This is referred as the objective of resource utilisation.

Operationsmanagement isalso concernedwiththe achievement ofbothsatisfactorycustomer service and resource utilisation. An improvement in one will often give rise to deteriorationin the other. Often both cannot be maximised, and hence a satisfactory performance must be achieved on both objectives. All the activities of operations management must be tackledwith these two objectives in mind, and many of the problems will be faced by operations managers because ofthis conflict. Hence, operations managers must attempt to balance these basic objectives.

ManagingGlobalOperations

The term '**Globalisation**' describes businesses' deployment of facilities and operations around the world. Globalisation can be defined as a process in which geographic distance becomes a factor of diminishing importance in the establishment and maintenance of cross border economic, political and socio-cultural relations. It can also be defined as worldwide drive toward a globalised economic system dominated by supranational corporate trade and banking institutions that are not accountable to democratic processes or nationalgovernments.

Therearefourdevelopments,whichhavespurredthetrendtowardglobalisation.Theseare:
1. Improvedtransportationandcommunicationtechnologies;
2. Openedfinancialsystems;
3. Increaseddemandforimports;and
4. Reducedimport quotasand othertradebarriers.

When a firm sets up facilities abroad it involve some added complexities in its operation. Global markets impose new standards on quality and time. Managers should not think about domestic markets first and then global markets later, rather it could be think globally and act locally. Also, they must have a good understanding of their competitors.

Some other important challenges of managing multinational operations include other languages and customs, different management style, unfamiliar laws and regulations, and different costs. Managing global operations would focus on the following key issues:

- Toacquireandproperlyutilisethefollowingconceptsandthoserelatedtoglobal operations, supply chain, logistics, etc.
- To associate global historicalevents to keydrivers inglobaloperations fromdifferent perspectives.
- Todevelopcriteriaforconceptualisationandevaluationofdifferentglobaloperations.
- Toassociatesuccessandfailurecasesofglobaloperationstopolitical,social, economical and technological environments.
- Toenvisiontrendsinglobaloperations.
- To develop an understanding ofthe world vision regardless oftheir countryoforigin, residence orstudies ina respectfulwayofperspectives ofpeople fromdifferent races, studies, preferences, religion, politic affiliation, place of origin, etc.

NatureofProduction Management

1. **Results in Value Addition:** Production management is a key tool available with an organizationwhichassist in value addition. It is a process whichenables inproducing high-quality products by purchasing raw materials from the right source, in rightform, at right price and in right quantity. These quality goods provide better satisfaction to customers thereby improving goodwill of an organization.
2. **Inter-Disciplinary Approach:** It is an inter-disciplinary approach which is derived from several disciplines and subjects.Differentsubjectslike statistics,mathematics,

   economics, engineering, sociology and human psychology have contributed toward the development of production management approach.
3. **Part of General Management:**Production management isanessentialcomponent of General management. It is a tool which assist managers in planning, organizing, coordinating and controlling all activities related to the production of products and services.
4. **Transformation Process:** It isa processoftransformation inwhichraw materialsare convertedintofinishedproductsthatarereadyforconsumptionbyconsumers.Production management focuses on economical production of products avoiding any wastage of raw materials used.
5. **Operative Function:** Production management monitors day to day operations of business for ensuring long-term continuity. It supervises all production activities on daily basis for checking out whether all resources are efficiently utilized.
6. **Both Art and Science:**It can be treated both as an art as well as science. Production managementis termed as art as it is the one which assign, coordinates and monitorsall work activities of an organization. Whereas, it is a science as it manages all machines and technical aspects helping in production activities.
7. **Management of Service Sector:** Production management not only manages the activities relatedto production oftangible products. It is a process which monitorsthe service sector also where intangible products are provided to customers as per their needs.

ScopeofProduction andOperations 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 organisational 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.'

Followingare theactivitieswhich arelistedunderproduction andoperationsmanagement functions:

1. Locationof facilities
2. Plant layoutsandmaterialhandling
3. Productdesign
4. Processdesign
5. Productionandplanningcontrol
6. Qualitycontrol
7. Materialsmanagement
8. Maintenancemanagement.

LOCATIONOFFACILITIES

Location of facilities for operations is a long-term capacity decision which involves a long termcommitment aboutthegeographicallystatic factorsthat affect abusinessorganisation. It isanimportant strategic leveldecision-making for anorganisation. It dealswiththequestions such as 'where our main operations should be based?'

The selection of location is a key-decision as large investment is made in building plant and machinery. An improper location of plant may lead to waste of all the investments made in plant and machineryequipments. Hence, location ofplant should be based on the company's expansionplanandpolicy,diversificationplanfortheproducts,changingsourcesofraw

materials and many other factors. The purpose of the location study is to find the optimal location that will results in the greatest advantage to the organisation.

PLANTLAYOUTANDMATERIAL 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 theplant layout isto designaphysicalarrangementthat meetstherequiredoutput qualityand 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 andfromone machine tothenextduring theprocess of manufacture'*.It is also definedasthe '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. This cost can be reduced by proper section, operation and maintenance of material handling devices.

Materialhandlingdevices increasestheoutput,improvesquality, speedsupthedeliveriesand decreases the cost of production. Hence, material handling is a prime consideration in the designing new plant and several existing plants.

PRODUCTDESIGN

Product design deals with conversion of ideas into reality. Every business organisation have to design, develop and introduce new products as a survivaland growthstrategy. Developing the new products and launching them in the market is the biggest challenge faced by the organisations.

The entire process of need identification to physical manufactures of product involves three functions: marketing, product development, manufacturing. Product development translates the needs of customers given by marketing into technical specifications and designing the various features into the product to these specifications. Manufacturing has the responsibility of selecting the processes by which the product can be manufactured. Product design and development provides link between marketing, customer needs and expectations and the activities required to manufacture the product.

PROCESSDESIGN

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 oftechnology, process flow analysis and layout ofthe facilities. Hence, the important decisions in process design are to analyse the workflow for converting raw material into finished product and to select the workstation for each included in the workflow.

PRODUCTIONPLANNINGAND 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.

The principle of production planning and control lies in the statement ‘First Plan Your Work and then Work on Your Plan’. Main functions of production planning and control includes planning, routing, scheduling, dispatching and follow-up.

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 fromwhere we are, to where we want to go. It makes it possible for things to occur which would not otherwise happen.

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. Routing determines themost advantageous path to be followed from department to department and machine to machine till raw material gets its final shape.

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.

Dispatchingis concerned withthe starting the processes. It gives necessaryauthorityso asto start a particular work, which has already been planned under ‘Routing’ and ‘Scheduling’. Therefore, dispatching is ‘release of orders and instruction for the starting of production for any item in acceptance with the route sheet and schedule charts’.

The functionof**follow-up** is to report dailythe progressofwork ineach shop ina prescribed proforma and to investigate the causes of deviations from the planned performance.

QUALITYCONTROL

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.

Themainobjectivesofqualitycontrolare:

- To improve the companies income by making the production more acceptable to the customers i.e., by providing long life, greater usefulness, maintainability, etc.
- Toreducecompaniescostthroughreductionoflossesduetodefects.
- Toachieveinterchangeabilityofmanufactureinlargescaleproduction.
- Toproduceoptimalqualityatreducedprice.
- To ensure satisfaction ofcustomers with productions or services or high quality level, to build customer goodwill, confidence and reputation of manufacturer.
- Tomakeinspectionpromptoensurequalitycontrol.
- Tocheckthevariationduringmanufacturing.

MATERIALSMANAGEMENT

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.

Themainobjectivesofmaterialsmanagementare:

- Tominimisematerialcost.
- Topurchase,receive,transportandstorematerialsefficientlyandtoreducetherelated cost.
- Tocutdowncoststhroughsimplification,standardisation,valueanalysis,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.

MAINTENANCEMANAGEMENT

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.

Themainobjectivesofmaintenance management are:

- To achieve minimum breakdown and to keep the plant in good working condition at the lowest possible cost.
- To keep the machines and other facilities in such a condition that permits them to be used at their optimal capacity without interruption.
- 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.

FACILITYLOCATION

Facility Location is an important factor in the supply chain that significantly impacts on the efficiencyand effectiveness of manysupply networks and the organization at large. Location decisionsare strategic incharacter, long-termin nature, and non-repetitive in nature. Without good and thorough site planning from the start, the new facilities may have ongoing operationalissues inthe future. Poor Locationdecision notonlyaffectsthegrowthofthe firm but impedes on the growth and development of the nation. The location decision should be made with great care, as any error that results in a poor location can be a constant source of higher costs, higher investment, difficult marketing and transportation, dissatisfied and frustrated employees and consumers, frequent interruptions of production, abnormal wastages, delays, and substandard quality, among other things.

Facility locationsignificantly impacts onrevenue, costs, and service levels to customers. It is thus a classical optimization problem for determining the sites for factories, service outlets andwarehouses. Facilitylocationdecisionis made byselectingthebest optionamongasetof possiblesitesdependingon thenatureor typeof business.Thechoiceoffacilitylocationis

strategically guided by profit maximization or minimization of all costs associated with the choice of location.

Facilitylocationplanning

Facility location is connected with capacity decisions. Capacity expansion considerations instantly raises the twin issue of where to expand in order to tie in effectively with the distribution network of facility location. Facility location of operations is a long-termcapacity decision which involves huge and long term commitment about the geographically fixed factors that affects business organizations. The selection of location is therefore a key-decisionofproductionand operations managers as large investment is made in building plant and machinery.

