MODERN PRODUCTION AND OPERATION MANAGEMENT

Dr. Nishant Labhane
Dr. Jayakrishna Herur

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CHAPTER 1

A DISCUSSION ON PRODUCTION AND OPERATION MANAGEMENT

Dr. Nishant Labhane
Assistant Professor, Master in Business Administration (General Management),
Presidency University, Bangalore, India.
Email Id: nishantbhimrao@presidencyuniversity.in

ABSTRACT:

Production and operations management (POM) is a critical discipline that focuses on efficiently and effectively managing the processes and resources involved in the production and delivery of goods and services. This abstract provides an overview of the key concepts and principles underlying POM and highlights its significance in today's business landscape. It emphasizes the role of POM in optimizing production processes, managing resources efficiently, and delivering value to customers to drive growth, profitability, and sustainability.

KEYWORDS:

Capacity Planning, Continuous Improvement, Cost Control, Demand Forecasting, Inventory Management, Just-in-time (JIT), Lean Manufacturing.

INTRODUCTION

During the Industrial Revolution, the fields of production and operations management were first developed. However, it became more significant in the late 1950s as researchers understood the necessity to examine industrial activities as a system unto itself. Production and operations management, sometimes known as POM, has gained importance as a field of study recently. POM may be defined as the organization's resources being planned, coordinated, and controlled in a way that will support the production process. In plain English, POM is concerned with the transformation of production and operational inputs into outputs that, when dispersed, will satisfy the needs of consumers. It is a business sector that is likewise focused on providing high-quality products and services. It also makes sure that all company operations, including manufacturing, design, and product performance, run smoothly and in a way that is both efficient and effective [1], [2].

activities management ensures that company activities like production function, design, and product performance are carried out effectively and is concerned with the creation of high-quality products and services. Regardless of the size of the firm, production and operations management has great potential and is steadily rising to the top among all functional areas of management. Businesses get an advantage via a variety of means, including higher-quality goods, less wastes, more inventory turns, better product designs, more flexibility, etc [3], [4]. The needs of management students enrolled in online learning programs were taken into consideration while writing this book, Production and Operations Management.

The work is organized according to the SIM, or self-instructional mode, structure, with each unit beginning with an introduction to its subject and an overview of its goals. The book is presented in an easy-to-understand but organized way, with Key Terms and "Check Your Progress" quizzes

to gauge the students' comprehension. For efficient recapitulation, each unit also includes a Summary and a collection of Questions and Exercises.

The goal of the production/operations management process is to coordinate the combination and transformation of various assets employed in the production/operations subsystem of the organization into value-added products and services. Therefore, it is that area of an organization that is involved in turning a range of inputs into what is required and having the required quality standards. Manufacture management is the coordination of related management tasks used in the manufacture of certain items. The same set of management tasks is called as operations management if the same philosophy is applied to services management.

DISCUSSION

Functions of Production Management

Operations management is a discipline that focuses on the efficient planning, scheduling, use, and control of manufacturing or service organizations through the study of concepts from design engineering, industrial engineering, MIS, quality management, production management, industrial management, and other functions as they affect the operations, according to the Association of Operations Management. Creation and operations management, in the words of Sherin Siegel and Joel G. Siegel, "is the management of all activities directly related to the production of goods and services." You may recall that both products and services are produced.

In the beginning, manufacturing used techniques used in mass production to create physical items. The management of the production systems became crucial as company complexity increased. Then, services were also 'made' or "rendered." These were abstract. Therefore, there was a need for some guiding principles that might apply throughout the full chain of production and delivery of a thing or service. It was discovered that the same ideas could be used to manage the processes involved in producing "goods" as well as providing "services" Production and operations management refers to this.

POM employs quantitative methods, shop-floor control, organizational behavior, safety management, maintenance management, and other industrial engineering concepts in addition to operations research's decision-making tools. Therefore, we may conclude that POM is concerned with the ideas and guidelines that businesses use to become successful and efficient [5], [6].

The Manufacturing Process

The translation of input into output during the manufacturing and operation of products and services involves a process.

Alteration: This covers all processes like altering the physical condition of the input, adding chemicals, changing dimensions, heating, rolling, galvanizing, etc. There are many different ways to modify things, and each product on the market has its own unique way.

Transport: This is the act of physically moving products from one location to another. Some businesses, like traders, are experts in acquiring products from one region and moving them to another where they may be sold.

Storage: Preserving the commodities in a safe environment so they may be made accessible at a later time, such food grains, is referred to as this. This process of metamorphosis is also present

here. Publishers of books, inspection or shipping firms, etc. may all provide value. As there are products, there are also processes. Every product has a different production method. In a nutshell, the transformation process includes any activity that enhances the value of a product.

Production: Production may take the shape of products, services, or a mix of both.

As organizational complexity increased, it was discovered that just translating input to output was insufficient. Input or transformation process adjustments have to be adjusted based on feedback from the output stage. Therefore, production control was implemented to account for input fluctuations, if any. In order to track the effectiveness of the transformation process, feedback mechanisms were set up and the quality of the created output was now continually compared to the quality of the intended output.

The transformation process was later discovered to be being hampered by a few random disruptions. These unforeseen and sometimes unplanned random disruptions are brought on by the outside environment and might take the shape of strikes, intervention from the government, recessions, etc. Every company begins with a purpose and a mission before planning the steps necessary to carry out these objectives. Accordingly, every activity is planned, especially those that transform inputs into necessary outputs. Any kind of organization's shared goals are:

1. Customer Contentment

An organization's sustainability depends on maintaining customer happiness. Before choosing a product, the company investigates what the client could anticipate from the service. An company may only continue to exist if its goods meet the following requirements for client satisfaction:

1. Product quality in accordance with ACCEP guidelines
2. Reliability and ease of maintenance of the product
3. Product functionality as described by the vendor

2. Profitability

To generate sales, the product's price should be competitive. For this reason, product prices on the market should be reasonable and in line with the characteristics they provide. A good company creates goods of the proper quality, which adhere to all product requirements, at the lowest possible cost. To increase profitability, the company should concentrate on cutting expenses and boosting revenue.

3. Timeliness

The firm loses if the good or service does not reach the customers when they need it, even if it is high-quality and cost-effective. The customer buys the product or service from a rival instead of waiting for it to arrive. As a result, by successfully managing production schedules, production and operations management plays a crucial part in delivering the product or service on time. In conclusion, we can conclude that a successful POM must create or provide services that are of the proper quality, quantity, timing, and pricing. Additionally, it should make sure that there is no system waste since this drives up costs and causes lengthy delays. The management may not be able to accomplish its goals and aims if the aforementioned aspects are not taken into consideration.

Production and Operations Management's Remit

All the processes involved in creating a products or service are included in the scope of production and operations management. The range of production and operations management is as follows:

1. **Product selection and development:** This topic examines the process of choosing and creating a product for commercial use.
2. **Process selection:** It discusses how the procedure necessary to create a product is chosen for mass manufacturing.
3. **Facility location:** It discusses the factors that should be taken into account while choosing a manufacturing site.
4. **Layout planning:** It examines how the industry or facility should be set up for maximum output.
5. **Material handling:** It examines the importance of material flow in an organization and various material handling techniques.
6. **Manufacturing system:** It looks at the many kinds of manufacturing systems and how they might be used.
7. **Production planning and control:** This discusses the procedures used in various manufacturing systems. The techniques used for work loading, scheduling, dispatching, PERT/CPM, and linear programming, among others, are included.
8. **Job Studies:** These include technique analysis and job sizing.
9. Materials management: This covers techniques for inventory control, inventory analysis, etc.
10. **Quality:** This covers TQM, Six Sigma, and other methods and standards.
11. **Safety Management:** It deals with guidelines and techniques for ensuring workplace safety, among other things.

Relationship with Other Functions in Production

The main duty of an organization is production. Production is the sole division or activity of an organization that exists. A company cannot function if there is nothing for it to create or sell.

1. Marketing creates a market for the commodities and helps producers sell their products.
2. Finance provides the funding for resources and equipment.
3. The administration of human resources supplies the labor force and looks after the workers.
4. Purchasing is the process of acquiring the supplies an organization needs to function.
5. Inventory management takes care of things.
6. The legal department defends the company in legal matters.
7. The department of public relations enhances an organization's reputation.
8. R&D is in charge of development and research.

However, the commodities and services are created via production. It is essential to fulfilling a company's strategic objectives. The majority of a company's workers work in production, which also accounts for a significant amount of its assets. It also has a significant influence on the cost and quality of the items produced, serving as the public face of the business. So, we might say that an organization's heart is its productivity [7], [8].

Types of Manufacturing or Production Systems

Production and manufacturing processes transform raw materials into tangible products. Any of the above methods may result in this value increment. Classification of Manufacturing Systems classifies manufacturing systems according to the kind of production process used to transform input into output.

System of Continuous Production

It entails a constant, if not constant, physical flow of material. Large numbers of standardized products are produced using specialized machinery. In order to optimize usage and prevent costly and time-consuming shutdowns and starts, the processes often run 24 hours a day.

Production via process: The term is a result of how the materials move throughout the procedure. Products with a strong or ongoing demand are produced using this technique. In this case, a single raw material may be converted into many products at various phases of the manufacturing process. Examples include steel production and petroleum refining, where various fractions such as kerosene, gasoline, etc. are recovered during the fractional distillation process.

Flow or mass production: There aren't many items that are produced in enormous numbers. Resources may be arranged around certain items because of the enormous volume and standardization of the products. The primary features of this system are the standardization of goods, procedures, materials, and equipment as well as the continual flow of supplies. It falls in the middle between batch and process manufacturing. Automobiles, home furnishings, computers, and other items are examples.

Characteristics of A System That Produces Continuously

1. Standard items, which are in high demand all year round, are made. Typically, production is "made to stock."
2. Machine tools, equipment, and inputs are all standardized, as well as the order in which they are performed.
3. Due to the production of the same or similar items every time, the division of labor is effective and requires less monitoring.
4. Low inventories allow for efficient material management. Compared to an intermittent production system, it will be lower.
5. The work is moving in a balanced manner. There will be little work in progress as a consequence.
6. advantages of a technology that produces continuously
7. reduced labor costs due to the lack of demand for highly qualified individuals. Additionally, job rotation and division of labor are also conceivable.
8. Once systems are in place, no close oversight is necessary since they take care of themselves.
9. Low cost due to high manufacturing quantities.
10. lower material handling and lower inventory.
11. Since the items are standardized, there is less waste.
12. It is possible to employ all production control, inventory and material management, and maintenance systems approaches.
13. Continual manufacturing system drawbacks.

14. To prevent manufacturing delays, constant maintenance is required.
15. It is challenging to adjust to changing demand since it requires time and financial effort.
16. Large capital expenditure.

Since the system is not adap, it is not possible to make frequent or abrupt modifications to the production schedule.

Two different continuous manufacturing systems are as follows:

Process Manufacturing

Manufacturing by Mass or Flow

A System of Intermittent Production

Instead of manufacturing against stock under this arrangement, the items are often produced to satisfy client demands. There is a sporadic flow of materials. The manufacturing facilities can accommodate a broad range of sizes and products. There is noticeable storage in between activities. Typically, individual activities are carried out in a manner that is independent of those that come before and after them [9], [10].

There are two different kinds of intermittent production systems:

1. Creation of jobs
2. Batch manufacturing.

Job Production: Job production refers to the manufacturing of a broad range of items in very small numbers; customisation is high, and there is significant complexity and divergence in the production processes, resulting in a chaotic flow rather than a line flow. The system calls for labor that is adap, highly skilled, and expensive. Examples include creating bespoke shelves and cabinets from a metal casting.

Batch Production: In this method, products are processed in lots or batches, and a new batch is only started for production after the previous batch's products have all been finished.

In actuality, it is possible to see batch-type production as an expansion of the job-type system. The chemical sector, where various medications are produced in batches, serves as an example. Production of machine tools, printing presses, and other things are more examples.

Characteristics of A System Intermittent Production

1. Products are produced in modest volumes.
2. There is a wide range of items.
3. There is a need for highly qualified professionals.
4. A huge ongoing project.
5. System is very flexible since product volume and diversity are always changing.
6. Unbalanced workloads since they are dependent on the current task.

Advantages of A System of Intermittent Production

1. Has the ability to adapt to changing circumstances, specifications, and demand fluctuations.
2. Initial costs are not extremely high in comparison to ongoing costs.
3. Managing the project

A project process is one in which the task is taken on to suit certain criteria and there is a high level of customisation. Every project is unique. The order of the phases or process flows is specified for each project. Instead of producing particular goods at a cheap cost, project processes are valued more for their ability to do certain types of duties. They often require a lot of time and call for the completion of several associated activities. Coordination is needed closely for this. The resources required for a project are assembled at its inception and dispersed after it is complete.

CONCLUSION

In conclusion, POM is essential to controlling an organization's operations and output. Its concepts and practices help businesses manage resources effectively, create value to customers, and improve operations. Organizations may achieve operational excellence, spur development, and maintain their position in the competitive and dynamic business world of today by adopting POM as a strategic priority. Ultimately, increased profitability and sustainability result from the effective use of POM ideas and practices. Organizations may acquire a competitive advantage and encourage steadfast consumer loyalty by providing goods and services more quickly, more affordably, and of higher quality. POM also assists firms in risk identification and reduction, resource management, and decision-making based on data and analysis.

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CHAPTER 2

INDUSTRIAL ENGINEERING, MANUFACTURING ENGINEERING AND OPERATIONS RESEARCH

Ms. Swati Sharma
Assistant Professor, Masters in Business Administration,
Presidency University, Bangalore, India.
Email Id: swatisharma@presidencyuniversity.in

ABSTRACT:

Industrial engineering, manufacturing engineering, and operations research are closely related disciplines that contribute to the optimization and improvement of industrial and manufacturing systems. This abstract provides an overview of these fields, highlighting their core principles and methodologies. It emphasizes the importance of integrating these disciplines to enhance efficiency, productivity, and decision-making in complex industrial and manufacturing environments. Industrial engineering focuses on designing, analyzing, and improving integrated systems involving people, materials, information, equipment, and energy. It applies principles of engineering, mathematics, and behavioral sciences to optimize processes and maximize productivity. Industrial engineers are responsible for streamlining workflows, reducing waste, implementing quality control measures, and improving overall system performance.