Cambridge dictionary defined a facility as "a place, especially including buildings, where a particular activity happens". Facility extends beyond a place or a building, it includes structures, equipment, or people. It also includes hospitals, food production plants, and gas stationsamong others. Adeleke and Olukanmi[1]suggestedthat facilitylocation issuesseeks to determine how to locate a number of facilities from a set of potential facilities that will serve a number of customers. Alenezy [2] added that the cost-effective site is to be chosen from the potential locations in which to place new facilities or retain existing ones.

Facility location can therefore be defined as the siting of facilities which could be structures, men, material, machines in such a manner that yields an optimum benefit to the firm and its stakeholders. Therearetwo major locationdecisionsorproblems faced bymanagers, theyare internal and external location problems. Internal location problems are concerned with decisionsonwhereto locatefacilities insidetheplant. Agood exampleofan internallocation decisioniswhereto placea new machineorstorageroomwithintheexisting facility. Internal facility location decision deals with the assignment or location of facility whose space constraint is equal to or smaller than the available space existing within the facility. An external location decision on the other hand deals with the problem of where to site a new manufacturing plant, warehouse, building, or a new branch within an agreed geographical area.

Thefollowingcircumstancesmaynecessitatefacilitylocationdecisions:

1. Uponthecommencementofanewbusinessor gaining entrance
2. Whenanestablishedcompanyoutgrowsitsexistingfacilityandexpansionisnolonger feasible, a new location decision is made.
3. Expansionofcurrentfirmor marketsizethatdemandstheopeningofnewbranches.
4. Insecurityissues
5. Creation/developmentofanewproduct.
6. Governmentpolicies.
7. Whenaleaseendswithoutbeingrenewedbythelandlord.
8. Socialorfinancialconsiderations

Whenexpansionis inevitablethreeoptionsareopentoanorganization

- Expandonthecurrentlocationofland/facilitiesavailable
- Lookfor anewspaceand useitasanextensionoftheotheroffice
- Look for a large portion of land that can accommodate boththe existing business and the new line of business

Importanceoflocationdecision

1. Locationstudyhelpstofindtheoptimallocationoforganizationfacilityorplantthatwill result in the greatest advantage to the organization.
2. Locationplaysahugeroleinattractingandretainingthebestemployees,thatgivesacompetitive edge over the firm's rival
3. Agoodlocationdecisionhelpsinavoidingwasteof all theinvestmentsmadeinplantand machinery equipment.
4. A good location decision helps to optimize performance of the firm by minimizingits totalcost of production.
5. Italsoensuressafetyforitsworkforce
6. Locatingafacilityin therightplacecan giveaccesstocustomersandalsoenablethefirm enjoy incentives provided by government

Factorsto considerwhen taking a locationdecision

There are severalfactorsthat must be criticallyanalyzed whenconsidering locating a facility. These factors can be grouped into two categories: controllable and uncontrollable factors.

Controllablefactors

1. **Availability of Inputs:** This is a major decision guiding facility location problems. Manufacturing companies that use heavy, bulky or perishable products as raw materials or factor inputs have to be located near the source of these raw materials or inputs, this is to ensure regular and timely supply of raw materials as well as reduce the cost of transporting and storing them. A good example are food processing companies, the major farm product used in processing those goods need to be in close range to ensure steady supply of these products. Similarly, most wood processing companies are located close to the supply of qualitytimber. Generally, the cost oftransportation or shipping of these raw material is to be weighed. Perishable products may be lost or damaged in transit if the distance to the plant is far, thus the closer the facility is to the source of its inputs determines its abilityto cut costs.
2. **Market/Customer Proximity:** Goods are produces to be sold to the identified markets or customers, therefore the proximity of a facility to the market or customers is of grave importance to the organization. Proximity helps to reduce transportation costs and time of delivery.
3. **Integration with Other Parts of the Organization:** Itisofsignificant benefit to keepanew plant or subsidiary plant close to the parent facility. This makes it easier for them to share resources and thus reduce total cost.
4. **Availability of Labor and Skills:** Education, experience and skill of available labour is an important factorthat affects location decision. It is always preferable to locate the plant in an area where skilled, semi-skilled and unskilled labour are available. This reduces costs of training and hiring experts from abroad
5. **Availability of Amenities:** Good roads, hospitals, school's churches, parks and residential area are necessary amenities that make living conditions for worker's desirable.
6. **Availability of Transportation Facilities:** Good transportation facilities makes the plants accessible for easy movement ofraw materials as wellas finished products, therebyreducing costs.
7. **Availability of Services:** The availability of basic support services needed by the facility to make their operations smooth should be considered. This decision affects to total cost of operation, wheresuchservicesarenot readilyavailableor at ahighcost,theorganizationwill have to spend more in providing such services, or attracting them at a higher cost.
8. **Room forExpansion:** Thepossibilityofincreasingfutureproductioncapacityoccasionedby

increase inproduct demand isa criticalfactorin locationdecisions. There should be adequate space for future expansion or diversification of the facility as the need arises.

9. **Safety:** The safety of employees as well as the facility needs to be taken into consideration when making location decisions. If the location is not safe, it may detract employees andeven potential customers from patronizing the facility. Also, the probability of loss of property, or damage of the machines increases when safety of the environment or location is poor.

Uncontrollablefactors

1. **Community and labour attitude:** Communities that are interested in attracting new plants may offer reduced prices or no cost sites to companies as a way of growing their communities. The cost of land and attitude of labour to work is a major factor to consider when making location decisions.
2. **Suitability of Land and Climate:** Due considerationshould be giventothe suitabilityofthe landandclimate forthenatureoftheproductsandthetypeofmachinesused inproduction. If the climate in a given geographical location does not support the product type it may lead to wastage in the long run, hence due consideration should be given to this factor.
3. **Regional Regulations:** The regulations in certain regions do not support the production of certain types of products or services, organizations should investigate the regulations of the desired region before going ahead to site their plants or facility.
4. **Political, Cultural and Economic Situation:** The political, cultural and economic situation of the location should be well considered. Areas notable for political unrest, may not favorthe facility as protests and other activities may lead to the damage of the facility. Also, some cultures are noted for certain behaviors that may not be compatible with the activities of the plant. Lastly, economic situation in a given location may stall the growth of the organization in the short and long run.
5. **Power supply:** Cost and quality of power supply is a high importance in the location of a plant. Cost of power supply is usually cheaper at rural locations than the urban areas. Some companies generate their own power. The overall cost of power supply should be taken into consideration when making facility location decisions.
6. **Regional Taxes, Special Grants and Import/Export Barrier:** The kind and amount oftaxes levied by a state should be considered in locating a plant/facility. Investigation should be made on the type of taxes and the biases for which they are fixed. Some places have special grants given to attract investors to such area. Similarly, import/export barriers should be duly considered as this affects the total cost of doing business.
7. **Government Policies:** The policies of the state governments and local bodies concerning labor laws, building codes, safety, etc., arethe factorsthat demand attention. Inorder to have a balanced regional growth of industries, both central and state governments in our country offerthepackageofincentivesto entrepreneurs inparticular locations. The incentivepackage may be in the formofexemption froma sales tax and excise duties for a specific period, soft loan from financial institutions, subsidy in electricity charges and investment subsidy. Some of these incentives maytempt to locate the plant to avail these facilities offered.

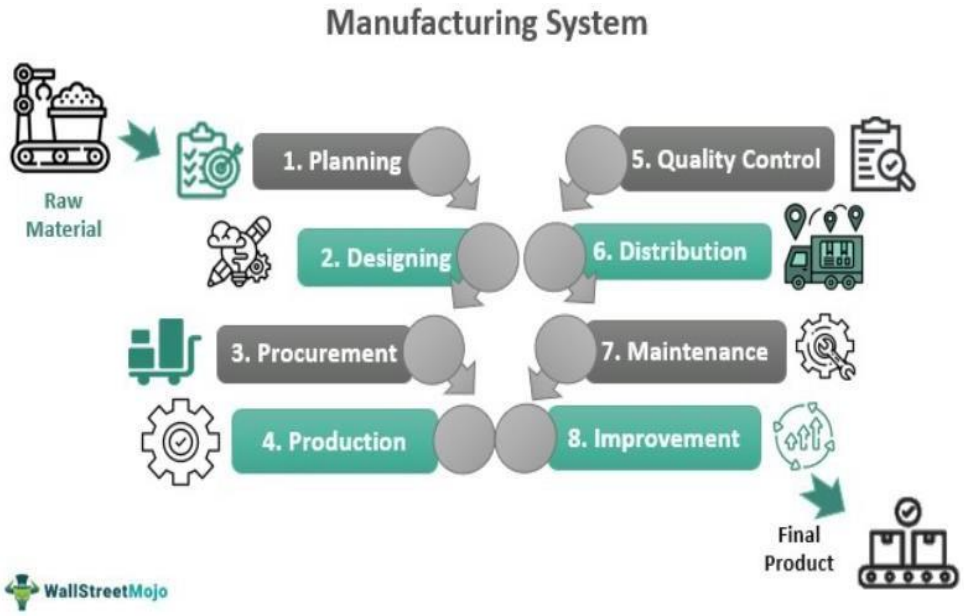
Solution methods for location problem

Therearevariousapproachesforsolving locationproblemssuchas:

1. TheDimensionalAnalysisapproach
2. TheSimplerankingofalternativesite approach
3. TheLinearAssignmentmodel
4. TheLinearTransportationmodel
5. TheQuadraticAssignment model
6. TheHeuristicsolutionprocedure

TYPESOFMANUFACTURINGSYSTEMSAND LAYOUTS

A manufacturing system is a collection of resources and processes that transform raw materials into finished goods. It aims to produce goods efficiently with high quality. Additionally, it can improve production processes by increasing regulations, reducing waste, and improving product quality and consistency.



Its prime motive is to reduce costs while meeting customers' demands and staying profitable. This is primarily done by including equipment, labor, and materials, while the processes can include assembly, fabrication, and inspection. It can assist businesses in adjusting to shifts in consumer demand. Systems for manufacturing can expand or contract depending on the volume of production.

- A manufacturing system is a collection of resources and processes that transformraw materials into finished goods.
- It aims to produce goods efficiently and with high quality while meeting customers' demands and staying profitable.
- Manufacturing systems require skilled labor to operate and maintain the equipment, which can be challenging to find and retain.
- Such a system typically involves several stages: planning, design, procurement, production, quality control, distribution, maintenance, and continuous improvement.

ManufacturingSystemExplained

A manufacturing system is a combination of tools and procedures used to turn raw materials into completed products. Its objective is to create products and services profitably,effectively, and by client requests.

Theprocessofsucha systemtypicallyinvolvesseveralstages,including:

1. **Planning** involves determining the type of products, resources, and production process.
2. **Design** involves designing the products, tools, and equipment used in manufacturing. It may include creating detailed drawings, specifications, and blueprints.
3. **Procurement** involves obtaining the raw materialsand components to create the finished products. It may include purchasing materials from suppliers or sourcing them from internal inventory.
4. **Production:** Transformation of raw materials into finished goodsthrough various manufacturingprocessessuchasassembly, fabrication,and inspection.It mayinvolve the use of multiple types of machinery and equipment, as well as manual labor.
5. **Quality Control** involves inspecting and testing the finished products to ensure they meet the required quality standards.
6. **Distribution** involvesdeliveringthe finishedproductsto customersorstoringthemin inventory for future use.
7. **Maintenance**involves maintaining the manufacturing equipment and tools to ensure they are in good working condition and can operate at optimal performance.
8. **Continuousimprovement** involvescontinuousmonitoring,whichwillincrease efficiency, reduce waste, improve quality and reduce costs.

Components

Componentsofamanufacturing systemcaninclude:

1. **Equipmentandmachinery** can constitute the tools and machines used to transform raw materials into finished goods. It can consist of everything from essential hand tools to highly automated and computer-controlled machinery.
2. **Rawmaterialsandcomponents** are used to create the finished goods.It can include raw materials, such as metal and plastics, to purchased ingredients, such as motorsand sensors.
3. **Labor** includes the human resources needed to operate the equipment and perform tasks such as assembly and inspection.

4. **Methodsandprocedures** include the systems that transform raw materials into finished goods. It includes assembly instructions, fabrication techniques, and quality control procedures.
5. **Softwareandcontrolsystems** include the software and control systems used to manage and control the manufacturing process. It can have everything from simple manual controls to sophisticated computer-controlled systems that monitor and adjust production in real-time.
6. **Workflowandproductionplanning** include the manufacturing process layout, the flow of materials and information, and the production schedule.
7. **Maintenanceandrepair** include the maintenance and repair of the equipment and facilities to ensure that the manufacturing process runs efficiently.
8. **QualityControl** includes inspecting and testing the finished products to ensure they meet the required quality standards.

Types

Thereareseveralautomatedmanufacturingsystems,eachwithuniquecharacteristicsand applications. However, some common types of manufacturing systems include:

1. **JobShopManufacturing:** It produces a wide varietyofproducts in smallquantities. It characterizes a high degree of flexibility and customization and is a one-of-a-kindor custom product.
2. **BatchProduction:** It produces small quantities of products. It is the ability to create various products using the same equipment with moderate complexity.
3. **FlowProduction:** It produces large quantities of products. It is a high degree of automation and a continuous flow of materials and information.
4. **LeanManufacturing:** It minimizes waste, maximizes efficiency, and increases overall quality. The use of pull systems, continuous improvement, and waste elimination in the production process characterizes it.
5. **Just-in-time(JIT)Manufacturing:** It is characterized by producing goods only when needed rather thanproducing goodsinadvance and storing them in inventory. It helps to reduce waste and costs and improve overall efficiency.
6. **MassCustomization** is characterized by the ability to produce large quantities of customized products with high flexibility and efficiency. It helps meet customers' specific needs by leveraging advanced technologies such as automation and robotics.
7. **Agilemanufacturing** is characterized by the ability to adapt quickly to changes in demand, technology, andother factors.Ithelps increaseresponsivenessand flexibility in the production process to meet the dynamic needs of the market.

LAYOUTPLANNINGAND ANALYSIS

Layout planning involves decisions about the physical arrangement of economic activity centre within a production or service facility. An economic activity centre could be amachine, a worker or group of employees, a workstation etc. It is anything which occupies space and is used in production of an output. Layout planning is an important decision for management as a properlayout has a direct effect onthe efficiencyofproduction. The proper and effective arrangement of economic centers ensures the smooth and rapid movement of material, from the raw material stage to the end product stage. Layout planning involves decisions regarding following aspects:

Determining type of centers: depends on type of jobs involved in production of a good or service.

For instance, a motorcycle service station should include specific service center for each motorcycle, tool station for each unit and a common tool center used by all the units. It should not include sitting space either for workers or for customers as it would hinder working and decrease productivity. Similarly, a barber shop includes economic centers i.e. centers which occupy space like sitting chair for customer, space for movement of workers, common and special storage space for tools and a waiting area.

- ***Determining space and capacity for each center****:* is very important for uninterrupted and unhindered movement of man and material. For instance, in motorcycle service station and barber shopexample, thereshouldbesufficient space inbetweeneachservicecenterasevery oneofthemisanindependent economiccenter soworkersor employeesengaged inactivities at these centers should have enough space to carry their activity unhindered.On other hand, in some service centers such as banks and retail stores where movement of customers is part of production process the layout design should involve space for movement of customers as well.
- ***Placement of different service centers:*** An educational institution has various economic centers in the form of teaching and non-teaching departments, library centre, canteens and hostels. The placement of each service centre in relation to each other is an important aspect of layout planning. Library should be placed near to teaching departments but away from canteen and similar decisions have to be considered. Inthis context, placement ofcenters has two aspects: *relative location* i.e. a particular space that a centre occupies relative to other centersand*absolute location*i.e. particular space that a centeroccupieswithina facility. This concept has been illustrated in educational institution example. Such institution might have numerousdepartments. For instancedepartmentsrelated to socialsciencesaregrouped inone center whereas departments relating to sciences to some other centre. Relative location of canteen w.r.t. teaching departments should be such that it does not disturb teaching function.

TYPESOFLAYOUT

Layout planning has numerous implications in both manufacturing and service firms. Proper layout designing has significant impact on making an organization competitive and improving its productivity. Layout planning is a strategic decision as type of layout selection depends on company's objective of its type of operation selected for production of productsor services. A company selects mass production system if its objective is to beat its competition by producing low cost products whereas batch production system is predominantly chosen if objective is to provide customized and high quality products or services. The characteristics of both types of operation system influence designing of layout. It should be noted here that selection of type of layout depends on strategic objectives of a company whereas design of layout is governed by type of production system that is associated with such objectives. For instance, a profit oriented company providing customized products would provide high variety of products but would produce each variety at low volume. So most appropriate system of production in such case would be batch productionsystem. This inturn would decide type of layout that company would select which fulfills criteria of batch production system. Similarly, cost oriented company providing low variety of products at high volume would opt for mass production system. Layout design for such system would be entirely different than in case of batch production system. More practically, majority of company's whether in service or manufacturing sphere asks for a hybrid of both kind of operating systems. For instance, in a car assembly plant all cars of similar kind are being assembled in mass production systems and they are painted in batches

involvingbatchoperationsystem.Insuchcaseshybridlayoutisadoptedwhichinvolves characteristics of both operating systems.

Followingarethetypeoflayoutsdiscussed dependingontypeofproductionsystems:

16.3.1PROCESSLAYOUT

A company would adopt a process layout for its operations if it is involved in manufacturing of low- volume, high variety category of products. A process layout groups workstations or departments according to function. For example, in a retail store all grocery functions are arranged at one place and not segregated. Most ofservice organizations suchas banking, retail stores, apparel stores, wedding dinner etc. adopt process layout. These organizations provide variety of services and volume of each kind of service is small.Demand levels for one particular kind of product or service is too low. Thus management does not have inclination to allocate dedicated human or capital resources.

Specifically,followingarethe***characteristicsofaprocesslayout***:

- Volumeofproductorserviceproducedislow.
- Varietyofproductorservice produced ishigh.
- Generalpurpose equipmentwhichcanperformvarietyofoperationsisgenerallyused.
- Layout is flexible as it is less vulnerable to change in product mix. In a process layout same resources can be used to produce different products or services. For example, in retail store grocery department can be replaced by any other department without hindering activities of other departments.
- Equipmentutilizationishigherassameresourceisutilizedforproductionof differentproducts.As demand forone type ofproduct is low so whenone machine gets free from producing that product it can be used to manufacture other products.
- Employee skill set is varied and high. For example, in a bank an employee can be used to provide different services. Same employee can be used for cash deposit and also for creating fixed depositsdepending onthedemand ofeachkind ofservice. Thus, skill set ofemployees' increases as they become proficient in carrying out different services.