KEYWORDS:

Product Development, Quality Control, Resource Allocation, Scheduling, Supply Chain Management, Waste Reduction.

INTRODUCTION

Operations research is a field of study that applies sophisticated analytical methods to help corporate organizations make decisions more quickly and effectively. It should come as no surprise that it is also known as management science or decision science. So how precisely does it relate to industrial engineering and manufacturing? You will learn how from this [1]. Operations research develops optimum or nearly optimal solutions to challenging decision-making issues using methods including mathematical modeling, optimization, and statistical analysis. Operations research has many characteristics with industrial engineering, organization science, and even psychology due to its emphasis on human-technology interaction and practical applications.

Operations research, or OR, is playing an increasingly important role in both the public and commercial sectors. In general, OR solves a number of challenges pertaining to manufacturing, transportation, communication, and inventory. It is thus essential to management. It makes it easier to handle computer operations, risks, earnings, financial resources, etc [2], [3].

Decisions including healthcare, energy policy, water resources, military, and urban systems are all made using OR in the public sector. It is a problem-solving and decision-making analytical approach helpful in the effective administration of businesses. The area of engineering known as industrial engineering is concerned with optimizing intricate systems or processes. Its objectives include creating, enhancing, putting into practice, and assessing integrated systems that include

not only people, information, money, knowledge, and technology, but also energy, materials, analysis, and synthesis. In order to evaluate the outcomes or consequences of such systems or processes, it also blends engineering ideas and methodologies with the mathematical, physical, and social sciences [4], [5].

Although its fundamental ideas are comparable to those of business-related subjects like operations management, engineering's emphasis is on mathematical skill and quantitative methods. Industrial engineering may also be referred to as manufacturing engineering, operations research, systems engineering, or safety engineering, depending on the subdisciplines involved. Those engaged, such as health management engineers and health systems engineers, might also be referred to be industrial engineers if the specialization in issue is healthcare. The Toyota Production System, abbreviated TPS, was created by Toyota and encompasses its management methods and philosophy, as the name implies. For Toyota, this system coordinates production, logistics, and interactions with suppliers [4], [5]. Its original name, "just-in-time," refers to the strategy developed by Sakichi Toyoda, the founder of Toyota, together with his son and an engineer. The TPS system aims to get rid of mura, muri, and muda, or inconsistency, overburden, and waste. The seven different types of trash the system handles include:

1. Overproduction
2. Transportation
3. Processing
4. Stock available
5. Movement
6. Unreliable goods

According to the system, reducing inconsistency or burden leads to a number of actions that eliminate waste without concentrating directly on doing so. Toyota is now a leader in the manufacture and manufacturing of automobiles as a result of the adoption of this approach. The concept is modeled on how things operate at a grocery store. In a grocery store, a client selects his chosen items in the necessary amount and pays for them. The retailer makes sure that the shelves are replenished with enough fresh items to fill them. Similar to this, a work center in need of components would visit a "store shelf" for the specific item and "buy" the amount it requires; the work center that made the part would then "restock" the "shelf." Just enough will be produced to restore the amount that was removed [6], [7].

The system's main result is that just a little amount of inventory is needed. Waste is efficiently removed. The fundamental tenets of the Toyota Following are the principles on which TPS is built:

1. Create a long-term vision and keep it in mind while you overcome obstacles.
2. Continuously enhance business processes while pursuing innovation and progress.
3. Before making judgments, ascertain the truth about all the situations at hand.
4. Maximize individual performance and foster cooperation by showing respect for and understanding of the individuals with whom you engage at work.
5. Make sure you get involved personally to grasp the issues.

Operation Guidelines

For the purpose of assessing an employee's performance, management must set objectives. Standards are created to achieve these objectives. Measurement and evaluation of the output take

place using a production and operations standard. The baseline for control may be established for any output characteristic, including quality, quantity, cost, and others.

Standards at different organizational levels

The following are the standards for the organization's different levels:

1. Personal standards
2. Departmental requirements
3. Plant requirements
4. Personal standards

In operations management, the words standard and labor standard are often employed. A labor standard is the production anticipated from a typical employee under typical working circumstances over a certain length of time. The time permitted per unit of production or the output necessary per unit of time is a standard for employees at the lowest level of the company. For instance, a candy manufacturing facility may have a standard of, where coconut is dusted over soft chocolate.

DISCUSSION

Departmental Standards

A group of employees may work together to complete a task. Each team may have a unique expectation for the group's productivity. Managers may establish department standards for quality, quantity, pricing, and delivery dates by summing up all the individual and team standards.

Plant Requirements

The organization is required to create a certain amount of products and services. Both the quality of the labor force and the cost of the materials must be maintained. Accurate cost systems for labor, materials, and overheads are more important than ever. Additionally, the items' quality standards must be upheld [8], [9].

Operational Standard Applications

Labor time standards are used to assess worker performance as a foundation for operational choices; these standards also aid in planning and regulating operations. Among the many applications of the standards are:

Evaluating an Individual's Performance

Evaluating process design, work practices, and the performance of an organization's many divisions

Estimating Typical Expenses

In accounting, standard expenses are calculated as follows: Cost is determined by standard consumption and standard labor rate. The industrial engineering established labor time standard is the accepted use. The approved pay rate for the labor force that will be doing the task is called the standard labor rate. The standard cost will display a mistake if the standard use and labor standard were created improperly.

The mechanism that deals with the planning, advancement, improvement, operation, and estimate of the put-together structure of people, knowledge, tools, energy, material, and process is known as industrial engineering. Industrial engineering predicts and analyzes the data obtained from such structures utilizing engineering analysis theory and the tenets of the physical, mathematical, and social sciences. An industrial engineer primarily focuses on product production with the aim of minimizing resource waste of time, money, materials, energy, and other types. He does not develop machines, but plans. Operations management, production engineering, manufacturing engineering, and other terms are also used to describe industrial engineering [10].

Applications

The majority of industrial engineers work in the manufacturing sector. There is a chance that other industrial engineers will also work in service settings. Thus, industrial engineers have a wide range of employment opportunities.

1. Engineers in plants
2. Industrial engineers
3. Process engineers, quality engineers, and method improvement
4. Engineers in Health Systems
5. Industrial engineers' roles
6. The following business-related tasks are fundamental to the core duties of an industrial engineer:
7. Quality Assurance
8. Manufacturing Methods
9. Plant Organization/Material Management
10. Time studies and labor cost estimation for engineering
11. Statistics, safety simulation, and human factors

Depending on his area of expertise, an industrial engineer has a wide range of obligations. The fundamental responsibilities and areas of knowledge of an industrial engineer may be divided into three groups based on the main tasks listed above:

1. Works as intended by the product
2. Performs according to Process
3. Generic Activities
4. carries forth its intended purpose

These are the duties of an industrial engineer according to product:

1. The industrial engineer in this category must carry out the tasks listed below in relation to a particular product of his company:
2. Examining the whole product design to make decisions on the procedures needed to accomplish the entire process or set of activities. This necessitates familiarity with the on-site resources.
3. Figuring out the process followed at each activity to manufacture or assemble the product. This comprises the necessary construction of the relevant machinery, tooling, jigs and fixtures, and safety equipment. It may be necessary for the industrial engineer to gather data on the organization's quality policies and regulations, such as ISO 9000. This necessitates knowledge of quality standards and obligations related to health and safety.

4. Calculating the amount of time needed to carry out the chosen technique, taking into account the operator's abilities. This is used to evaluate the operation that was carried out, to balance the assembly and machining flow lines, and to determine the necessary production capacity. This method is called work study.
5. Defining the equipment required for components and the completed product, as well as the maintenance, handling, and delivery procedures. This should aid in minimizing any potential harm.

Generic Procedures

The general responsibilities of an industrial engineer are listed below.

1. Deciding on the maintenance strategy for the specific process.
2. analyzing the potential for process improvement by rearranging the present facilities or by investing in better equipment after surveying the range of goods involved in the process. This may need outsourcing that process, which in turn calls for expertise in design methodologies and investment analysis.
3. Revising each of the process's separate products to account for the cost that process contributes, or standardizing the materials, equipment, or procedures employed.
4. Performs as intended generally

The following are the duties an industrial engineer would typically perform:

1. Analyzing the flow of goods through the factory's facilities to gauge overall effectiveness and determining if the most crucial goods get preferential treatment from the most effective machinery
2. Teaching new hires the skills needed for machine operation or assembly procedures
3. Organizing initiatives to ensure the timely launch of new procedures and products
4. Industrial engineering methods

The methods that may be used in industrial engineering are as follows:

Quality Control and Assurance

A number of procedures known as "quality control" are carried out to ensure that no faulty goods or services are created and that the product design satisfies performance standards. All processes including designing, developing, manufacturing, installing, maintaining, and documenting are included in quality assurance. Quality is free, as the saying goes. Every time a product rolls off the assembly line, it is produced for free and always works. This requires the industrial engineer to put in a sincere effort and also lowers the cost of waste and rework. A portion of the final product is often randomly tested as statistical process control advances. Given the expense and time constraints, as well as the potential for product damage, testing every unit of the product is often avoided. Before any defective components are made, production procedures are reformed and crucial tolerance deviations are continuously tracked.

In a similar vein, testing product samples till failure is another method. The engineering and production processes are then improved using the resulting data. When relatively little adjustments are made to the product, such as switching to mold-resistant paint or include lock-washed placement in the training of new assembly staff, the product service may be dramatically improved. To reach "Six Sigma" standards of quality, a lot of firms use statistical process control. Every

component that generates value for consumers is under control in a six-sigma organization to guarantee that the overall failure rate in a sample of customers with a normal distribution is higher than this. Examples of products that are often managed include routine industrial procedures and administrative jobs like order input.

Producibility

The accuracy, product procedures, or elements of final goods are often superfluous. These may be eliminated with a simple redesign, which will reduce manufacturing costs and improve profitability, manufacturability, and dependability. For instance, some liquid-fuel motors are purposefully made to enable unsightly welding and to do away with grinding and polishing processes that do not improve the motor's performance. 'Near net shape shaping' is another method for increasing producibility. The term indicates that the item's initial manufacture has a striking resemblance to its ultimate form. Therefore, a number of poor precision drilling or machining operations may be eliminated throughout an ideal building process.

For Instance:

1) Precision transfer stamping can speed up the manufacturing of a large number of high-quality items from standard steel and aluminum rolls.
2) Metal items made of strong tin alloys or aluminum are produced via die casting.
3) Plastic injection molding is a potent process, particularly if inserts made of brass or steel are included to enhance the part's unique characteristics.

Digital signal processing software is starting to replace many analog electrical circuits for audio and sometimes radio frequency processing as a result of the rapid advancement of computer technology. Some printed circuit boards include cables that are meant to serve as delay lines, resistors, and inductors in order to cut down on the number of components. The elimination of the leads on "surface mounted" components was a no recent breakthrough. This eliminated the need to drill holes in a printed circuit board and clip the leads after soldering all at once.

Today, when a product is first being designed, producibility is routinely taken into account. 'Design for manufacturability' is the term used to describe this procedure. Instead of changing the items after their original design is finished, it is far more beneficial and cost-effective to take alterations into account during the first phases of design. The industrial engineer has a greater understanding of the market value and needs of the product, making the original design of the product very important to him.

Motion Efficiency

Industrial engineers research how employees carry out their occupations using this method. They examine, for instance, how the employees or operators pick up the electrical components to be put on the board and the sequence in which they are placed on the board in the case of a circuit board. The records of chemical testing provide as another example. The industrial engineer researches the order of tasks included in the chemical mixing records technique and then supplies the appropriate testing stages. The goal is to lower the number of people needed for a particular activity by cutting down on the time needed to complete it and shifting labor.

Robert Winslow The majority of the groundbreaking work on "Motion Economy" was done by Taylor and Frank and Lillian Gilbreths. Taylor's work attempted to investigate and comprehend

the reasons for the exhaustion of coal mine employees as well as solutions to increase production from the miners without adding extra man-hours. The Gilbreths created a mechanism to divide all movements into therbligs, or smaller organizations. To understand the usual function of a worker in the modern workplace, industrial engineers often conduct time studies or work sampling.

Production Automation

Automation refers to the use of machines in place of workers. The introduction of numerically controlled machine tools in the 1950s marked the beginning of automation and sophisticated technology. N/C machining made it possible for a computer software to replicate a machinist's abilities and save it on a computer media like punched paper tape. When creating intricate shapes, a tool was moved by a computer program. The size and cost of N/C computer hardware, the sophistication of computer-controlled software, and the complexity of machine tools have all decreased over time. This sparked the creation of flexible production methods and industrial robots. Manufacturing equipment has improved as a result of advancements in communications and computer software, and vice versa. The information base used to make choices about production planning and control has been greatly enhanced. Computer aided manufacturing was created by fusing knowledge bases with actual process control.

CONCLUSION

Industrial engineering, manufacturing engineering, and operations research are essential disciplines for optimizing industrial and manufacturing systems. By integrating these fields, organizations can achieve significant improvements in efficiency, productivity, and decision-making. Industrial engineering focuses on system-level optimization, considering factors such as human factors, material flow, and energy utilization. By applying engineering principles and behavioral sciences, industrial engineers streamline processes, eliminate waste, and improve overall system performance. Manufacturing engineering specializes in the design and improvement of manufacturing processes and systems. Manufacturing engineers employ methods and tools to optimize production, reduce costs, and ensure high-quality products. Their expertise lies in selecting appropriate machinery, materials, and methods to maximize efficiency.