Aprocesslayoutcomeswithfollowing***disadvantages***:

- Productive time is lost in changing resources for production ofdifferent productsor services. For example, supposeageneralpurpose machine hasacapacityofproducing1000units inan 8 hr. shift. Company gets an order of manufacturing 400 units of product A and 600 units of product B. Nowthe machine mightnot be able to produce all1000 units in specified time of8 hr. shift. Some productive time might be lost in changing or setting the machine for production of product B after manufacturing product A.
- The flow of resources is jumbled making movement of material handling equipment costly and time consuming. For example, a customer 'A' visiting a retail store whose layout might follow a path of kids ——- grocery —— books and then exit whereas another customer 'B' might follow apparels —— vegetables ——— books ——and then exit. The point is every customer might follow different paths thus making movement of man and handling material jumbled. This can also lead to obstruction as customers might find movement hindered making movement as time consuming process.

- More skilled labor is required resulting in higher cost as employees are engaged in different activities. For example, IndianIT industryworksonprojects. IT companies get projects from all type of sectors like banking, automobile, finance etc. so employees of such companies need to have varied skill set to work on different projects.
- Time gap or lag in production is higher. Because of loss ofproductive time in changeover of machines and labor processing rate tends to be slower leading in loss of production.
- Work in progress inventory is high needing greater storage space. Process layout is based on features of batch shop production system which asks for general purpose machines i.e. same machine is used to produce variety of products. So, if a machine is processing raw material into finished good of one kind of product then raw material of other product has to wait for processing. This causes increase in work in process inventory occupying essential storage space.

DesigningofProcessLayout

Thus,to meet thechallengesofprocesslayout followingare fewaspectsthat needto consider in designing of work centers based on process layout:

- The distance between departments should be as short as possible for avoiding long distance movement of materials
- Thedepartmentsshouldbeinsequenceofoperations
- Thearrangementshouldbeconvenientforinspectionandsupervision.

These aspects have been discussed in following llustration.

Illustration: Suppose there are three departments 1, 2 and 3 which have to locate at given three locations A, B and C. Now, byusing proper layout designtechniques it has to be found that which department should be assigned to which location and how these departments need tobearranged.Followinginformationisgiven:

Distancebetweenlocations	**Workflowbetweendepartmentsi.e. travel distance between two departments**
AandB=20meters	1 and 3= 170
BandC= 30meters	2 and 3= 100
AandC=40meters	1 and 2= 30

Step 1:A and B locations are closest to each other and workflow between departments 1 and 3 is maximum so 1 and 3 departments should be assigned to locations A and B or B and A.

Step 2: 2 and 3 have higher work flow than 1 and 2 so these two departments should be closer than1 and 2. Also B and C are located closer to eachother than Aand C. So, 1should be assigned to A, 2 should be assigned to C and 3 should be assigned to B

PRODUCTLAYOUT

A firm would adopt a product layout for its operations if manufacturing of its products is based on mass production system. Such a system is characterized by high volume and very low variety of products. As high volume of products is required so operations are continuous and repetitive. Car assembly, car washing, computer manufacturing and other manufacturing operations predominantly use product layout. It is important to emphasize that services predominantly use batch production system and thus inclined to adopt process layout for its operations whereas manufacturing firms use mass production system and so adopt product layout for its operations.

Specifically,followingarethe***characteristics***ofaproductlayout:

- Productlayoutinvolvesproductionofhighvolumeandlow-varietyofgoods.
- Equipment required to manufacture such high quantities are specialized in nature. Such machinery is equipped to performonlyone kind of operation at a very fast rate. For instance in car washing example as shown in Fig. 16.3.2.1 one machine is equipped to perform only one kind of job i.e. machine 1 can perform washing,machine 2 is for rinsing andmachine 3is for drying operation. No machine can replicate the job of other machine.

- Productive time is notlost in changing operations. As only one kind of product is producedso machines or other resources are dedicated for only one kind of job. There is no need tostop operations of a particular machine for changeover resulting in high production and almost nil wastage of production time.
- Flow of products is streamline and not jumbled as was in process layout. As machines are arranged in a sequence depending onthe process of production so allthe raw material would flow according to aset flow. Thisresults ina very streamlined flow ofmaterial. For instance, in car washing example all cars would move according to the process i.e. washing—— rinsing—— –drying. No car can skip or change the flow of operation.
- Work in progress inventory is low so there is no wastage of storage space. Dedication of resources in a particular flow determines which machine, material and labor is required for which operation. So, material keeps on moving on a conveyor belt from one operation together without stopping in between the machines.
- Employee skill set is most ofthe time low and entails lower costs as compared to employees involved in batch shop production system. An employee is required to operate only one kind of machine or he/she indulges in very few types of operations thus, limiting his/her skill set. But ashe/she is involved in doing one kind of job repetitively so he/she becomesproficient in that job. Also time taken to carry out that job would be less as workerhas become efficient in performing such a job. This is required in product layout as high volume ofunits needs to be produced which asks for efficient operations at less time.
- Material handling cost is also low in product layout.

- Layout is fixed. Product layout is also called as assembly line layout as machines arearranged in a sequential format. The format is dictated by the process of production. In car washing example, rinsing cannot be carried out before washing so resources for rinsingwould only be placed and used after washing operation. Thus a product layout is not flexible to changes.

- Equipment utilization is low as compared to process layout. In a product layout which is based on mass production systemspecial purpose machines are installed to manufacture very few types of products. So, if demand for such products falls then these resources cannot be utilized to manufacture or produce other products. Also, if one machine goes out of orderthen it would affect entire assembly line. For example, if machine operating rinsing function breaks downthen drying machine cannot operateitsoperation as no car would reach its work centre.
- Equipment used is capital intensive i.e. cost of special purpose equipment is very high. To fulfil high demand production rate has tobe very high so special purpose machines are used in mass production system. To incur such huge costs machines and other resources need to runcontinuouslyresulting in lower per unit costofproduct. Whereas inprocesslayout which is governed by batch production system general purpose machines produce at low volumes thus, increasing cost of services being delivered.

DesigningofProductLayout

A product layout is also termed as assembly line layout because of arrangement of workstations in a sequence. The product moves from one station to other in a dedicated fashion until its completion. Little inventory gets build up between workstations. No workstation should sit idle. A workstation should receive the product for processing after it has processed previous product. Now, it is quite possible that each operation might not use same time. For example in car washing example, washing and drying might require only 2 minutes per car whereas rinsing might require 4 minutes per car

HYBRID LAYOUT

Some processes calls for combination of both product and process layouts. Some activitiesare processed b y using characteristics of product layout and some are carried out by using features of process layout. Assembly lines are good example of hybrid layout. In carassembly products are assembled using product layout. Machines are arranged in a sequence wherein each car moves along a designated process flow. At the end of assembly line final product manufactured in similar or sometimes almost identical. But painting of cars is donein batches. Different cars might be of different colours. So, painting operations involve process layout whereas assembly operations require product layout.

Another illustration is comparison of food arrangements in a dine-in restaurant and that of fast food restaurant. In a dine-in restaurant each familyor group of individuals might ask for different meals. Thus, such a restaurant provides high variety of goods at low volumes. Whereasa fast foodrestauranthastoprovide high volumeofgoodsat lowvarietyas majority of customers asks for similar kind of products. With increasing competition some restaurant are providing both kind of services. In such cases these restaurants adopt hybrid layout. High variety and low demand products can be produced by using process layout whereas high demand, low variety goods can be produced by using product layout.

UNIT2

MATERIALHANDLING- PRINCIPLESAND EQUIPMENTS

Material handling is an activity that involves movement of material or products within an organizationfromoneplace to another placeortheflowofmaterialor productsto vehiclesor from vehicles. The activities are usually confined within the boundaries of an organization. The movement of material from one organization to another is categorized as transportation work, which is not part of material handling activities.

It isnotonlyaboutthe movement ofmaterial. It also involvesstorage,protection, and control of material while it moves in different departments like a warehouse, production, and manufacturing departments. It is one of the essential tasks for organizations. A poorlyhandled material become waste before it can be used for production purpose or before it is sent to retail stores.

In the old times, it was mostly done manually because of the lack of technology. Because of that, the number ofaccidents during handling work was quite high. In present times, with the introduction of technology, almost all of the work is done using automation or semi-automation. The introduction of technology not only reduced the cases of accidents occurred but also made the work fast.

MaterialHandlingProcessesDefinition:

Material handling can be defined as the science and art involved in receiving, packing, storing, and moving material in any form.

ObjectivesofMaterials Handling Processes

Materialhandlingisoneofthemostcriticalactivitiestakingplaceinanorganization.Material handling makes a large portion of the total business expense of a company.

Therefore, achieving the lowest cost and maximumproductioncan be considered asthe main objectives of the material handling process.

1. Reducedcostusingamaterialhandling

The first and foremost objective of material handling is lowering the cost of production. Because a large portionofthetotalproductioncost is spent onmaterialprocurement, storage, and movement. Material is crucial for the production process.