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CHAPTER 3

VARIOUS TECHNOLOGIES OF AUTOMATION

Ms. Neha Saxena
Assistant Professor, Masters in Business Administration,
Presidency University, Bangalore, India.
Email Id: nehasinha@presidencyuniversity.in

ABSTRACT:

Automation technologies have revolutionized industries across the globe, enabling increased efficiency, productivity, and cost savings. This abstract provides an overview of various automation technologies and their applications in different sectors. It highlights the key advancements in robotics, artificial intelligence (AI), machine learning, and Internet of Things (IoT) that have transformed the way businesses operate and streamline their processes. Automation technologies encompass a wide range of tools and systems that aim to reduce human intervention in repetitive or complex tasks. Robotics plays a crucial role in automation, with the development of advanced robots capable of performing intricate tasks with precision and accuracy. AI and machine learning algorithms enable machines to learn from data, make decisions, and adapt to changing environments. The IoT connects devices and enables real-time data collection and analysis for efficient decision-making and process optimization.

KEYWORDS:

Augmented Reality (AR), Blockchain, Cloud Computing, Collaborative Robots (cobots), Cybersecurity, Data Analytics, Digital Twin.

INTRODUCTION

Modern CAD systems are centered on graphics terminals, while early CAD systems were essentially computer-controlled plotting devices. With the use of CAD, engineers and designers may work in two and three dimensions and make complicated designs simpler by using color. The top, side, and front views of a design, rotations around any axis, and cross s may all be obtained by designers while performing geometric changes at rapid rates [1], [2]. Additionally, CAD systems enable the automated compilation of Bills of Materials and process data for production planning and scheduling systems, as well as the storing and retrieval of designs for simple update.

Manufacturing with Computer Aid

In CAM, the manufacturing process is computer-controlled, including the selection of tool motions and cutting rates. Robotics is a contemporary example of CAM; N/C machines are an older one. CAM has benefits over traditional production techniques. It may be employed when several components are produced with variable or cyclical needs, when design modifications are made often, when the manufacturing process is complicated, when multiple machining operations are performed on a single item, or when expert operator skills and tight control are necessary. Each machine in a CAM system is capable of choosing and adjusting a variety of tools in accordance with preprogrammed directives. As a result, CAM offers a great level of flexibility in carrying out and managing production operations [3], [4].

For example, Caterpillar Corporation utilizes CAM to create parts for tractor engine drive assemblies. Between the work stations on each side of a track, where 30 to 40 machining operations are carried out, a transfer device transfers components. The pieces are clamped onto and off of the transfer mechanism by operators at the entrance and exit locations; the remainder of the operation is computer-driven [5], [6]. The phrase "CAD/CAM" is used when a CAD system and a CAM system share a single data base. The coordination between design and production is greatly facilitated by the integration of CAD and CAM; as a result, process planning lead times may be shortened, quality control is enhanced, and cost savings in tool design and other capital expenditures can be obtained.

System for Flexible Manufacturing

A natural progression from CAM is a flexible manufacturing system. An FMS is made up of two or more computer-controlled machines connected by robots and other handling equipment. Computers manage the machine's operations, pick and load the right tools, route the work piece to the right machine, and guide the entire sequence of activities. It is possible to manufacture many pieces of work at once, and numerous s may be produced in any sequence. An FMS was used by General Electric to improve their Pennsylvania locomotive facility. Engine-frame component machining took just 16 hours instead of 16 days, and total productivity climbed by 240%. Capacity also increased by 38%, and design flexibility increased as well.

The benefits of FMS

1. Work-in-process inventory is decreased.
2. Due to quicker setup, it offers improved capacity.
3. It offers improved scheduling and operating control and predictability.
4. It provides cost savings for material handling.
5. Greater sensitivity to market demands is provided.
6. All of these benefits boost the company's profitability and competitive position.

DISCUSSION

Computer-Integrated Manufacturing System

Computer-integrated manufacturing systems, or CIMS, are the result of the total integration of CAD, CAM, and FMS. through organize and control production processes from planning and design through manufacture and distribution, this system combines hardware, software, database management, and communications. A significantly more manageable and affordable batch manufacturing capability is made possible by CIMS. In this way, a business may match its production efforts to a considerably larger range of demand and gain a competitive edge by reacting quickly to market shifts and the introduction of new goods. Additionally, CIMS offers all the benefits mentioned for CAD, CAM, and FMS. A completely functional CIM system is expensive to build and install, and it takes a lot of management commitment and work [7], [8]. The benefits of thoroughly thought-out systems are starting to be realized by several businesses. Manufacturing will put a lot of effort into developing CIMSs in the twenty-first century.

Robotics

A robot is a programmed device used to handle objects or equipment while carrying out various duties. When George Devol submitted a design to the U.S. in 1954, industrial robots were first

used in manufacturing. For a straightforward pick-and-place robot, file a patent. The first business to manufacture industrial robots was Unimation, which was established in 1962. In 1986, there were around 16,000 industrial robots in operation in the United States and 60,000 in Japan. Because of managerial opposition to change, an abundant labor pool, human worries of being replaced by robots, and a lack of technical expertise about their applications, the employment of robots in the United States has been rather gradual [9], [10].

The robot can be "taught" a wide variety of motion and operation sequences via computer control, and it even has the ability to reason. A robot's ability to be reprogrammed and moved from one application to another is one of its main advantages. Automotive spot welding, spray painting, machining tasks including drilling and assembling, inspection, and material handling are just a few of the regular uses for industrial robots. Robots are particularly helpful when handling dangerous materials or large items, doing manual labor, improving the quality of low-volume manufacturing equipment, increasing its capacity, and giving it greater flexibility. They also don't ever complain!

Vision Apparatus

A camera and video analyzer, a microprocessor, and a display screen make up vision systems. Computer vision systems have the ability to read symbols, recognize things, measure measurements, and check for faults in components. As a result, they are starting to be used extensively in quality control. Vision systems are used in combination with robots in automotive applications to weld body seams of variable widths, tighten loose bolts, laser-mark identifying numbers on engines and gearboxes, and position vehicle hoods on racks with irregularly spaced slots. For instance, a robot system at a General Motors facility in Lansing, Michigan, utilizes a pneumatic nut runner attachment to tighten 12 lower suspension rail nuts to exact torque standards after locating their exact position with the use of vision technology. The method has improved bolt torque accuracy and reduced the amount of manual repair needed later on the manufacturing line.

Systematic Automated Identification

The information needed for efficient production management at the operational level of manufacturing requires a significant volume of data from the shop floor. The traditional approach to data collection is manual register entry by supervisors. Then, to process the data, it is typed into a computer system. This process is cumbersome and prone to mistakes. Automatic identification systems are one alternative to the traditional technique of data collection. These systems read source data and transform it into a format that computers can understand to operate machinery and provide reports. Automatic identification systems have error rates as low as 1 in 3 million and operate at speeds that are hundreds of times quicker than those of traditional techniques. In comparison to earlier methods of data collecting, automatic identification systems decrease paperwork, increase accuracy, and provide more timely and usable information.

Barcode scanners and speech recognition software are two examples of automated identification systems. Barcode readers distinguish between symbols based on the quantity of light reflected, estimating the width of the bars and gaps. The most common, quickest, and most precise technique of automated identification is undoubtedly bar code scanning. Voice recognition software is helpful in tasks that need a worker to use both hands and eyes, such as in receiving and inspection applications where simultaneous data processing, sorting, and recording is required.

Processing of Materials Automatically

In applications involving material handling, automation is crucial. Automated sorting and automated storage and retrieval are two important uses here. Post offices, air cargo terminals, mail order distribution centers, airline baggage handling, truck terminals, and publishing companies are just a few locations that often utilize automated sorting technology. Large material flow rates through warehouses are made possible by automated storage and retrieval systems, which are especially useful for large volume, unit load storage. Pallets are delivered by a conveyor to one of the storage aisles, where they are then transferred to a loader. When a storage spot is vacant, the storage/retrieval truck deposits the cargo there after moving both horizontally and vertically. S/R vehicles often pick up a necessary item to be sent on the way back. S/R vehicles may be completely automated or manually operated. For effective recovery, an up-to-date list of storage locations must be kept under computer control. Despite the fact that the higher productivity and decrease in direct labor are the main advantages, capital investment in AS/RS is considerable. Planning, organizing, directing, and controlling the operations of the production function are all included in the process of production management. In accordance with the organization's policies, it gradually combines and transforms various resources employed in the production subsystem into value-added products. The manufacturing process involves transforming a variety of inputs into outputs that are desired by consumers. Companies rely on a range of production methods to generate their output, which might include anything from consumer items to sophisticated electronics. There are three main systems used in manufacturing: o Continuous production system.

A system of Intermittent Production

Project Management

1. Continuous production is a method for generating things without interruption in manufacturing, production, or processing.
2. In an intermittent production system, there are frequent machine changes for producing a variety of goods throughout the short production cycle.
3. A project process is one in which the task is taken on to suit certain criteria and there is a high level of customisation.
4. A branch of engineering known as "industrial engineering" is focused on creating intricate processes or systems.
5. industrial engineering typically refers to a variety of industrial methods, including tool research and development, a chain of operations, equipment, and apparatus.
6. Operations research is the process of applying scientific principles to corporate management by providing a quantitative foundation for complex choices.
7. Production automation is a procedure used to optimize mechanical production in which management and oversight tasks that were previously handled by people are moved to automated equipment.

Planning for Capacity and Facilities

No matter what a firm wants to manufacture or what kind of workforce it hires, if it lacks the equipment or capacity to generate the required output, all of its plans will stay on paper. Modification techniques for capacity, requirements, goals, kinds, and activities are part of capacity planning. To maintain efficiency levels, machinery requires regular maintenance. You will

discover how to adjust capacity, requirements, goals, kinds, and activities in this unit's capacity planning lesson.

A methodology of accounting approach used to ascertain a company's current production capacity is called capacity requirement planning. Planning for capacity requirements starts by analyzing the production schedule that the firm has created. To determine if the objectives can be accomplished with the current production capacity, it then looks at the company's real productive capacity and compares it to both the planned and actual productive capabilities. Planning a facility's location, blueprint, plan, or plant layout are examples of tasks that fall under the category of facility planning.

Considerations for Capacity Planning

Production planning has a component called capacity planning. Capacity planning is the process of determining the capacity of a production unit that is needed for producing in order to fulfill the needs of the present and the future. Capacity is the ability to produce.

1. When an organization plans its capacity
2. It is launching a new production facility.
3. It is expanding the output of a current manufacturing facility.
4. whenever new goods are released.
5. as demand changes, when items are added or removed.
6. influencing factors for capacity planning
7. The variables influencing capacity planning include

i. **Type of product or service:** A business's capacity is determined by the goods it produces. The quantity of the items cannot be great if they are manufactured to order. However, if it's a common or typical item, the volume will be substantial.
ii. **Process type:** The capacity is also impacted by how automated or manual the process is. The capability of manual procedures is poor. To boost capacity, more people must be hired, but even then, there will be differences in the final goods, performance, etc. The production volume in automated procedures will be consistently high.
iii. **Technology Used:** The kind of technology used affects capacity as well. High-end technology will result in better items being produced quicker and with less waste. The availability of resources like space, electricity, etc. has an impact on capacity as well.
iv. **Worker skill level:** Higher productivity will result from better-trained, more motivated employees.
v. **Raw material accessibility:** Raw material accessibility will also have an impact on capacity.
vi. Capacity is also impacted by external variables like governmental regulations, tax exemptions, manufacturing caps, etc.

Techniques for Changing Capacity

There are two main categories of capacity modification strategies: short term and long term.

Rapid-Fire Techniques

In the near term, these techniques will alter the capacity or amount generated. However, they cannot be used as long-term solutions to change the organization's capabilities. The short-term techniques for changing capacity are:

1. **Inventories:** Businesses may continue to manufacture when there is no demand, accumulating stock. This may be used when demand is higher.
2. **Labor:** Businesses recruit workers when there is a high demand and let them go when there is a low demand. Additionally, they could provide overtime compensation for extra hours worked or permit flexible hours during times of low demand.
3. **Multi-skilling:** Some businesses help their staff learn a variety of talents. This is advantageous because it allows for the handling of variable demand via employment rotation.
4. **Process Redesign:** Occasionally, altering the tasks performed at each workstation might address varying demand.
5. **Subcontracting:** Many businesses outsource a portion of their work. For instance, several businesses outsource the production of their goods during periods of high demand. After the product is created, it is examined and given a brand name.
6. **Normal Maintenance:** To ensure that output is unaffected during times of high demand, several businesses postpone their normal maintenance to less busy times.

Long-Term Strategies

Capacity changes take a long time using these approaches. They come in two varieties:

1. Augmentation of capacity
2. Contraction of capacity

1. **Expanding Capacity:** This strategy demands a substantial financial investment in the form of more land, new equipment, additional labor, etc. They again come in two varieties: Expand once every five or more years. This strategy is used when the business has to borrow money from outside sources for growth. Although it necessitates a substantial investment, the firm is certain that in the years to come, its supply will always satisfy the demand. A benefit of this strategy is that the business does not have to take out large loans to make investments since sometimes the money is produced internally. When a business anticipates that demand will gradually rise each year, it follows this technique.

2. **Capacity Contraction:** When a business believes that one of its products has reached the end of its useful life, it may opt to diversify or stop producing the product. The technology and expertise are then sold or transferred to other businesses. It is also possible to devote less bandwidth to the company's other goods. For process design, a work center's capacity is a crucial factor. In most cases, capacity is expressed in terms of the number of hours of labor or machine availability. An efficiency factor for capacity that accounts for failure and maintenance downtime should be used. Let's use the following instances to demonstrate this.

Capacity Evaluation

The rate of production, such as units per day, week, or month, tons per month, gallons per hour, labor hours per day, etc., is used to represent a plant's capacity. Finding a standard unit of output,

however, may be challenging for businesses with increasingly diversified product lines. For these businesses, expressing capacity in terms of the monetary worth of production over a certain period of time is a more sui way to quantify it. Capacity may also be described in terms of input as an alternative. A law office's capacity may be expressed in terms of the number of attorneys hired annually. The amount of available labor hours and/or machine hours per week, month, or year may be used to represent the capacity of a custom work shop or an auto repair facility.

The outputs or inputs of the conversion process may thus be used to assess capacity. It is important to keep in mind that when capacity and restrictions are defined together, the measures of capacity become arbitrary because various individuals within the organization may have different meanings of the words. For instance, if capacity is determined by converting the sale of goods from rupees to dollars, currency changes will alter the findings.

The capacity of service organizations is determined by how homogenous or diversified the services are. For instance, the service provided by insurance firms is homogeneous and dependent on the volume of policies it services annually. Transport firms and banks both provide a variety of services. Due to the few resources they have at their disposal, their offer is constrained. For instance, in banks, it is determined by the number of man hours available each week, whereas in transportation businesses, it is determined by the tonnage per kilometer.

Planning for Capacity Requirements

There are many approaches for the organization to fulfill a product's capacity requirements:

1. **Overtime:** By extending workers' workdays, the company may operate at full capacity. By doing this, the company may avoid paying more to hire more workers to help it reach its goal.
2. **Casual Workers:** These workers are regarded as permanent but only work when there are fewer full-time workers. Benefits offered to full-time workers are not available to casual workers.
3. **Inventory:** Finished products inventory may be held at a time of low demand so that it can be utilized during a time of high demand. By doing this, the company avoids paying the additional costs associated with recruiting extra or temporary workers.
4. **Cross-Training:** By hiring workers with a variety of skills who are capable of handling any task assigned to them, the company may provide some flexibility to the working environment.

In order to match required and available capacities, service organizations must be able to predict future demand, translate prediction into physical capacity requirements, develop alternative capacity plans, analyze the economic effects of those plans, and assess the risk and other strategic ramifications of those plans.

CONCLUSION

In conclusion, Automation technologies have revolutionized industries and significantly improved production, efficiency, and decision-making. Organizations may streamline their operations, raise the quality of their products, and save costs by using robots, AI, machine learning, and the Internet of Things. To guarantee a seamless transition and the appropriate use of these technologies, it is necessary to take into account the ramifications of automation, including the effect on the workforce and ethical issues. Although there is no denying the advantages of automated

technology, there are worries about job loss and moral issues. The workforce has to be given the necessary reskilling and upskilling programs in order to prepare them for the changing nature of the workforce. To guarantee ethical and just use of automation technology, ethical issues such as data privacy and algorithmic biases must be addressed.

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CHAPTER 4

FACILITY PLANNING: LOCATION OF FACILITIES

Dr. Vijayarengam Gajapathy
Professor, Master in Business Administration (General Management),
Presidency University, Bangalore, India.
Email Id: vgajapathy@presidencyuniversity.in

ABSTRACT:

Facility planning, specifically the location of facilities, is a critical aspect of operations management that involves strategically selecting optimal locations for various organizational facilities. This abstract provides an overview of the significance of facility location and highlights the key factors and methodologies involved in the decision-making process. It emphasizes the importance of considering factors such as market accessibility, cost, infrastructure, competition, and regulatory requirements to ensure successful facility planning. The location of facilities has a significant impact on the overall performance and competitiveness of an organization. A well-planned facility location can enhance operational efficiency, reduce costs, improve customer service, and provide a competitive advantage. It involves analyzing various factors, such as proximity to suppliers and customers, transportation networks, labor availability, local regulations, and market dynamics.

KEYWORDS:

Cost Analysis, Demographics, Environmental Considerations, Expansion Potential, Infrastructure, Land Availability, Market Proximity.

INTRODUCTION

The Nano project experienced losses even before commercial manufacturing had started, as we've read in the Introduction. Additionally, the vehicle was scheduled to begin mass production in December 2008. You will learn about the numerous elements that influence location choices in this. The next paragraphs discuss these variables [1]–[3].

Closeness to Customers

The cost of transportation is minimal when the factory is close to the markets and/or consumers. This lowers the price of the goods. The majority of small auxiliary businesses are situated close to huge car plants. The institutional buyers of these auxiliary units' tiny parts, components, or subassemblies are the OEMs. A no illustration of how closeness to the client lowers the transportation costs of auto auxiliary units, which provide the parts, components, sub-assemblies, etc. for manufacturing the Maruti automobile, is the Maruti Joint Venture Complex in Gurgaon, which is close to the Maruti Suzuki car plant. The ability to quickly match surges in demand is another benefit of being close to marketplaces, giving businesses an edge over rivals that are situated farther away. To be able to service a large number of consumers, institutions like hospitals, schools, post offices, banks, and insurance firms are often located in high-population areas [4].

Access to Raw Materials

Why are Bihar, West Bengal, and Orissa home to SAIL's integrated steel plants? This is because there are many mines in these areas that provide the essential raw materials for creating steel, including iron ore, coal, dolomite, and limestone. The site of the facility should take proximity to the raw material supply into account, particularly if the raw materials are big and would need expensive shipment [5], [6]. The cost of the material is found to be equivalent to the shipping cost when it is absolutely essential to transport them, making the raw resources exceedingly expensive at the place of usage.

Reliable Transportation Infrastructure

For the movement of both products and people, adequate transportation infrastructure are required. These facilities are located in areas close to major cities because such areas have efficient rail, air, water, and road transportation systems.

Power Availability

Most industries have as a fundamental necessity an uninterrupted power supply. If a company is situated in an area with power issues, it must install its own DG sets or have captive power plants. In addition to creating new issues with operating the DG sets, captive power plants, etc., this raises the price of the product.

Nonessentials

The location site must include a few fundamental amenities, such as a sewage system, piped water supply, security, etc., that are overseen by the neighborhood government. Roads leading up to the factory are usually ideal. The workers' lives will be made simpler and they will be more ready to work at that factory if these necessities are offered. Additional benefits of placing a facility in a location include the availability of housing options, housing facilities, schools, universities, banks, post offices, hospitals, etc.

Governmental Guidelines

Industrial activity are drawn to an area by permissive tax laws, excise duty exemptions, and numerous other marketing strategies. We discover that several businesses have offices or warehouses in the "no sales tax regions" that have been designated as Pondicherry, Daman, and Diu. By establishing Industry Development Zones, Special Economic Zones, etc., several state governments support industrial development in their areas. Software development parks have been established by the governments of Karnataka, Andhra Pradesh, Tamil Nadu, and Uttar Pradesh.

These parks provide software firms discounted access to resources including high-speed Internet and servers [6], [7]. Governments at all levels, including the federal and many state levels, heavily subsidize agriculture. These benefits are available to various processing facilities for agricultural and horticultural goods that are situated in these states. The local government's policies must be taken into account before building a facility there.

Environmental and Societal Factors

Many state governments have strong environmental regulations that businesses operating there are required to abide with. States like Uttaranchal forbid such enterprises from discharging harmful effluents. The whole project may be derailed by community opposition to the development of a

plant in the area. An instance of local resistance delaying the building of a dam across the Narmada is the Sardar Sarovar Dam project. In the S.L. Bahuguna-founded Chipko Movement, the villagers adopted one tree each and forbade the authorities from felling them in order to clear the forest. Every new firm is closely inspected on the environmental front in the region since the Union Carbide factory accident in Bhopal a few decades back.

Distance from Subcontractors

Any new factory must include small supplementary units that produce tiny parts and assemblies. Joint ventures and ancillary units established their locations close to the OEM. The benefit to the ancillaries is that it will drive down the price of their component. If the OEMs locate their operations next to these ancillaries, both parties win. In order to take advantage of the suppliers present at the Maruti Joint Venture Complex in Gurgaon, Maruti Suzuki established a second site in Manesar, close to Gurgaon. The essential need for building a new facility is the availability of inexpensive land. Because of the accessibility of inexpensive property, several large corporations established their operations in underdeveloped regions.

Affordable Construction Fees

A specific location's low cost of labor may result in reduced construction costs for a facility. Another location could provide cheaper building supplies. For planting, these locations are preferable.

Access to Low-Cost, Skilled, and Effective Labor

Many businesses position their operations in areas with access to labor that is affordable, skilled, and productive. South India is where many businesses are setting up their branches since the people are more disciplined, effective, and competent.

DISCUSSION

Locating Foreign Operations Facilities

Regardless of where they are created, buyers now want the greatest goods at the lowest costs as a result of globalization. Therefore, in addition to all of the variables described above, the following additional factors should also be taken into account when deciding where to locate a facility in a foreign nation.

India Offers Low-Cost, Skilled, and Effective Labor

India is where many multinational corporations have branches since the labor costs are low and the workforce is more disciplined, effective, and competent.

Trade Obstacles

Certain imports are subject to limitations imposed by the Indian government's import and export policy. The imposition of import tariffs makes certain items more costly on the domestic market. In these circumstances, international corporations circumvent these trade obstacles by localizing the production of the products in that nation.

Local Clientele

It may be advantageous for a foreign corporation to launch local operations in a nation if it has a sizable client base there. By doing this, the business may better service its clients and benefit from their steadfast brand loyalty.

Incentives

Certain nations provide industrial infrastructure, insurance, tax exemptions/reductions, interest-free/subsidized loans, and other incentives to international businesses that are prepared to set up operating facilities in their territory in order to boost the inflow of foreign direct investment.

Share Prices and Goodwill

As investors increasingly value overseas activities, the firm's market value might increase. Operations in the Home Country of the rival Starting operations in the rival's home nation may sometimes push the competitor to focus more on the domestic market and discontinue or scale down its worldwide operations.

Flexible Location

Location-based variables may have an impact on productivity and profitability.

Raw materials are readily available as inputs, and proximity to the source will result in savings on transportation costs, boosting total profitability. The placement of the plant must be closer to the source of the raw material when the raw material is heavy or used in large quantities.

1. **Market proximity:** It decreased the price of transportation as well as the possibility that the completed goods, particularly perishable goods, would be harmed or destroyed while in transit. Additionally, a facility that is close to a market might get a big market share and provide speedy service to clients.
2. **Transportation Resources:** A sui mode of transportation, such as roadways, rail, water, or air is chosen, and the site of the plant is chosen in accordance with the size of the raw materials and completed items.
3. **Labor Availability:** S and a sufficient labor supply, in large part, determines where the factory is located.
4. **Fuel and power availability:** Coal, oil, and electricity are the primary energy sources. The availability of fuel and electricity will be one of the key determining factors in plant site for power-intensive sectors like steel manufacturing plants or continuous process industries like petrochemical and cement.
5. **Climate:** This variable varies depending on the kind of industry and the goods being produced. For textile mills, for example, a fundamental need is a climate with a sui level of humidity. The area around Bombay and Coimbatore has seen the construction of several textile factories for this reason.

Water Good quality water is a fundamental necessity for plant site in sectors including paper, chemicals, and textile dying. Water is essential for garbage disposal in general as well as for processing and ejecting effluent into rivers.

Governmental Measures: For the balanced development of the country's regions, the federal and state governments may label many discussions as being in the past and provide several concessions, such a tax holiday, dependable electricity, capital subsidies, easy access to loans, etc.

Land: The selection of the location will be influenced by the topography, area, the form of the site, cost, drain age, and other infrastructure, as well as the likelihood of earthquakes and floods.

Community Attitude: Because of the community's welcoming and upbeat attitude, industries including matches, crackers, hosiery, and leather have prospered.

Accommodations Security

different forms of infrastructure and support services, such as hospitals' marketing departments, educational institutions, banks, and clubs.

Process for Choosing a Location

Now let's examine the different phases of site planning. Listing the available locations is the first step in choosing the site of the facility. The benefits and drawbacks of each place are then listed. These are then contrasted with the list of requirements for that specific business, such as the important criteria or the elements that would benefit that industry specifically, etc. The places are then graded using several models that have been used to screen each location choice. The most sui site is picked based on the results of this experiment [8], [9]. Nowadays, a variety of techniques and models are employed to find the best placement. Here, we'll discover two crucial techniques.

Factor- And Location-Based Rating Methods

This is the quickest way to go to the ideal spot. Two categories of ratings are used in this method:

1. Every aspect that is important to the sector is rated between 1 and 5. No matter where they are, these criteria are important to the industry. The term for this is factor rating.
2. For each of the suggested sites, a relative score between 1 and 5 is assigned to each of the factors described in. The term for this is location rating.

Choosing a Location for Warehouses

An important aspect of the whole distribution plan is warehousing. Let's say a company has no warehouses of its own. The expenses of incoming transportation will be particularly expensive if the plant is situated distant from its raw material sources. Additionally, lengthier delivery durations raise the possibility of production-related material shortages. Transport expenses for moving goods from the plant to the retail shops are quite expensive if the manufacturing is distant from its retail outlets. Delivery delays raise the possibility of out-of-stock circumstances, which lowers the degree of customer service. In both cases, the existence of warehouses nearby, both the markets and the plant, may enable swift and effective operation of the production and distribution to retail outlets.

System of Distribution

Orders may be consolidated at a warehouse rather than being sent in tiny amounts from the facilities straight to the retailers. The economic benefit of such a method is that shipping in truckload or wagonload numbers is often less expensive than shipping in small quantities. Since

transportation equipment is utilized more effectively and unit costs are decreased, productivity is raised.

Storage Distribution

The quantity of distribution centers also affects the quality of customer service. Customer service may be measured using a wide range of productivity metrics. These are typical among them:

1. The typical time for processing orders
2. The proportion of deliveries made within x days after receiving an order.
3. The proportion of correctly completed orders the quantity of damaged goods

Therefore, the managers in charge of choosing locations must base their choices in large part on the company's general aims and objectives as well as its customer service rules.