The process of production will haltif the material is not provided in sufficient quantity andon time. Therefore, material handling is given the utmost importance. Companies alwayslook for methods that can be used for the optimized use of material.

By the use of sophisticated methods, the cost of production can be reduced to a significant amount.

2. Reducedwasteofmaterial

Another significant concernofanorganization is to minimize materialwaste. Sometimes, the material gets wasted because of poor storage, or sometimes it gets wasted while moving it from one place to another.

An appropriate material handling not only concerns about the movement of material but also takes care of placing orders of the right amount, making the use of the material at the right time, keeping the right amount ofinventory, and moving materialusing bettertechniquesand with caution.

All of this is taken care of to reduce the wastage of material. Moreover, lower wastage for material results in lower costs. As a result ofwhich the profit margin ofthe organization will increase.

3. Improvedworkcondition

Before the inclusion of technology, all movement and storage works were done manually. Some labors were responsible for performing these tasks. They were responsible for all the loading and unloading work.

Poor results in frequent accidents on-site because of poor work conditions. A proper andwell-thought material handling also takes care of people performing the work.

4. Enhanceddistribution

Distribution means the delivery of final goods to the retailers and wholesalers. A lot of material gets damaged during transportation because of poor packing and poor storage.

It helps in the reduction of damage to **products**during shipping and handling. In addition to this, it also concerns the storage location of the material. A proper storage location reduced the chances of material gets damaged in the storage house.

TypesofMaterialHandling Systems

1. Manual Handling

As the name suggests, manual handling depends primarily on the human workforce. In comparison to automation, manual shifting is affordable, which is why many smallbusinesses rely on the manual method.

Manual is the most common method used for lightweight materials in small quantities. Manual handling typically involves human labor and equipment, like trucks, forklifts, pallet jacks, etc.

2. Mechanical Handling

Mechanical handling uses machines, like conveyor belts, cranes, and hoists for material shifting.The mechanicalmethod isoftenused forshiting heavymaterialin bulk,significantly improving the efficiency of the entire process.

However, setting up the infrastructure facilitating mechanical material movement involves significant investment in heavy machines like conveyor belts and is often time-consuming.

3. AutomatedHandling

AnAutomated Storage & Retrieval Systemuses the most advanced technologies, such as roboticsandguided vehicles. Usingautomation, businessescanmovegoodsofdifferent sizes and volumes faster. The automated handling method is highly customizable and can be tailored to the specific needs of the business.

Companies can opt for any of these types or apply a combination depending on their project requirements, quantity, type of material, warehouse size, and time.

TypesofMaterialHandling Equipment?

Trucks, forklifts, and racks are some common types of material handling equipment.Because ofthe wide varietyoftoolsand machines used for moving materialin factories, they are categorized into four types for simplicity of understanding: storage and handling equipment, industrial trucks, bulk movement equipment, and engineered systems.

StorageandHandling Equipment

Storage and handling equipment temporarily stores your inventory and materials when they are not in use. You can use this equipment in your warehouse for organization, space optimization, and to prevent product damages or losses.

Commonstoragetoolsare:

- Stackingframes
- Palletracks
- Mezzanines

IndustrialTrucksandMachines

Material shifting equipment such as industrial trucks facilitates transportation from one location to another. These can be manually operated trucks or motorized vehicles like forklifts. Industrial trucks usually carry material in bulk, ensuring speedy and safe transportation of material and inventories.

Commonexamplesofindustrialtypesofmaterialhandlingequipmentare:

- Forklifts
- Pallettrucks
- Handtrucks

BulkShifting Tools

Bulk material shifting equipment –the types of material handling equipment – is the best bet for moving material in large volumes. These are equipment designed to carry large volume and weight. You can use these machines within the warehouse space or outdoors, depending on your requirements.

Thebulkshitingequipmentincludes:

- Conveyerbelts
- Reclaimers
- Stackers

- Bicketelevators

EngineeredSystem

Engineered systems use automated equipment and machines for moving material within or outside the factory. These machines include warehouse robots, Automatic storage and retrieval systems (AS/RS), Automatic Guided Vehicles (AGVs), palletizers, and others. Engineered systems significantly reduce manual involvement and improve the speed and accuracy of the process.

KeyPrinciplesofMaterialHandling?

When setting a process, it is important to standardize it for the best outcome. These key principles are set by the industry exponents to make the process smooth. You must evaluate your requirements in advance and lay out a plan before starting. Making efforts to plan and standardize the process will contribute to long-term savings.

The key principles of material shifting include the following. These form the basis ofbuilding a process to improve speed, accuracy, and efficiency.

1. StrategyPlanningforMaterialMovement

It requires determining the best way to move material to ensure the process is safe and efficient. The process focuses on analyzing requirements, evaluating the existing facilities, and designing the layout. Businesses can develop tailored processes to meet specific needs and challenges.

Material planning as a part of an extended warehouse management system helps maximize labor and space utilization.

2. FormulatingStandardProcedure

Standardization ensures that the same process and equipment are followed for similar tasks. Setting standards enhances coordinationamong departments, minimizes errors, and improves overall productivity.

To achieve the goal of standardization one must focus on identifying and grouping similar tasks and testing the viability of the process.

3. PlanningWorkProcess

A higher involvement ofhuman labor in materialshifting increases the chances ofworkplace injuries. Planning the work for the best combination of manual and automation processesaims to reduce the involvement of manual labor and optimize process automation.

4. IntroducingErgonomics

Ergonomic designs of the workplace make it safe for workers and reduce work-related injuries. As a part of material shifting, ergonomics promotes the utilization of machines and equipment to reduce workplace strain and fatigue.

5. OptimizingSpaceUtilization

If you are running a business you need to build or rent a warehouse to store your goods and material. These warehouse spaces charge a premium. Space optimization as a part of warehouse management, optimizes space utilization policy including maximizing the available space for storage.

6. ProcessAutomation

Automationimprovesproductivity,reduceslaborcosts,andmakestheprocessmoreefficient.
Process automation using robotics, conveyors, and automated guided vehicles (AGVs) significantly increases the output of an existing system and lifts overall productivity.

ImportanceofEffectiveMaterialHandling?

For any company, eliminating hiccups in the material transportation process is critical to attain higher efficiency levels, reduce losses from product damage and loss, and make products timely available in the market.

According to a research report by the Govt of Tamil Nadu, 80% of accidents in materialhandling are due to human failure or unsafe acts. This signifies the importance of effective material handling.

Efficient material handling ensures smooth distribution of material, supply chain optimization, warehouse management, and improved productivity.

1. EnhancingEfficiency

An under-optimized workplace has higher chances of workplace accidents. Implementing a material shifting process will help reduce workplace injuries and stress.

Methods like process automation reduce events of ergonomic stress-related injuries among workers. Moreover, automated machines make warehouse management more efficient.

2. Cost Reduction

It helps minimize waste, reduces labor expenses, lowers the chances of product damage during transportation, and contributes to overall cost savings.

3. EnhancedWorkplaceSafety

By improving the material shifting process, companies can reduce the risks of workplace injuries and accidents, improving employee safety. Material handling best practices,including implementing ergonomic design for lifting and transporting material, can reduce injuries among workers and improve efficiency.

4. InventoryManagement

When deployed with inventory management software, it reduces challenges related to inventory management by accurately tracking, storing, and transporting inventory. An inventory management system allows businesses to maintain an optimal inventory level and improve turnover rates.

5. SupplyChainOptimization

Efficient material shifting as a component of supply chain optimization ensures the smooth handling of raw materials for timely delivery to the production line and finished goods to customers. Supply chain optimization also contributes to waste management and reducing costs.

An all-roundedERP software likeSage X3with integrated supply chain management allows businesses to simplify material movement and tracking.

6. ImprovedServices

A tailored material shifting process ensures that products are easily available to your customers when they want. It also guarantees that damages are minimal, accurate, and fast, resulting in improved customer loyalty and satisfaction.

AdvantagesofMaterialHandling

Materialshifting processcanensure qualityassurance byminimizing damagesand lossesdue to transportation. Supply chain automation and distribution speed up the quality control process and guarantee a shorter delivery period.

1. QualityControl

Material shifting process can ensure improved quality control by minimizing damages and losses due to transportation. Supply chain automation and distribution speed up the quality control process and guarantee a shorter delivery period.

2. IncreaseOverallProductivityand Efficiency

Bystreamlining the process, organizations can improveoverallproductivityand efficiency. It allows your business to allocate resources more efficiently and frees workforce time. For example, by focusing on the bulk movement of products, you can reduce occurrences of damages and loss.

3. TimelyHandling

An integrated system makes the operation process more streamlined and well-timed. It ensures that materials are available at every stage of the production process at the right time and quantity.

4. Reducescosts

A proper material movement strategy can improve a company's financials by reducing labor costs and wastages byminimizing product damage or loss risks during handling, storage, and transportation. Regular cost audit enhances productivity and savings.

5. Competitiveadvantages

Businesses enjoy improved efficiency, better tracking of inventories, and quick responses to market demandanddeliver superiorvaluetocustomers. Efficient materialmovementoffersa competitive advantage in the market.

DisadvantagesofMaterialHandling

The downside of material handling includes higher installation costs, maintenance and operating costs, integration challenges, and others.

1. HigherInstallationCosts

Implementing material handling systems and equipment requires a significant upfront investment that increases your capital investments. This can prohibit some companies from implementing material movement infrastructure in their organizations.