Techniques and Process of Facility Design

The following 5 stages make up the facility design process:

1. Outlining the site goals and related restrictions
2. Determining the relevant criteria for decision-making, which may be quantitative or qualitative
3. Using the proper models, such as economic cost models, to relate the goals to the criteria.

Breakeven Evaluation

Analyzing qualitative factors with linear programming

4. Conducting research to gather pertinent data and using the models to assess the options.
5. Deciding on a place that meets the requirements. Techniques for locating a facility

The following elements are seen:

Industry Priority Success Technique

The fundamental premise is that if a site works well for numerous businesses in the same sector, it will likely do so for a new business as well. Since the selection of places is governed by the "Principle of Precedence," there is no need to perform a comprehensive location analysis.

Preferential Elements

Individual choice and personal factors influence the decision.

Dominant Factor (c)

This is based on the availability of raw materials, such as in the mining, cement, and oil exploration sectors. Moreover, the presence of quality infrastructure and qualified employees Now, factor ranking and factor weight rating are the strategies utilized to evaluate qualitative factors.

Break-Even Analysis by Location

The use of Cost-Volume-Profit analysis, commonly referred to as "Location Break-even Analysis," facilitates the economic evaluation of site choices. You will find it easier to comprehend the idea if you use the graphical method since it shows you which of the choices is best.

Break-Even Analysis by Location

1. The following phases make up the location break even analysis process.
2. Calculating the fixed and variable expenses related to each potential site.
3. Putting all of the site possibilities' total cost lines on the same graph.
4. Figuring out which site will cost the least overall for the production level anticipated.

Urban locations have extremely high initial fixed costs while having very low variable costs. Although the starting cost is modest in a remote area, the slope increases as a result of the high variable cost. The cost of the semi-urban site will fall somewhere in the middle. Consequently, if the volume is modest, we may choose rural areas to build the plant in. If the volume is more than a certain amount, we may locate the plant in an urban area [10]. To maximize the advantages, it is preferable to situate the plant in a semi-urban region if the yearly production falls between.

CONCLUSION

In conclusion, A crucial part of operations management is facility planning, especially the placement of facilities. The performance, cost effectiveness, and competitive advantage of a company may be dramatically impacted by making intelligent facility location selections. Organizations may strategically place their facilities to maximize operational productivity and fulfill customer expectations in a constantly shifting business environment by taking a variety of criteria into account and using the right approaches. Making judgments on where to locate facilities also requires knowing the competitive climate, observing rules, and taking the environment into account. In order to capitalize on competitive advantages, prevent saturation, and preserve good stakeholder relations, organizations must strategically locate their facilities.

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CHAPTER 5

A STUDY ON PRODUCTION PROCESS PLANNING

Mr. Venkatesh Ashokababu
Assistant Professor, Masters in Business Administration,
Presidency University, Bangalore, India.
Email Id: ashokababu@presidencyuniversity.in

ABSTRACT:

Production process planning is a crucial aspect of manufacturing that involves determining the most efficient and effective way to transform raw materials into finished products. This abstract provides an overview of production process planning, highlighting its significance in optimizing production operations. It emphasizes the key considerations, methodologies, and techniques involved in developing an effective production process plan, such as process design, layout optimization, workflow analysis, and resource allocation. Production process planning encompasses various activities aimed at streamlining manufacturing operations. It involves analyzing product specifications, identifying production requirements, and designing a sequence of operations that maximizes efficiency, minimizes waste, and ensures high-quality output. Effective production process planning improves productivity, reduces costs, shortens lead times, and enhances overall operational performance.

KEYWORDS:

Assembly Line, Automation, Bottleneck Analysis, Capacity Analysis, Cell Manufacturing, Cycle Time.

INTRODUCTION

The lifeblood of every production process is, at its root, production process planning. It aims to reduce production costs and costs, effectively organize the use of resources, and maximize office productivity [1], [2]. Planning the production process entails a variety of production fundamentals, ranging from the ability to grasp specific distribution schedules for the client to the daily actions of personnel. Any form of production process has the potential to use all of its potential with an efficient production process planning at its foundation.

Planning and execution are the links between process design and production. The kind of output to be utilized and the appropriate process length are determined by process selection decisions. Food's flavor is influenced by its preparation, or technique, as well as by its components, or raw materials. So what exactly is a process? A process is a set of actions that changes an input into an output, gives it value, and turns it into a product that can be sold on the market. It combines technology resources owned by the company with market environment input to create a productive activity that is cost-effective [3].

Every process has a unique set of goals, which necessitates a workflow that crosses departmental lines and calls for materials and data from several organizations, including marketing, R&D, operations, etc. To produce the organization's goods, it also needs cooperation from a lot of other agencies. Although many companies have achieved a high degree of automation, a significant

portion of the production process is still managed by humans. It is obvious that staff must also be "managed." People from various ethnic and educational backgrounds work there. In addition to the highest standards of quality, service, and responsiveness, this, along with the organization's goals, call for a clear description of the roles for the workforce. The employment should also be secure, fulfilling, and inspiring for the employee [4], [5]. This is accomplished via the idea of work study. This defines work study, outlines its goals, and discusses the methods used to evaluate output.

Design, Selection, And Classification of Process

We are aware that a process entails the utilization of an organization's resources to provide the client something of value. Without a process, neither a service nor a product can be produced, and vice versa that is, a process cannot exist without at least one service or product. An organization's procedures determine how successful it is. Every procedure is created with the 'consumer' in mind. Some of the company's clients are third parties, or the purchasers or final consumers of its completed goods and services. Other clients are "internal," meaning they are staff members or other systems that depend on the results of the current process [6], [7]. There are internal and external suppliers for every process. External suppliers are organizations or people from outside the company who offer the essential inputs the company need. Internal suppliers are those who work for the company and who also provide the inputs that a specific process requires. We have discovered so far that a process determines how input will be transformed into output. We have also discovered that it involves several functional areas and that the effectiveness of the company's core and supporting procedures is crucial to its success.

1. You will discover the numerous categories into which processes fall in this.
2. Process classification based on the number of steps

The number of stages that a process takes may be used to classify it in its most basic form.

One-Step Process

An input must pass through only one step in a single stage process. This approach is too straightforward and does not apply in an industrial setting.

Multiple Stages

A multi-stage process consists of numerous phases or stages, and the raw material moves through them in a certain order to produce the finished product.

Multiple-Step Procedure

Let's first grasp certain terminology that are often used in this field of research.

Buffering: The storing activity in between two succeeding phases is what this alludes to. Buffering is the process of temporarily storing output from one step before transferring it to the next as input. Decoupling or delinking two subsequent stages enables them to function independently for a period of time if one fails while still utilising the buffer stock [8], [9].

Blocking: This stage's production must come to an end when the buffer is so high that there is no longer room for storage. Management may opt to halt stage production for a variety of reasons in addition to a shortage of available space. Starvation occurs when a stage's activities must cease since there is no longer any of the product from the previous stage to utilize.

Bottleneck: Think about a two-stage process:

Let Stage 1's output be 8 units per hour, and Stage 2's input be 6 units per hour. What will occur? The buffer supply will increase by 2 units per hour. This will continue until a point when it is decided to halt Stage 1 manufacturing.

Parallel Activity

One kind of simultaneous activity is this. Producing many items simultaneously is another instance of simultaneous action.

'Made to Stock' or 'Made to Order' Basis

Whether a procedure is "Made to Stock" or "Made to Order" is another method to categorize it.

1. In a "Made to Order" procedure, manufacturing doesn't begin until the customer places an order. As soon as the order is received, the firm starts producing the items. Examples of this include how an airplane is made, what happens at a fast-food restaurant, etc.
2. In contrast, in a "Made to Stock" situation, the producer creates the products and releases them into the market in expectation of sales. This approach is mostly used in the consumer durable goods sector.

Today, the majority of tasks are "hybrid," meaning that some are "made to order" and others are "made to stock." As a work in progress, a generic product is created and supplied at some time. 'Made to Stock' describes this. These generic pieces are finalized in a final procedure as and when an order is received, at which point it becomes a "Made to Order" product. This is a common occurrence at restaurants. The ingredients are ready and waiting to use. The ingredients are properly combined, cooked, and provided to the client as soon as the customer order is received. In a similar vein, vehicles are made by an automotive manufacturer. The fittings, such as wheel covers, mirrors, seat coverings, etc., are installed and provided to the client in accordance with their specifications.

DISCUSSION

Process Design and Selection

Planning for manufacturing starts with a product development concept and moves forward from there. Drawing a product is a typical method of defining it. The constituent parts of a product and how they relate to one another are shown in an assembly drawing. The relevant technical parameters are provided via detailed engineering drawings to buying agents who are allowed to purchase the item from a vendor as well as to internal production staff. These drawings may be used to check final items to see whether they adhere to requirements.

Then a components list is created. This offers thorough technical details that are absent from assembly drawings. item numbers, names, whether the item is made or purchased, and an engineering drawing number are all included in a parts list. The components list also includes information on the parts' size, material requirements, and other production details.

The necessary materials and equipment are determined by component lists and drawing together. When purchasing a product that must be constructed by the customer, assembly instructions and assembly drawings are often sent together.

Process Design and Process Selection Parameters

The choice of process is influenced by a range of economic, quantitative, and qualitative considerations. The manufacturing method that satisfies the following requirements is the most sui one:

1. The product satisfies all requirements while maintaining a high level of quality.
2. The product can be produced at a reasonable cost.
3. The method is reliable to produce for the anticipated amount of time, or it is sustainable.
4. All legal and governmental requirements are upheld.

Priorities of competitors

Every process has to include a few essential components in order to satisfy both its present and potential future internal and external consumers. Competitive Priorities are the name given to these important criteria. Any company's four main competitive objectives are: 1. Cost

1. Cost
2. Time
3. Quality
4. Flexibility

Let's examine each of them in further depth. Cost reduction will boost demand and sales, whilst cost rise would boost profits but reduce demand. Therefore, the company must choose a procedure whose cost is at its lowest possible level. This is achieved through a variety of techniques, including automation, workforce optimization, process redesign, scrap or rework, etc. Businesses should strive for "Low Cost Operations," or the production of products and services at the lowest cost while satisfying both internal and external consumers [10].

A production process's effectiveness is measured by its capacity to generate the needed quality and quantity at the lowest possible cost. Large-scale production of the items is the way to go to accomplish this. But once again, the choice of how much will be produced depends on the market's demand for that product and the marketing division's projection of sales. The management must choose the method that will produce the needed volume of the requisite quality at the lowest possible cost, depending on the volume.

Time

Money is time: A corporation loses more clients, goodwill, demurrages, and other things the longer it takes to fulfill its deliveries. Processes should be set up so that the product may be sold as soon as feasible. This is only achievable if managers meticulously outline the procedures and amount of time required to supply a product or service, and then examine each step to see if they can shorten it without sacrificing quality. In the following circumstances, process time is crucial –

Deliveries: Delivery lead time is the amount of time it takes to complete an order after it is placed. Companies work to shorten lead times as much as they can by streamlining operations, eliminating buffers, and so forth. In the present market environment, customer demand and expectations for a product change fast. If the product doesn't get on the market right away, customers can switch to another brand or buy a competitor's product that is already on the market. The product's demand will thereafter decline. To ensure that the product can reach the market within the allotted time limit, it is crucial to choose the appropriate manufacturing procedure. Deliveries that are made on

time have become a crucial factor in determining how well-run services like trains and airplanes are. The pizza giant Dominos is always working to streamline its procedures so that orders may be delivered in only 30 minutes. Producing a product, a company may benefit greatly in this quickly evolving business climate by introducing a product to the market before its rivals. It should take as little time as feasible to produce a product from a concept. Processes should be chosen in a way that makes product development quick, precise, and effective.

Quality

Conformity to client criteria is what quality is. The capacity of a company to continuously create the same set of items while adhering to the established requirements is referred to as consistent quality. The process used should be such that it consistently produces products and services with the same standards under the same circumstances. The next modules will have extra reading on quality.

The quantity and range of the items that will be produced are important. Even though the variable costs will increase due to the increased variety, management must attempt to cut fixed costs if the variety is greater but the volumes are lower than the variety. Fixed costs may increase but variable costs won't be particularly high if a product has to be produced in a large volume but with little diversity.

Flexibility

The capacity of a company to rapidly and effectively respond to the changing requirements of its consumers is referred to as flexibility. Flexibility may refer to shifting quantities, shifting types, or customizing.

Volume flexibility: The most frequent kind of volume flexibility is accelerating or reducing the pace of production to account for changes in demand. Other competitive criteria like delivery or development pace are often supported by it. Processes must be chosen in a way that allows for rapid volume variation handling.

Flexibility in variety: Variety flexibility is the capacity to manage a range of goods effectively. Processes with variety flexibility should be able to effectively change their attention between a range of goods and services while maintaining a focus on the demands of the consumers.

Customization: Customization differs differently from variety flexibility in that it pertains to the particular requirements of a certain consumer. These goods are often "tailor made," which means they cannot be purchased elsewhere on the market; they are more costly, and their lead periods are typically longer. A process that prioritizes customisation should be able to collaborate directly with its clients and meet their specific requirements.

We might assert that there is no such thing as the ideal industrial method. By weighing all of the available possibilities and selecting the most appropriate one under the current conditions, we should arrive at the optimal manufacturing method. The best option would be to choose a procedure that satisfies the strictest requirements and budgetary restrictions while taking competition into account.

Adoption of the Right Technology in Line with Market Needs

An entrepreneur must first choose a sui technology before he can produce a product or provide a service. To transfer the company's objectives to the level of the processes that carry out the task, it is helpful to take competitive considerations into account. As we have previously seen, in a commercial transaction, competing priorities mirror the objectives of the external client. This is crucial since a company has to both gain and keep customers in the future. The firm's core and supporting processes must be given competitive priorities that not only take into account the demands of internal customers but also of external consumers if it is to remain viable in the market.