2. MaintenanceandOperating Costs

The equipment would require regular maintenance and repair to function at optimum levels. The costs you incur in operating and maintaining equipment will increase your operating expenses and impact overall profitability.

3. IntegrationChallenges

Integrating a new system with your existing system can be complex, resulting in downtime and temporary disruption to productivity. Before implementing a material handling strategy, considering all aspects, including the economy, is crucial.

LINEBALANCING

Line balancing is intended to match the production output rate to the production planenabling on-time delivery, with reduced surplus inventory level. Line balancing is usually practiced to resolve problems occurring in production lines. It is a technique to reduce imbalance between workers and workloads in order to accomplish required run rate (H.Jay and R.Barry, 2006).

An unbalanced production line may lead to poor machinery utilization, a reason for product layout requiring line balancing. A typical example is a production line with work stations A, B and C with each having the capacity to produce 200 items, 100 items, and 50 items perhour respectively.

If each of the machines were to produce only 50 items per hour then each hour the machines at A and B would be idle for 45 and 30 minutes respectively. Such a layout will be unbalanced and the production line needs balancing. Another example is a baking factory with its oven continuously baking loaves at the rate of 800 loaves per hour and the wrapping machine only wrapping 400 loaves per hour. This kind of system is an unbalanced system, thus requiring line balancing.

WhatisLineBalancing?

Line balancing is a technique that helps businesses to increase product speed to fulfill customers'demandsontime.Itisalsocalledloadbalancingandhelpsin minimizing production waste. This method of production levelling is a must to managesupply chain operations.
Balancing resources and machinery to avoid wastage and maximize profits can result in higher productivity. This balance helps managers easily assign workers and machinery for a specific time to meet the target production rate.

LineBalancing inManufacturing

Line balancing in the manufacturing industry is vital in balancing production rates and fulfilling customerdemand intime. It involves balancing managers and machine time per the production rate and takt time.

Thetakttimeistherateatwhichproductsareproduced to fulfillordersshipmenton time. Productionoperationsareperfectlybalancediftheproductiontimeisthesameasthetakt time.Itremovesproblemsandsmoothensthesupplychain. The
Benefits of Production Line Balancing

Thebenefitsofproductionlinebalancingarementionedbelow.

1. ReduceWaitingWaste

Line balancing helps the working of machineryand the operators staybalanced. The balance guarantees that every machinery or operator is well-rested and functional. It reduces waiting waste by minimizing downtime.

2. ReduceInventoryWaste

Inventorywaste is a type ofwastethat representsthe wastageofproducts dueto mishandling of inventory. It reduces production rate, and production time is far from takt time.

3. AbsorbIrregularities

A balanced production line absorbs all internaland externalirregularities inthesupplychain. It keeps the production chain flexible enough to avoid delays and always deliver timely products.

4. ReduceProductionCostsForMaximumProfits

Whenproductioncostsareless,profitsarehigher.Itistheresultofoperationswhen
machineryand workers areincoordination. Using allresources attheir fullpotentialcanhelp businesses to achieve maximum profits with minimum production costs.

Howcanyouachievelinebalancing?

Toachievelinebalancing,followthesesteps:

1. CalculateTask Time

Balancing the production line requires the production rate equal to Task time. To find the value of Task time, managers should divide available working time per shift by customer demand per shift rate.

2. PerformTime Studies

Timestudieshelpmanagers tounderstand the schedule required tocomplete a task. Italso tellshowmuchmachineryandoperatortimeeachprocesswilltaketocompleteproduction.
Businessesusesoftwareforbetterdatacollectionandanalysistocalculateexacttimestudies.

3. IdentifyProblems

Whenit'stime fordataanalysisabouttime studies,businesseslookforprocessesdelayingthe production line. In other words, it helps companies identify and solve problems for smoother production operations.

4. ReallocateResources

Businesses also reallocate resources when problems are found. They also aim to avoid any blockage or burden of workload. This relocation helps employees to relax and use their abilities in other operations. It allows businesses to increase productivity by combining workstations and processes to make operations faster.

5. MakeOther Improvements

With emerging technology, businesses can use applications and software to find defects and improve productivity. These software are beneficialfor companies in balancing the resources in increasing production rate.

HowtoOptimizeLineBalancingProcess?

It is important to improve the line-balancing process to reduce delays. It involves the following steps:

1. ShiftExcessCapacitytoProblemAreas

Reassign workers and equipment that are overburdened and delaying the production line. It will eliminate waiting waste and increase productivity.

2. SimplifyManualActivities

Manual activities among operators should be distributed with a fair division of workload. If manualworkisassignedtosoftware,managersmustreassigntheworkersto other processes for a better work culture.

3. AssigningTasksbasedonAvailability

Businesses can also use software and programs to assign tasks to departments in which multiple employees work. It results in better distribution of work and improves production rate.

4. SettingUpReal-TimeSupportSystem

By setting up a real-time support system, businesses can quickly identify and resolve all issues and faults in the production line to avoid delays.

AssemblyLineBalancing

Assembly line balancing is the process of managing workflow and maintaining production rates. With proper and timely task and resource distribution to operations, businesses can balanceproductiontimewithtakttime.Thisbalanceincreasesrevenueandmakes demands fulfilment on time.
Withassemblyline balancing, businessescanguaranteethatthetimetakenbyeachprocess is balanced. It is helpful for companies in mass production industries. It can be achieved by equal task distribution among employees and all equipment for optimized production lines.

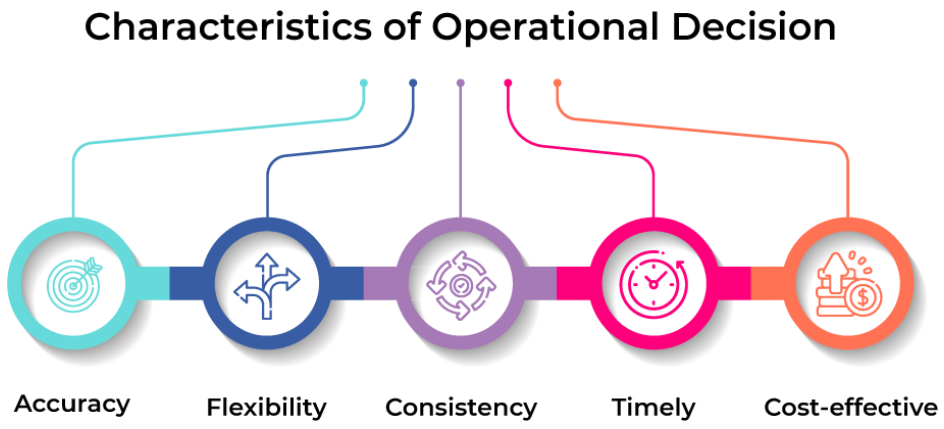
OPERATIONSDECISION

Operational decisions are short-term choices that are typically made on a weekly, daily, or hourlybasis. Theyare primarilyconcerned withoperationaldetails, dailyresource allocation, inventory control, and delivery routing to maximize product flow along biomass-based production chains. Due to the changing internal and external conditions of supply chains and related activities, operational decisions might be changed and amended often.

Operationaldecisionsconsist ofthree steps:

- InputData
- DecisionLogic
- Outputoraction

CharacteristicsofOperationalDecision



Accuracy

Goodoperationaldecisions behave like informed employees with the appropriate reports and analysis, using data quickly and effectively to take the right action. Instead of just beingawareofthepast,theyusethisdatatogetinsight intothe futureandusethat understandingto

behave more appropriately. Through micro-segmentation and intense customization, they target their customers using information about them.

Flexibility

Operational choices must be made quickly to reflect new possibilities, organizations, and threats; otherwise, their value will quickly deteriorate. No modern business system canendure protracted periods of static. Given the current competitive, economic, and regulatory context, it is impossible. When businesses automate their transactions and procedures, they frequently discover that how rapidly they can alter their information systems greatly affects how quickly they react to change. Operational decisions must be simple to alter quickly and effectively to reduce missed opportunity costs and increase overall business agility.

Consistency

Your operational decisions must be consistent throughout time and space across many channels you use to conduct business, including the web, mobile devices, interactive voice response systems, Auto attendant systems and kiosks. They enable you to act differentlywhen you desire to, such as offering a reduced price online to promote the usage of a lower- cost channel, but theymake surethat you don't act differentlyunintentionally. These systems support the people who directly work for you and the third parties and agents who represent you. Theyensure youstayoutoftrouble byupholding your company's laws, rules, and social preferences everywhere it conducts business. They continually provide your employees witha top-notch experience.

Timely

You need to act as quickly as possible. Your competition is only three clicks away, as they say online. Your coworkers are developing short attention spans and a lack of patience. The systems that manage your supply and demand chains must act swiftly and shrewdly as they become morereal-time. Youmust reducewaittimes fortheseassociatesas fewerstaffhandle more clients, partners, and suppliers. You must make a choice swiftly and take action.

Cost-effective

Operational choices must, above all, be economical. Cost cutting is still crucial despite significant efficiency improvements and reductions in previous years. Effective operational choices reduce costly reports and needless tasks. They lessen fraud and avoid penalties. They enable your employees to work more effectively and allocate their time wisely. They ensure that you get as many things correctlythe first time and steer clear of costly "do-overs." They lessen friction, which slows down operations and raises expenses.