Let's examine airline services to have a better grasp of how competitive considerations are applied. Passengers traveling in first class and those in economy class will be two market groups we will look at. Both of these market groups share the same essential services, including ticketing, seat selection, luggage management, and transportation to the customer's final destination. These two groups' ancillary services, however, vary greatly.

A first-class passenger benefits from a larger baggage allowance, exclusive airport lounges, preferred treatment during check-in, boarding, and deplaning, more comfor seats, better meals, and frequent attention all for a higher cost, of course. These things all contribute to the sense of uniqueness. On the other side, travelers in economy class are pleased with the uniformed services, cordial flight attendants, and affordable rates.

However, both market sectors depend on the airline to adhere to its times and deliver consistently on time. As a result, we may conclude that superior quality and on-time delivery are the competitive objectives for the first-class market sector, whereas low cost operations, reliable quality, and on-time delivery are the competitive goals for the economy class market segment. The airline is familiar with both its needs and its market sectors. Correlating its capabilities with the needs of the client is now the task. For both segments, the airline cannot use the same parameters. A traveler in economy class is not likely to appreciate receiving a three-course dinner since he is trying to save money. A first-class passenger will also not like standing in line to board the flight.

Any other manufacturing company would face the same issue. No matter whether it is a manufacturing or a service provider, every firm must first analyze its fundamental operations. Customer interaction, new service/product development, order fulfillment, and supplier relationship are often regarded as the fundamental activities. Every basic core process contains a number of layered processes inside it; for instance, customer relationships might entail high quality/consistent quality, promptness, variety, etc. Customization, quick development, and other factors would be part of the creation of new services or products.

The supplier relationship would include quality, delivery, variety, and low cost, and order fulfillment would comprise low-cost operations, on-time deliveries, etc. Each core process is given a competitive priority in order to provide the service standards necessary to guarantee total client satisfaction. We might conclude that there is no such thing as the ideal production process, and that the optimal production process should be determined by weighing all available possibilities and selecting the one that is most appropriate in the current situation. The best option would be to choose a procedure that satisfies the strictest requirements and economic limits while also taking competition into account.

Flowchart Design

Process Design comes next. It describes the choices of inputs, resources, processes, and procedures required to convert inputs into outputs. The mix of human and mechanical abilities, as well as which procedures should be carried out by whom, are important factors in process design decisions. Process decisions must be in line with the firm's competitive priorities and its capacity to get the resources required to achieve those objectives. In addition to these factors, judgments on process design also take into account options for quality, capacity, layout, and inventory.

The goal of process design is to discover the optimal method to arrange a company's physical resources. For instance, work centers are one approach to describe a factory. A work center may be a single machine, a collection of machines, a team of employees doing related or identical jobs, or a collection of diverse machines working together to carry out a series of operations on one or more items.

The ability of a company to respond to changes in product mix or volume, the level of control necessary for planning and scheduling, and a number of labor force-related management challenges are all impacted by product design. Process technology is the subsequent phase. It speaks about the process of selecting the tools and procedures required to produce the good. It is a crucial part of the business' production strategy.

Process Choice

Process technology and design influence process choice. The latter is the method through which processes must be chosen in order to match the firm's competitive criteria, namely Cost, Time, Quality, and Flexibility, as well as its financial and other restrictions. There are two categories under which the problems with process selection may be categorized:

1. Technical
2. Managerial

When choosing a process, management and technical factors must be taken into account. Operating issues may often be caused by a limited technical viewpoint. It was agreed that the 32-bit CPU and high-resolution graphics capacity of the Apple Macintosh personal computer were better to those of the then-current goods at the time. However, the fact that it was incompatible with the software used by the current programs was its main flaw. As a result, it was unsuccessful. On the other side, having a technically sound product to sell but poor management skills may also lead to an organization's demise. Process selection choices must take into account both technical and management views for a company to succeed.

CONCLUSION

In conclusion, Planning the production process is a key component of industrial operations. Organizations may increase efficiency, save costs, and produce better products by carefully planning and optimizing the manufacturing process. Production process planning transforms into a strategic strategy that helps firms to optimize their competitive advantage in the changing business environment with the integration of sui approaches and technologies. The creation of plans for efficient production processes is supported by the use of approaches and techniques including value stream mapping, lean manufacturing, simulation modeling, and CAD software.

These technologies help businesses find opportunities for development, get rid of waste, and increase operational effectiveness overall.

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CHAPTER 6

A BRIEF DISCUSSION ON PRODUCT PROCESS MATRIX

Dr. Bipasha Maity
Professor, Master in Business Administration (General Management),
Presidency University, Bangalore, India.
Email Id: bipasha@presidencyuniversity.in

ABSTRACT:

The product-process matrix helps organizations understand the relationship between product variety and volume and guides them in selecting the most sui production process. The matrix consists of four quadrants that represent different production strategies. The project quadrant is characterized by unique, one-of-a-kind products that require custom production methods. The job shop quadrant is sui for low-volume, customized products with a wide variety of specifications. The batch quadrant is ideal for moderate-volume products that can be produced in batches with standardized processes. The continuous flow quadrant is for high-volume, standardized products that can be efficiently produced using continuous flow processes.

KEYWORDS:

Continuous Flow, Customization, Efficient Process, High Variety, Job Shop, Low Variety, Mass Production.

INTRODUCTION

A manufacturing process may be chosen using a variety of techniques. The manufacturing and marketing strategies should be integrated into the production process that is chosen. Every approach has advantages and disadvantages, but the technology or method chosen should be able to achieve the following goals:

1. Lower costs
2. Increase output
3. Offer dependable quality

The proper technology or manufacturing process must be chosen based on a product-process matrix. Three parameters make up the matrix.

1. Volume
2. Product design.

Matrix of Process Product-Processing

The aforementioned matrix demonstrates that there are several process options for a product. The complete manufacturing process or a single particular sub-step within the manufacturing process may both be implemented using this matrix [1], [2]. We can see from the aforementioned matrix that the number of variations that must be produced and the amount of each variety affect the production technique that is selected. A large product diversity need highly trained labor, adap machinery, enough planning, and management. So, the job or batch procedure is correct. Low

skilled labor, high automation, and relatively less planning and regulating are required when the volume of the product is low and the diversity is large. It is necessary to choose between a mass or process production system.

A business may choose a different spot on the matrix as well. Imagine, for instance, that Honda Motor Company announces a restructuring of its assembly lines to enable the production of any model. Because of this overhaul, it won't be able to produce at the large quantities it formerly could because of more flexible lines. This horizontal transition from Line Process to Batch Process relates to the condition of reduced volume with greater diversity of items [3], [4].

Process Choice Using PLC Phases

Economic analysis is used to compare various product processing methods since fixed and variable costs tend to vary from one manufacturing process to the next. It's crucial to take the price of each option into account while choosing between different manufacturing processes in companies. Capital costs are recurring monthly fixed expenses. When the original cost of machinery, structures, and other fixed assets is large, the fixed costs are higher. The variable costs, or the expenses that change depending on the number of items produced each month, fluctuate for various production and processing systems. Each sort of process design often has a varied capital need [5], [6]. Due to its pricey robotics, computer controls, and fixed-position material-handling equipment, automated assembly lines have the greatest fixed costs. On the other side, the automated assembly line has the lowest variable costs. Cellular manufacturing has intermediate fixed and variable costs, whereas workshops have extremely high fixed costs and very low variable costs. The best process design is therefore dependent on the amount of product being produced, assuming capital availability is not a consideration and yearly production costs are the main criteria.

DISCUSSION

Process Simulation Tools

A number of operations management applications are now considering the use of simulation modeling as a viable solution. Many technologically oriented businesses employ simulation to evaluate new concepts and alternatives before to real deployment. The process may be modeled, examined, and quantified, and the behavior can be observed. Simulation may be used to research and contrast alternative designs or troubleshoot current operations, regardless of the system in question being a manufacturing line, distribution network, or communications system. It is possible to clearly depict how a new or proposed operation may act under the same or different inputs, as well as how an existing operation might function under a variety of inputs, using simulation models. The key draws of simulation have been its simplicity in building and using models as well as its capacity to provide data and animations regarding outcomes [7], [8]. Operations and production managers would find it much simpler to master the latest simulation software since it is windows-based, doesn't involve programming, and can be used for a number of everyday operational concerns such feasibility studies, finding bottlenecks, and process optimization. There are almost no limitations to the applications of simulation. Workflow generation, layout, design, allocation, resource management, and process modification all employ simulation models.

For instance, simulation may be quite beneficial in the customer service industry. client service refers to an organization's capacity to continuously and consistently provide the client with what

they need in a timely manner. Telephonic services, service facilities, hospitals, or retail establishments are all examples of customer service procedures. Because both the flow items and the resources in customer service operations are people, simulating these processes presents a special problem. Compared to things, people behave in a far more complicated and unpredic way. Companies can use simulation modeling to see how to improve customer satisfaction levels while minimizing disruption to existing customer service procedures. Other benefits include the ability to see how to improve process flow, customer communication, problem handling, problem resolution, and feedback.

Productivity

Finding more efficient methods to create products and services is essential for productivity development. Simulation models are made to resemble the process being researched. The analyst may thus access all variables and their values at any point in the simulation. The discovery and elimination of bottlenecks in a process or operation, the reduction of inventory and work-in-process, and the reduction of cycle time are some typical methods for increasing productivity.

Definition and Significance of the Work Study

Studying human labor is known as work study. Work study is described as "A management service based on those techniques, particularly method study and work measurement, which are used in the examination of human work in all its contexts and which lead to the systematic investigation of all the resources and factors which affect the efficiency and economy of the situation being reviewed, in order to effect improvement" in British Standard 3138: 1969. This means that it is a process for comprehending and determining the a.

Method study and work measurement are two interdependent methodologies that fall under the umbrella term "work study." Method research is described as "the systematic recording and critical examination of the factors and resources involved in existing and proposed ways of doing work, as a means of developing and applying easier and more effective methods and reducing costs" in the same British standard. Therefore, method research is concerned with how the task is carried out. By the same British standard, "work measurement" is described as "the use of techniques designed to determine the time for a qualified worker to perform a specified job at a defined level of performance."

Work study is different from other productivity enhancement strategies in that the latter need for significant capital investments in plant or equipment. However, work study guarantees productivity by using available resources. The human aspect is highlighted in work study, and operation is valued more highly than technical procedure.

the following are the main goals of work study:

1. Efficient plant and equipment usage
2. Efficient use of human power
3. Assessment of human effort

The methods of work study are likely to run into opposition at all levels if they are not effectively implemented. Even trade unions agree that work study offers employees the following advantages:

1. Removes tedium, irritability, and harmful workplace conditions
2. Gives employees the chance to boost their income
3. Increases the organization's micro health and the macro health of the country as a whole.

In its 35th session, held in Geneva in 1952, the International Labour Organization stressed the value of work study as well as dialogue and cooperation between employers and employees.

You will discover the two techniques method research and work measurement in the sentences that follow.

Evolution of Standard/ Normal Time and Method

As you already know, method research is a technique for looking at, documenting, and analyzing the way that work is currently being done in order to suggest ways to make a system more effective. The currently used approaches could result in extra expenses. The technique research identifies the causes of these expenditures. The rigorous evaluation of suggested techniques also avoids wasteful expenditures in the new positions.

The Technique Research Process

A method study is a scientific and organized way for a company to decide which manufacturing process is best for a certain product. Now, why would a company investigate a process? It should investigate a procedure to spot delays, cut down on labor and material transportation distances, streamline operations, and minimize processing time needs. The firm wants to get rid of any stages or steps in the process that don't provide any value by doing a method study.

Choosing A Job

Management is responsible for choosing the work for which the technique study is to be conducted. Economical, technological, or personal factors may all be taken into account while choosing a job.

Economic factors:

1. These are activities that could impede other manufacturing activities, such as:
2. unnecessary long-distance transfer of laborers and supplies
3. operations requiring a lot of people
4. operations that underuse both humans and machines
5. s or divisions where there are too many ideas for improvement
6. a technical point to consider
7. operations that generate a lot of trash or damaged products
8. activities that need repeated work
9. complaints about not being able to meet performance criteria
10. operations that need regular oversight
11. jobs that are of worse quality
12. Operations involving differences in the performance of materials and tools
13. jobs requiring more man hours for inspecting and double-checking work
14. Considering people:
15. Employees gripe about being overworked

16. low employee morale
17. frequent mishaps and health risks
18. Employee pay irregularities brought on by overtime

Facts Are Recorded

The effectiveness of the method research is dependent upon accurate and exact recording of information relating to a technique. Facts like the amount of time it takes to complete a technique and the amount of labor necessary are often recorded graphically in method studies. Five symbols are used in the graphical method to record the information about a technique. As follows:

This sign indicates that a task is in progress. An operation is, in general, any action that improves the value of a product. It involves metamorphosis.

1. Transportation This sign indicates that a person, service, or item is being transported from one place to another.
2. Inspection This sign denotes quality control, accuracy, conformity to requirements, etc.
3. Delay This sign indicates that the research subject must wait before beginning the subsequent phase.
4. Storage is indicated by this symbol. T or P, which stand for temporary storage or permanent storage, may sometimes be inscribed within the triangle.
5. The following are some benefits of the graphical technique over the descriptive method:
6. It requires less time and effort.
7. It makes it easier to separate a method's useful parts from its worthless parts.
8. Visual clarity makes critical scrutiny simpler and more efficient.

Critical Analysis

Analyzing the information pertaining to a procedure is known as critical examination. The facts pertaining to a technique should be reviewed critically as they are, not as they ought to be. A methodical analysis of each stage is necessary, and rash judgments should be avoided [9], [10]. The critical examination is carried out using a thorough and organized questioning approach. All operations, including those connected to processing, inspection, material handling, and other aspects of a technique, are documented in a chart throughout the questioning process. Each action in a technique is thoroughly reviewed after being recorded throughout. When asking questions, it's important to take into account five key aspects of an activity. These elements consist of:

Determine if the chosen action is required to finish a procedure or not. Analyzes whether or not the chosen action takes place at the designated time and in the designated sequence. When is the activity finished? is one of the queries posed. Is it necessary to do the task at that precise moment, or may it be done at any other time or in any order? Could it be paired with a different process step? Examines if the appropriate individual is carrying out the chosen activity. Who does the activity, are the questions posed?

Why should the individual carry out such action? Can someone else complete it? Should the employee have advanced capabilities, or would lesser skills suffice? To determine if the chosen operation is carried out using the appropriate materials, tools, jigs & fixtures, measurement equipment, and gauges. Questions such, "How is the activity done?" are posed. Why is it the method used? Is there a more effective approach to do the task?

Creation and Selection

Development entails analyzing every concept created through critical evaluation and putting it into practice. It's possible that not all of the concepts developed through critical analysis will work. Therefore, the organization must first separate the conceptual concepts from the practical ones. The development and selection process then refines and develops the chosen concepts. Three tasks make up the development process: appraisal, research, and selection.

The ideas developed during the critical evaluation are all examined to determine their genuine worth and if they should be pursued or abandoned. They are initially classed as follows in order to separate the useful concepts from the worthless ones:

Good Suggestions

Investigation Phase: To ascertain if a new concept can be adopted for actual execution, the ideas developed during the assessment phase are examined. Making prototypes, doing trial runs, having work measurement studies redone from industrial engineering, creating new cost estimates, and arranging discussions with workers from different departments, including design and quality control, are all part of the research phase. Every concept is looked at to see whether it is technically and economically feasible.

Picking the finest choice from the given alternatives is what the selection step entails. The amount of investment needed, the production rate represented in terms of cycle time per unit of product, the manufacturing cost per unit of output, and the physical effort needed to carry out the process are only a few of the variables taken into account. There are points allocated to each factor. Every factor's points are put up, and the option with the most points is chosen.

Installation

The recommended technique installation is referred to as the proposed method. The management is given a proposal for a technique modification together with a list of the sequential actions that must be completed to put the revised plan into practice. The implementation plan is created after the official permission has been received. It is possible to do a demonstration of the suggested approach to allay concerns and dispel misunderstandings. It is also possible to train the staff members who will apply the new techniques.

Maintenance

Following the implementation of a method, it's crucial to keep an eye on how it's working. To notify the relevant authorities about the outcomes of the monitoring process, a feedback mechanism is required. To establish whether or not the implementation work is finished, the savings realized by using the new approach should be audited. The audit will also identify new elements that might boost profitability, and after that, the cycle will repeat again.

1. At this point, the practitioner's strategy is examined as well.
2. Did he use the sensible strategy? Does it need any alterations?
3. Was the application procedure favorable and effective? If not, what adjustments to the strategy are needed to ensure the successful execution of next projects?
4. Which techniques were effective for gathering data? Can these techniques be applied in future initiatives of a similar nature?

Performance Evaluation: Performance evaluation is the last maintenance stage phase. This aids in calculating the productivity benefits of the suggested strategy, which are periodically assessed.

Human consideration is crucial in job selection, just as human replies are crucial in technique studies. The approach study's suggested improvements should be accepted by the workforce. A change that the employees do not completely embrace is not seen as a positive change. Humans tend to be resistant to change. By talking to the employees in private, opposition from the workforce may be averted. The following factors should be taken into account to prevent worker resistance:

Changes that are proposed should be communicated to the staff ahead of time since they are more likely to be accepted if they are not.

1. The company must correctly implement approved processes.
2. It is best to implement changes gradually so that the company can quickly adapt to them. This aids in the employees' progressive acclimatization to the modified methods.
3. Apply the techniques in a manner that the organization's complete human resource is convinced of their value.

Measurement of Work

Work measurement, as described in the units that came before it, is a method for determining the amount of time needed for a skilled worker to do any task at a certain level of performance. In other words, it is a method for creating time criteria for the completion of tasks. The operation must first be taught to do a certain task in order to produce useable standards. Measurements of the work should be provided by these technique analyses and studies.

Study of Time

When the task is repetitious, this type of work measurement is often utilized. It is a sampling procedure in which a small number of observations are made from a sample. The time needed for the worker to complete the succeeding cycles is calculated using the conclusions gained from the analysis of the sample. The work or job chosen for time studies is first divided into activities. Then, using tools like stopwatches, each task is timed independently. The division of the task into its activities is done in accordance with certain rules. These include

1. Each task should be quick to do while yet lasting long enough to be timed using a stopwatch.
2. It is important to differentiate between the operator's operations and those of the equipment. Both need to be timed independently.
3. It is also important to track operator and equipment delays individually.

It is necessary to take many readings for each activity. The average of these data will reveal how long an activity typically takes. To calculate the average time for a work, the average times for each action are summed.

CONCLUSION

In conclusion, Organizations may use the product-process matrix as a useful tool to match their production methods with the features of their goods. Organizations may efficiently satisfy consumer demands, manage their operations, and increase efficiency by choosing the best

manufacturing procedures depending on volume and diversity. The product-process matrix improves overall operational performance in the challenging business climate and supports strategic decision-making. Organizations may enhance their manufacturing processes and boost operational efficiency by using the product-process matrix. They can increase overall productivity, decrease waste, cut down on manufacturing time, and better manage resources. Organizations may fulfill client requests, achieve cost efficiency, and keep a competitive advantage in the market by being aware of the product's qualities and choosing the best manufacturing method.

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CHAPTER 7

A BRIEF INTRODUCTION ON JOB DESIGN AND RATING

Dr. Vankadari Gupta
Associate Professor, Master in Business Administration (General Management),
Presidency University, Bangalore, India.
Email Id: chithambargupta@presidencyuniversity.in

ABSTRACT:

Job design and rating are essential components of human resource management that involve structuring and evaluating job roles within an organization. This abstract provides an overview of job design and rating, highlighting their significance in optimizing employee performance, satisfaction, and organizational productivity. It explores various approaches to job design, such as job enrichment, job rotation, and job specialization, as well as the process of job rating and evaluation. Job design focuses on structuring job roles to enhance employee motivation, satisfaction, and productivity. It involves considering various factors, including job tasks, responsibilities, autonomy, skill requirements, and work environment. Job design approaches such as job enrichment aim to provide employees with more challenging and meaningful tasks, job rotation encourages employees to gain exposure to different roles, and job specialization aims to optimize efficiency by dividing tasks into specialized roles.

KEYWORDS:

Autonomy, Compensation, Cross-training, Ergonomics, Flexibility, Job design.

INTRODUCTION

The integration of multiple separate activities or tasks into a job that can be given to either a single worker or a group of employees is known as job design. How a certain task is divided across the company is decided upon in the job design process. The activities to be completed, who will do them, and the anticipated outcomes are all specified in the job design. A manager may design a job using many various techniques, such as work specialization and job expansion, just as an architect can construct a building in many different ways using many different materials [1].

The Goals in Job Design

A manager strives to achieve the goals of job specification. The three primary goals are as follows:

1. Technology readiness
2. Financial viability
3. Behaviorally plausible
4. Technology readiness

A person is given a number of jobs or responsibilities that he must carry out. It is necessary for the individual given a job to be able to do it. The demands of a work cannot exceed a person's abilities, physical stamina, and cerebral capacity. Technical viability is ensured by giving personnel the appropriate knowledge and training.

Financial Viability

The expense of doing the work shouldn't be excessive. It implies that a decent work environment and worker remuneration are required. Businesses operate in a competitive context, thus they are compelled to deal with pressure to maintain fair resource pricing.

Behaviorally Plausible

A person must be motivated when given several duties and responsibilities in order to do them effectively. By giving the employees intrinsic benefits, the job should help them adopt a good mindset.

The Methods for Job Design

A manager may create the positions using any of the following techniques to job design:

1. Specialization of work
2. Expanded employment
3. Job augmentation
4. Specialization of work

Maintaining a balance between a job's speciality and the task provided is a crucial factor to keep in mind while determining a worker's duties and responsibilities. When a task gets specialized, it is broken down into smaller component s and given to experts. The experts grow more knowledgeable and effective in their fields when given a variety of jobs or works [2], [3]. A worker may also be quickly taught to become specialized, enabling him to do the job at hand more effectively.

The benefits of career specialization

1. Among the many benefits of work specialization are:
2. Employees may improve their skills and work rhythm, which leads to high production.
3. It is simpler to manage and train employees.
4. Since fewer fundamental abilities are needed, it aids in cost reduction.
5. The drawbacks of specialization in the workplace
6. These are the many degrees of job specialization:
7. Employee autonomy and control over what is done are nonexistent.
8. It causes employees to be absent more often.
9. The employees provide poor-quality work.

DISCUSSION

Job Enlargement

Job enlargement is the process of adding new duties to an existing position that provide the employee more flexibility and responsibility. The repetition of the same kind of labor might eventually make employees bored and unsatisfied. They can be compelled to leave the company as a result. As a consequence, the company has significant levels of attrition and absenteeism. Managers might lessen the negative consequences of specialized professions if they could expand the positions by adding duties and more incentives [4], [5].

There are essentially two methods to expand a job. If a worker completes a wider range of duties without taking on more responsibility, the job design is said to have expanded horizontally. For instance, if a worker's duty is to tighten a single nut on a single bolt, the task may be changed to require tightening four separate nuts on four different bolts. The task would then be horizontally expanded. Second, other activities that need a comparable degree of expertise but are distinct in nature may be introduced. For instance, the worker may connect two pieces of metal and one piece of plastic, tighten a nut and bolt to secure the assembly, and replace tightening one nut on one bolt. Thus, the work would grow vertically.

Four opportunities are presented to workers by job expansion, including:

1. **Variety:** the chance to put a range of skills to work
2. **Autonomy:** The capacity to exert control over the manner and timing of task completion
3. **Identity of the task:** The chance to be in charge of a comprehensive work program
4. **Feedback:** A chance to learn about recent work performance data.

Job Augmentation

Job enrichment is another name for vertical job expansion. By integrating workers in the administrative tasks of planning, organizing, and regulating, it entails rethinking employment to increase job satisfaction. The main difference between this vertical shift and the vertical job expansion is that management duties are added to this change rather than identical responsibilities. For instance, a company that manufactures cornflakes is attempting to market their version under the brand name of a bigger supermarket chain. The supermarket chain's buyers came to the company to inspect the cornflakes' quality [6], [7]. The company's conference room was where the boxes of the rival brands and the company's cornflakes were on display, and two manufacturing employees were chosen and brought there immediately. Which cornflakes were superior was put to the employees' vote. They provided an explanation by sampling the different brands on and thoroughly outlining their roles in quality control. There were two advantages as a consequence. First, the employees' expertise pleased the customers, and second, the staff enthusiastically returned to their area of employment. Their attitude toward their employment also changed as a consequence. Effective job enrichment requires the following two conditions:

1. The workforce must be informed about objectives and performance by management.
2. The company shouldn't exert too much control over employee behavior.

Plant Design

Studying a plant layout entails doing an engineering examination of several physical configurations for an industrial facility. A well-established plant reduces production costs by reducing the amount of materials handled, the amount of staff and equipment needed, and the amount of process inventories. Failures in sales forecasting and production planning might be detrimental to a well-planned plant structure. When considering all of the divisions, the plant planning process is just getting started. When they are further discussed, new problems arise, and the initial arrangement could be changed as a result of a feedback process. An appropriate plant layout results in a nice, roomy system. This should simplify scheduling and control of the production process, reduce manufacturing delays, and boost use of the plant's current capacity.

Plant Layout: Function and Importance

Planning a layout is required

A schematic or design is prepared to determine where each department, entry and exit gates, bathrooms, storage spaces, etc. will be situated once the facility site has been chosen and land has been purchased. We shall see how this kind of planning is carried out in the sentences that follow.

Layout Planning

Layout may be described as "The physical location of a facility's various departments/units within the facility's premises."

1. The locations of the departments must take certain factors into account. Common factors include:
2. Logical order of processing operations
3. Material handling and material flow direction
4. Considering the aesthetics
5. Governing bodies' rules
6. Particular needs

The layout design of facilities often depends heavily on the entry and exit gates.

Intentions behind a Plant Layout

Plant layout is a technique for organizing resources and facilities to maintain a consistent flow of production at the lowest possible cost. A well-designed facility always makes its employees feel comfor and satisfied, which inevitably boosts output. Unsafe industrial layouts result in unneeded issues and accidents.

The following goals are built into a good plant layout:

1. Material and finished products processing that is economical
2. Quick and effective manufacturing
3. More effective use of the area that is already available 4. Flexibility in changing plant designs and the potential for future growth
4. Productivity increases when work conditions improve
5. Systematic and unidirectional flow of manufacturing operations
6. A shorter waiting period
7. A decrease in the cost of production

Benefits of a Well-Designed Plant

Better productivity and cheaper costs are the consequences of an efficient plant structure. The following are some benefits of a good plant layout:

1. **Production Flow**: A smooth production function flow is the primary focus of plant architecture. A well-designed factory will have a work flow that is unimpeded, constant, quick, and even.
2. **An Orderly Workspace:** A well-organized workplace with sufficient amenities for both the equipment and the workers are the hallmarks of a successful plant layout. Congestion is eliminated when equipment and tools are arranged properly. There is no

misunderstanding since the necessary items are kept where they belong. Additionally, workers are assigned to their appropriate departments so that there is no misunderstanding at work [8], [9].