ExamplesofOperationalDecisionsthatBusinessesmake

- Monthlyanddailyforecaststodeterminethedemandfromendusers.
- Determining the deadline for satisfying demand and analyzing the variances between lead time and deadline.
- Schedulingandplanningfordailyandweeklyproduction.

- Assigningacargoofbiomassproductsorsourcestoacertainmethodof transportation and vehicle.
- Routesandtimetables fordailyandweeklydeliveries,fleetmanagement.
- Keeping trackofsupplyshortfalls and backlogs, planning additionaldailyand weekly operations to address the shortages.
- Controlandreplenishmentofinventorieseverydayandeveryweek.
- Schedulingtheworkandkeepingshifts.

PRODUCTIONPLANNING ANDCONTROLINMASSPRODUCTION

Production planning helps manufacturerswork smarter by efficiently managing internal resources to meet customer orders or demands. It solves what, when, and how much to produce. It establishes production capacity and identifies what raw materials, bill ofmaterials, or alternatebill of materialsare needed to meet demand. Then it prepares a workable production plan.

Whatisproductioncontrol?

Production planning and control manages and schedules the allocation of human resources, raw materials, work centers, machinery, and production processes. It finds the most efficient waytoproducefinishedgoodswiththeleadtimesneededtomeetproduction demand.Production planning and control are two strategies that work cohesively in manufacturing. Planning involves what to produce, when to produce, how much to produce, and more. Production control ensures optimum performance from the production system by using different control techniques for better throughput targets.

Production control monitors production and measures performance, providing visibility and reporting. If any corrective action is needed, it gets initiated with production control. It includes different control techniques to achieve optimal levels of production performance.

Whataretheobjectivesofproductionplanning and control?

Theoverallobjectivesofproductionplanningand controlare to:

- Optimizeresourcesandtheschedulingofresourcestomeetproductiondemand
- Ensureanefficientschedule
- Have resourcesreadywhenneeded
- Keepinventoryatoptimallevels
- Increaseproductivityofinternalresources(people,workcenters,machines, tooling,etc.)
- Improvecustomersatisfaction
- Ensuretherightpersongetsassignedtospecificprocesses
- Coordinatewithotherdepartments(sales,customerservice,purchasing, etc.)

Production planning and controlis the core of any manufacturing unit. It includes material forecasting,master production scheduling, long-term planning, demand management, and more. The planning process kicks off with demand forecasting of a product. Using that forecast data and the internal resources available, the production plan is created.

Production planning and control is a strategy to plan a chain of operations that supports manufacturers to be at the right place and time. It helps them achieve the most efficiencyfromtheir resources. It also includesactivitiesofother departments, suchassales, marketing, and procurement.

Whatarethebenefitsofproduction planningandcontrol?

Someofthemanybenefitstoproductionplanningandcontrolinclude:

- **Optimized manufacturing capacity**–It ensures machines and employees workto capacity. That keeps costs down, increases efficiency, and provides greater profitability. It helps to identify areas of improvement and to plan for growth.
- **Reduced inventory costs**– allows manufacturers to only hold the necessary inventory. The software can predict demand and have a Just-in-Time scheduling strategy. Without a surplus of inventory, costs are kept low.
- **On-time deliveries**– helps to ensure production optimization and prompt deliveries. Getting productsto their destinationontime improves customer satisfaction. That increases customer retention and referrals.
- **Better procurement of materials**– shows when materials should get purchased for production. Having this information helps to knowwhento order and what is needed to meet customer and production demand. Knowing when to order lets procurement buy in advancetofindthebest deal. Thisalso helpstosave moneyand improvesrelationshipswithsuppliers.
- **Streamlined production processes**– ensures that materials and internal resources for production are ready when needed and shows what capacity is available, and when. This keeps production running smoothly. It also helps employee satisfaction as it eliminates frustration from interruptions in production and workflows.
- **Minimal resource waste**–eliminates materialshortagesorsurpluses for lessresourcewaste. This lessens employee time wasted. Capital is not tied up in inventorythat is not used. There is less production waste because delays that cause discarded materials get eliminated.

Whatistheroleofproductionplanningandcontrolinmanufacturing?

Production planning and controlensures the resources for production are readywhen needed. Materials, equipment, and labor must be available at the right time to optimize production. It is the central part of a manufacturing business. The larger a business gets, the more PPC becomes essential for a smooth-running operation.

Whatarethestepsinproductionplanningand control?

1. Planning

Planning determines what will be produced, by whom, and how. It formulates the plan for labor, equipment, work centers, and material requirements needed for production. Relevant information from various sources helps to develop a production plan. For instance, datafromsalesonorderquantitiesandpromiseddeliverydates.Productspecificationsfrom

the engineering department may also be needed. The planning step helps to keep a streamlined approach to the production process.

2. Routing

Routing determines the path raw materials flow within the factory. Using the sequence, raw materials are transformed into finished goods.

Coordinating everyproductionprocess and scheduling everystep is importantto measure the production process duration. Routing shows the quantity and quality of materials and resources needed. It also shows the operations used and the place of production.

Routing manages the "How", "What", "How much", and "Where" of production. It systematizes the process and optimizes resources for the best results.

3. Scheduling

Scheduling emphasizes "when" the operation will be completed. It aims to make the most of the time given for the completion of the operation.

Asper KimballandKimball,thedefinitionofschedulingis–

"The determination of the time that should be required to performthe entire series as routed, making allowance for all factors concerned."

Organizationsusedifferenttypesofschedulestomanagethetimeelement.These include Master Schedule, Operation Schedule, Daily Schedule, and more.

4. Loading

Loading looks into the amount of work loaded against machines or workers. The total time to perform new work is added to the work already scheduled for the machine or workstation.

Ifa machineor workstationhascapacityavailable, moreorderscanmakeuptheunderload. If there is a capacity overload, proactive measures can prevent bottlenecks. Adding a shift, requesting overtime, bringing in operators from another shop, or using a sub-contractor are possible options.

5. Dispatching

Dispatching is the release of orders and their instructions. It follows the routing and scheduling directions. This step ensures all items are in place for the employees to do their jobs.

Here arethe pointsthatarepartof"Dispatching":

- Issuematerialsor fixturesthatareimportant for production
- Issueordersor drawingsforinitiatingthework

- Maintainthe records fromstarttofinish
- Startthecontrolprocedure
- Cascade the workfromone process toanother

6. Follow-up

Also known as expediting, follow-up locates fault or defects, bottlenecks, and loopholes in the production process. In this step, the team measures the actual performance from start until the end and then compares it with the expected performance.

TypesofProductionPlanning

1. Masterproductionschedule

A Master production schedule is a plan that tells when the production will begin for what products,at whattime,and inwhat quantities.Thepurposeofa masterproductionschedule is to create a realistic plan to ensure on-time delivery of goods while minimizing overstock.

2. Materialsrequirementplanning

Material requirement planning ensures availability of raw materials, maintains the lowest possible stock level, promotes inventory control, and helps plan purchasing activities.

3. Capacityplanning

Capacity planning is the process of determining the production capacity needed by the organizationto meet customers'ordersandchangingdemand fortheproduct.Itaimsto strike a balance between expenses and resources as well as demand and supply.

4. Workflowplanning

Workflow planning is planning a sequence of operations performed during the production process. It allows you to track each item's work and see whois responsible for the task andits completion. In other words, workflow planning helps check the status of the task.

ProductionPlanningTools

Manufacturers rely on multiple tools to prepare the production plan and track progress suchas charts, spreadsheets, or visualization software, etc. Instead of investing in multiple tools, a single ERP solution can help you plan production and use production control strategies to ensure that the plant floor is performing well and deliveries are on time.

Enterprise Resource Planning (ERP) software offers real-time visibility that helps decision-makersunderstand variances,eliminatewaste,rampupproduction,and improvetransparency within the organization. ERP makes updating a job's status easy as it can be done on mobile devices without leaving the workstation.

MASS PRODUCTION

WhatisMassProduction?

Mass production is the manufacturing ofthe same standardized product lines for a prolonged period of time. It uses automation or assembly lines to facilitate the high volume production of similar products.

Mass production is synonymous with continuous flow production or series reduction. The concept is identified with the rise in modern capitalismthat succeeded in the Industrial Revolution. Mass production commonly uses mechanization to achieve labor division, high volume, monitoring and quality control, and material flow.

HowMassProduction Works

Mass production involves multiple assembly lines, where various people run routine procedures and do one specific job. The same equipment is used to perform the identical operation on a batch of products being manufactured.

For the efficiency of the labor process, companies use differentiation, formalization, and specialization. The rationale behind such principles is to keep manufacturing costs low by using repetitive and standardized processes to produce uniform products.

The evolution and innovation of sophisticated technologies play a great role in making manufacturing less complicated. The large-scale demand for mass-produced products manufactured at a low cost using a minimalworkforce is achieved using precision machining equipment.

MassCustomization vs.MassProduction

Mass customization involvesprovidingend-userswithwhat suitstheir needsat alowercost. Thus, productsthat meaningfullymeet customer'sneedsare customized ona large scale. The conventional firms that dealwith mass customization call for flexibility, responsiveness, and the configuration of units, processes, people, and environments to provide uniquely customized products that meet user requirements at a relatively low cost.

Mass customization focuses on markets with fragmented customer segments and with customer's preferences being harder to hypothesize and prone to changes. More intimate knowledge about end-usersand higherprofitscreatesafeedback loopsystem, whichcanhelp companies provide even better and different products.

In contrast,**mass production** is the forerunner of mass customization. Mass production companies replicate a hierarchical and bureaucratic system where workers perform repetitive

roles that are narrowly defined, resulting in standardized, low-cost products.

Consumers generally accept standard products under a mass-production system. On a mass basis, companies manufacturing goods benefit fromeconomies of scale since it facilities market expansion and price reduction. The low product pricing encourages demand clusters around homogenous products. It acts as a feedback loopthat reinforces standardized products to the manufacturing firms, given the interplay between consumers and producers.

However, the two concepts are viewed to be on a continuum of continuous improvement. A company may also practice mass customization and mass production, albeit in two different factories meant for different market segments.

Advantages ofMassProduction

1. **Highprecision rate**

Mass production can result in a high-precision rate if production is strictly monitored and validated using present parameters.

2. **Lowproductioncosts**

It is also associated with low production costs because the mechanization eliminates redundant job roles, thus requiring fewer workers.

3. **Higherefficiency levels**

Additionally, mass production can lead to higher efficiency levels since automationassembles mass-produced items faster. It also gives firms acompetitive edgeand higher profitability because the rapid assembly helps in the faster distribution and marketing of products.

DisadvantagesofMass Production

1. **Capital-intensive**

First, mass production requires automated assembly lines, which is capital-intensive and requires large sums of investments to set up and maintain. Only companies with a large capital outlay can implement mass production in their manufacturing process.

2. **Requiresconstant upgrades**

Second, mass production systems require upgrading and new improvements to keep up with the latest innovations in the market. A typical scenario can be seen in a pharmaceutical firm that manufactures popular drug products on a comprehensive assembly line. If a different production process is required due to regulatory changes, the company will be required to incur significant investment in time and money to adopt a new assembly line.

3. **Lowemployeemoraleandincreasedemployeeturnover**

Lastly, mass production is associated with low employee moraleand increased levels of employee turnover due to the repetitive nature of the production process.

INBATCH/JOBORDERMANUFACTURING

What is batchproduction?

Batch production is a method whereby a group of identical products are produced simultaneously(rather than one at a time). It is up to the manufacturer to decide how big the batch will be, and how often these batches will be made.

Each batch goes through the separate stages of the manufacturing process together. Meaning that another batch can't begin a stage, ifthe previous one is still within that part ofthe cycle.

Each batch can be different, as manufacturers can decide to change the specifications from one group of productsto the next. Perhaps it is necessary to change the colour or size of that particular group (depending on the preferences specified in a particular order).

Quality checks can be carried out after each step ofthe production cycle. And machinery can be tested between batches to ensure there are no performance problems. This kind of flexibility isn't possible when using some other approaches.

It's important to look into these opposing methods, to see which best suits the needs of your business. But it's fair to say that batch production is well fitted for small to medium-sized manufacturers, for reasons we'll come on to.

Whatarethemainfeaturesofbatchproduction?

- CanbesuitableforgrowingSMEs
- Aflexiblemethodofproduction
- Eachbatchgoesthroughallstagesofproduction together
- Qualitycontrolcanbe carried outbetweenbatches
- Goodformaintainingsensiblelevelsofinventory
- Canbelotsofdowntimebetweenbatches

Whataretheadvantagesanddisadvantagesofbatchproduction?

Advantages

1. **Savemoney**

This method is useful for smaller companies, as moneycan be saved thanks to lower running costs. Machinery isn't operational at all times, only when a batch is being produced.

It's cheaper to purchase materials in bulk too, rather than on a smaller basis. If you're preparing for a large batch, suppliers are likelyto give you a better deal for a big order.

It also takes some of the strain off your equipment and workforce, if products are being created inbig groups, asthis is more efficient (and faster)thanproducing goods individually.

2. **Reducewaste**

There is slightly more room for error compared to larger-scale techniques. If a manufacturer needs to create a large quantity of a product, but they break this down into smaller batches, there will be lesswaste, if, for example, one ofthese batcheswere to possessdefective items.

Similarly, if a product isn't selling well, manufacturers aren't committed to producing an overly large amount. They can make changes before it's too late. Inventory can be kept at sensible levels, which also keeps storage costs down.

3. **Greaterflexibility**

If there was to be a new trend in the industry, or if a wave of seasonal demand were to come into effect, batch production makes it possible to tweak items from one production cycle to the next (rather than having an unchanged item for a long period of time).

Disadvantages

1. **Losttime**

It could be argued that batch production causes a lot of downtime, between batches, when machinery is not in use.

Equipment must be turnedoffat the end ofone cycle, and sometimes it takesa while for it to be reconfigured (in preparation for the next batch).

2. **Lackof specialisation**

It’s not possible to create a completelyunique item, ifan individualcustomer were to make a specific demand.

3. **Moreexpensivethansmallerproduction methods**

There will be larger storage costs associated with batch production (compared to a smaller operation). Plus, an entire batch could be lost if an error wereto occur.

However, batch production strikes a good balance between smaller and larger methods, arguably achieving the best ofboth worlds (and is ideal for a manufacturing SME looking to scale up).

JOBORDERMANUFACTURING

Job order production is a manufacturing process that is used to create special products for specific customer orders. Each product helps individual customer needs. Job Order Production simplifies manufacturing by expertly outsourcing specific tasks, improvingoverall production success in the following ways:

1. Tailored Solution: Businesses can produce custom-made products.This approach makes sure that each order is perfect and meets the customer's unique needs.
2. Cost Efficiency: It reduces excess inventoryand storage costs. Successful job order production can lead to cost savings. Manufacturers can reduce operational costs, such as labour, equipment, and facility expenses, ultimately increasing their revenue.

3. Scalability: It allows manufacturers to adapt to changing market demands. Businesses can scaleproductionupordownwithouttheburdenofmaintaining in-houseproductionfacilities.
4. Expertise Access: Production outsourcing gives manufacturers access to industry expertise and experience. This valuable knowledge can improve product quality. This givesoutsourcing manufacturers a competitive edge in their market.
5. Reduced Waste: Job order production typically produces goods in smaller batches, which leads to less waste in comparison to mass production methods. This waste reduction is good for the environment and economy.
6. Core Strengths: Job order production lets businesses focus on their core strengths, such as marketing, sales, and product development while leaving the manufacturing to the experts. This concentration on core strengths can lead to overall business growth and profit

ProductionPlanningMethod	**Description**
Master Schedule	Aplanbasedonacomprehensiveoverviewofproduction needs.
Batch Production	Producingitems ingroupsorbatches, oftenforefficiency.
JobOrderProduction	Customizingproductsforspecificorders.
Process-BasedLearning	Focusingonstep-by-stepprocessesforefficientproduction.
LeanProduction	Reducingwasteand increasingefficiencyinoperations.
Just-in-Time(JIT)	Producinggoodsasneeded to reduceinventorywaste.

JobOrderProductionSystem

Job order production is a manufacturing process that is the complete opposite of mass manufacturing. Mass manufacturing produces identical goods in big quantities. In job order production, every product is different.

AdvantagesOfJobOrderProduction

JobOrderProductionoffersmoreflexibility,lowcost,exactbudgeting,andbettermanufacturing processes. Here are some key advantages:

1. Sub-ProcessesforAllGoods

Job order productions help to add sub-processes to each master Bill of Material(BOM). One can manage semi-finished goods by optimizing the production process.

2. DefineRoutingTasks

Businessescanspecifyoperationslikecutting,machining,orfinishingwithineachBOM. With this level of specificity, one can be confident of quality.

This makes sure everystage ofthe productionprocess is clear-cut. It also makes sure that the job order production is perfect.

3. EfficientWorkOrderManagement

Most job order productions make creating work orders simple. This way, a business ownerhas total control over one's production schedule.

Businesses can even turn a single or a group ofwork orders into a job order production. This in turn will reduce the job order costing calculating unit product cost.

4. QualityAssurance

Joborderproductionsgivequalitydeliverythetoppriority.Itfirstupdatesthenumberof complete items in inventory. Then, businesses can collect the goods' testing data.

Businessescanmakesureofthequalityoftheproducts beforedeliveringthemtoclients.

JobOrderProductionExamples

Toseetheimpactofjoborder production, let's lookatafew examples:

1. CustomFurniture Manufacturing

Thinkof abusiness thatproduces upscalefurnishings.They getrequests for one-of-a-kind furniture with specific style, size, and material recommendations.

Theycanmakethesepiecesaccordingto customer orders,providing furnituretailoredtotheir client's preferences and requirements.

2. AerospaceComponent Manufacturing

In the aerospace sector, accuracy is important. Ordersfor specialized items like engines or landing gear, are put in place with manufacturers.
Job order manufacturers make sure that these parts follow strict quality and safetystandards. This, in turn, makes sure of air travel security.

3. MechanicalToolsandSupplies

Consider a business that produces specialized mechanical tools and equipment. Customers place orders for specific tools with unique features. The manufacturer produces these tools according to the customer's requirements, making sure they meet quality and standards.

4. ElectricalandElectronics

In the field of electrical and electronics, job order production is common. Businesses receive orders for customized electronic components or devices. They manufacture these items according to the customer's specifications, making sure they function correctly and follow safety standards.

These examples show how job order production can tailor products to individual customer needs, ensuring quality and satisfaction.