3. **Enhanced Working Conditions:** Thanks to enhanced and hygienic working circumstances, a good plant layout increases worker satisfaction. Improvements in lighting and other aesthetics have been linked to higher motivation levels. Another crucial element is the safety of the workforce. A well-designed plant makes sure that the machines are positioned correctly and that there is enough room between them so that there is neither traffic jam nor risk of worker injury. This guarantees the workers' safety and fosters a productive work atmosphere.
4. **Reduction of material handling expenses:** An efficient plant structure reduces material handling expenses. Transferring materials between workstations is not difficult because to the placement of the gear and equipment. Ample material handling systems will guarantee that labor costs, weariness, etc. are kept to a minimum and that workers may be employed in profi tasks.
5. **Minimization of material damage and spoilage:** In a well-designed factory, materials are handled correctly, leading to high-quality manufacturing. The materials are just little damaged and spoiled. Reducing waste also helps a business enhance its profitability [10].
6. **Flexibility in adapting to changing production conditions:** A good plan leaves enough room for extensions in the future, the installation of more workstations, etc. The benefit is that if market circumstances change in the future, the company may quickly install new machines, etc. without having to take down the old ones and with little disruption to the regular workday.

Different Layouts

Product Design

The term "product layout" or "line layout" refers to the arrangement of the tools and materials in the sequence in which they will be utilized to create the product. This kind of arrangement is used in sectors like the automotive industry where materials and pieces are assembled. In these sectors, the process begins with the introduction of raw materials and concludes with the creation of the finished product.

Benefits of product layout include:

1. Low work-in-process since output from one step immediately feeds into input from the following stage;
2. Because the process is mechanized, there is minimal material handling.
3. Because there is a division of labor, labor expenses are lower.
4. Quality control is simpler to put into practice.
5. It is feasible to schedule supplies with ease and accuracy.
6. Less product diversity makes production control easier.
7. It is difficult to update the product since doing so requires changing the layout, which is costly and time-consuming. This design is thus not particularly flexible.
8. The whole line will halt if even one machine malfunctions.
9. It is difficult or impossible to expand the work space or place a machine between two others.

Process layout for example, milling machines can be grouped together to form one department, and grinding machines can be grouped together to form another department. The layout in which all the equipment/machineries performing comparable tasks are grouped together is known as a process layout or functional layout. Parts are transported around departments in a variety of sequences based on their processing needs. The whole workspace may be divided into smaller pieces to improve productivity and workplace efficiency. The way the process is set up may produce a wider range of goods. For instance, in a garment factory, the sewing machines are stored in one area, the irons and other pressing equipment in another, the knitting machines in still another, and so on.

One benefit of process layout is its adaptability to changing volumes and variety.

1. Aids workers in expanding their skill sets as a result of job rotation.
2. Production need not halt if a problem with one machine does not impact other machines.
3. The current setup does not have to be removed in the event of future expansion or a rise in variety.
4. One drawback of the process arrangement is that as work volume rises, more space is needed.
5. Material handling cannot be mechanized or it would be exceedingly expensive to do so.
6. There is a lot of work in process since there must be a line for each action.
7. Work scheduling is challenging since various tasks need distinct workflows.
8. Extensive monitoring is needed. Planning and controlling production is more challenging.

Project Structure

The term "project layout" or "fixed position layout" refers to a layout in which the manufacturing process is carried out in a fixed location; examples of this sort of layout are the shipbuilding and aviation industries. Workers, scientists, equipment, and raw materials are transported to the site of the rocket's construction while the rocket is being built. Projects include building roads, bridges, the Metro rail system, etc.

A Project Layout Benefits of a Project Layout

1. It reduces equipment and machinery mobility.
2. Continuity in production enables several tasks to be completed at once.
3. One drawback of the project structure is the need for skilled and adap staff. Finding the right set of talents might be challenging. Sui employees would need to get competitive pay.
4. The tools and supplies will need to be transported when the job is finished. This is not only a costly proposition, but it also results in poor equipment utilization since the equipment remains idle while it is being moved.

Group Setup

This layout, which is increasingly typical in the business today, combines the styles we have already covered. Both process planning and line layout are benefits of group technology, sometimes known as cellular production. Families are formed for pieces in group technology. The layout comprises of collections of several machines that are required to produce families of related components.

Technology for groups has advantages

1. New items have excellent design.
2. Because machine scheduling is less complicated and fewer equipment and materials are needed, production control is easier than in process planning or project layout.
3. Lower material handling expenses compared to Process layout.
4. There are setup time savings, which boost productivity.

Storage and Warehouse Layout Planning

A manufacturing unit has a somewhat different design and layout than a warehouse. A warehouse is used to store semi-finished and completed items, tools, equipment, and raw materials and supplies. In many cases, warehouses are situated far from real manufacturing or client sites.

High productivity should be the main goal of a warehouse's daily material management tasks. The following productivity goals are listed:

1. Maximum space use.
2. Effective stock identification and location.
3. Equipment, labor, and time conservation.
4. Quick and simple transportation to and from storage.

Meeting these objectives relies on a number of variables, including the physical facility's size and form, the kind of material-handling equipment available, the placement and arrangement of stock, and the nature and intended use of the products. Small businesses provide storage space within their own factories or in a nearby warehouse. Larger organizations make the best use of cubic feet, especially multi-plant businesses and pure distribution networks like supermarket chains or retail department stores. To make use of the potential for vertical stacking, pallets or por platforms are employed. Forklift trucks and other handling equipment can transport them without difficulty. For tiny or seldom used products, other storage techniques are utilized. Small objects are stored in racks, shelves, and bins and are often chosen by hand.

Several variables affect how goods are organized in storage. Which are: Foodstuffs, medical supplies, iron, and paints are examples of items that need to be kept against moisture, insects, and severe temperatures. Special storage places with security features are required for valuable valuables. Hazardous materials need specific handling and placement. Storage and handling are impacted by an item's size, weight, and form. For instance, delicate things should not be piled extremely high, and it is better to keep large or bulky items close to the shipping area to minimize handling requirements. Storage and handling are also impacted by produce turnover. those that move swiftly must be handled immediately, while those that move slowly may be kept in areas that need lengthier handling.

CONCLUSION

In conclusion, Essential elements of human resource management that influence employee happiness, engagement, and organizational productivity include job design and rating. Organizations may improve employee engagement, performance, and general success by strategically organizing work roles and using fair and objective job rating systems. A pleasant work culture, employee retention, and organizational success are all influenced by a well-designed and appropriately graded work environment. Organizations may maximize employee performance, job

satisfaction, and organizational productivity by putting excellent job design and rating processes into place. Higher employee engagement and motivation are a result of well-designed employment that provide autonomy, challenge, and development chances. Systems for assessing jobs fairly and openly enhance equality and a productive workplace.

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CHAPTER 8

PROCEDURE OF LAYOUT PLANNING

Dr. Jayakrishna Herur
Associate Professor, Master in Business Administration (General Management),
Presidency University, Bangalore, India.
Email Id: jayakrishna.udupa@presidencyuniversity.in

ABSTRACT:

Layout planning is a crucial process in operations management that involves determining the optimal arrangement of facilities, equipment, and resources within a physical space. This abstract provides an overview of the procedure of layout planning, highlighting its significance in maximizing efficiency, productivity, and utilization of resources. It explores the key steps involved in layout planning, including data collection, analysis, layout design, evaluation, and implementation. The procedure of layout planning begins with data collection, where information about the facility, processes, workflow, and spatial constraints is gathered. This data serves as the foundation for further analysis and decision-making. The next step involves analyzing the collected data to identify bottlenecks, opportunities for improvement, and specific requirements for the layout. This analysis may include factors such as workflow patterns, equipment placement, material handling, safety considerations, and future expansion plans.

KEYWORDS:

Equipment Placement, Facility Layout, Group Technology, Information Flow, Input-Output Analysis, Layout Design.

INTRODUCTION

Since the machines must be set up in accordance with the process flow required to transform raw materials into finished commodities, this is simpler to design. The challenge in line planning is not how to arrange the work areas sequentially or comparatively, but rather how to organize the job parts such that there is minimum downtime between the work centers [1]–[3].

Line or Product Layout

The challenge in process layout is to organize the various work areas such that the expenses associated with material flow are maintained to a minimum. It is anticipated that this optimizing process would also result in a decrease in the other layout-related expenditures.

Process Flow

Distance between the two work areas + Load handled between the two departments in a unit of time = Material handling expenses between the two work areas. The collecting of information on the number of loads per unit time transferred between various combinations of the work areas serves as the basis for such a mathematical optimization technique for the Process architecture. The 'load summary' of this data is shown as a matrix.

Closeness Score

The relative level of attractiveness of having one department located next to another is rated by proximity. These are highly useful tools, particularly for designing the layout of service facilities. For instance, it is preferable to locate the library and computer center as near to the lecture halls as feasible at an MBA school. As much space as feasible should separate the hostels for males and girls. The ladies' hostel is often situated close to the instructors' homes [4]–[6].

Products Management

You have studied the 6 Ms of a company, or the man, machine, materials, money, methods, and management, which make up the input. Production planning is the process of scheduling inputs over a predetermined time frame to produce the desired result. Depending on the planning period, it may be:

Strategic or long-term planning: focuses on a time frame that is longer than a year.

1. Long-term or intermediate perspective: typically lasts between six and 18 months. Aggregate planning is what is done on a yearly basis.
2. Routine planning may be done on a daily, weekly, or monthly basis.
3. Production Planning Elements
4. Production planning is a multifaceted task involving many different components. 4.5 demonstrates the components of production planning.
5. Production Planning Elements
6. Control and Planning in Mass Production

Planning for mass manufacturing involves more than just the production system itself. To guarantee the product reaches the customer, the significant and continuous flow of items from the manufacturing shop floor need a well-planned distribution and marketing structure. To build up mass manufacturing, it is necessary to take into account market research, advertising, transportation, licensing, and tariffs. Thus, a thorough system plan that converts a raw material into a final product is included in mass production planning. Planning for mass manufacturing not only reduces costs but also significantly raises product quality and consistency. Control and inspection procedures are made possible by large-scale, standardized design, materials, and manufacturing processes. This ensures production and controls quality.

The following is a list of the fundamental tenets of mass production:

Work is divided up into specific tasks: dividing up the broad manufacturing operations into specialized activities that include relatively simple motion patterns that are repeated a lot. This makes it easier to design and analyze human motion patterns that are quick to acquire and carry out with the least amount of extra movement or mental adjustment.

Standardization and simplification: the standardization and simplification of component parts to enable the creation of readily adap components that don't need modification.

The creation and use of specialized tools: The creation and use of machines, materials, and processes minimizes the amount of labor required, increases the return on investment per unit, decreases the production of non-standard items, and lowers the cost of raw materials.

Systematic planning and engineering of the production process allows for the balancing of human labor and the use of machinery, the effective division of labor and specialization of skills, and the integration of the production system to increase productivity and reduce costs. An essential component of the design process is mass production planning, which demonstrates how a product design may be manufactured on a mass production line using both skilled and unskilled labor. The first mass manufacturing line was established in the US around the turn of the century. Every vehicle that left the Ford Motor Company's manufacturing line was put together by a "line" of employees. There were multiple persons in the queue, and each one of them only performed one task. Every step of the manufacturing process must be kept simple while designing the production line. Planning for'mass manufacturing' is what is referred to as this [7], [8].

When a product is created, whether in a workshop at a school or on a factory production line, it is equally crucial to keep quality control in mind. The quality of the work should be assessed and any errors should be corrected at every level of production. Taste and fragrance, for instance, are two markers of quality for a brand of coffee. A "critical control point" is a term used to describe each quality control point. By comparing a product to certain quality control indications, the quality of the product is assured. In a mass production setting, the effectiveness of the control and monitoring systems heavily influences how successfully a process is carried out. The degree of procedural automation affects how well control and monitoring systems operate.

DISCUSSION

Aggregate Planning

The company's overall or aggregate plan for manufacturing a product over a certain timeframe, such as the next 12 months, is known as the aggregate plan. Any production planning process begins with the creation of an aggregate plan, which is based on the orders anticipated during the planning period. To estimate the estimated aggregate demand for the product family, many forecasting methods are applied. Because the entire production volume cannot be modified quickly without incurring major unanticipated expenditures, the plan must be set in stone for a fair amount of time.

Every manufacturing volume uses a certain combination of labor, supplies, and machinery. When the output volume changes, a new optimum mix needs to be created by altering how the different resources are used. Long-term change may be achievable, but it is challenging to make effective short-term changes. A master production schedule is the aggregate plan broken down into its component parts. This implies that it provides information on the number of different models and sub-models of a product that are anticipated to be produced during a certain time period. The master production schedule displays the volume and delivery dates for each distinct product over a certain period of time.

A master production schedule provides information on the quantity and timing of each product's scheduled manufacturing. The MPS informs the sales staff how many units of a product they may commit to clients in a certain amount of time. Each company has a different time frame for MPS. It depends on the kinds of items utilized, how much is produced, and how quickly the materials are delivered. The planning horizon refers to the time period that the MPS covers. The MPS is often modified weekly within a 12-month aggregate plan to account for shifting sales demand and scheduling-related internal issues.

The planning process in manufacturing may be described as follows:

1. An aggregate plan is entered by the production control group using current or anticipated orders. The MPS is generated from this.
2. For each order, the MPS creates the necessary quantities and delivery dates for certain goods.
3. The availability of production and warehousing facilities, machinery, labor, and major suppliers' allocation of adequate capacity to provide materials when required are then confirmed by rough-cut capacity planning.

The Material Requirements Plan is then created

1. This plan outlines when the items must be manufactured, the raw materials that must be used, how many are needed, and when to place an order with the suppliers.
2. Daily or weekly task order scheduling to individual equipment, manufacturing lines, or work centers is the last planning action.

Capacity Management

A component of production planning is capacity planning. Capacity planning is the process of determining the capacity of a production unit that is needed for producing in order to fulfill the needs of the present and the future. Capacity is the ability to produce.

1. When an organization is launching a new production unit, for example.
2. It's expanding the output of an existing industrial facility.
3. Whenever new things are unveiled.
4. When there is a shift in demand product additions or deletions.

Influencing Factors for Capacity Planning

The following are some variables that impact capacity planning:

1. **Product or service type:** A company's capacity is determined by the goods it produces. The quantity of the items cannot be great if they are manufactured to order. However, if it's a common or typical item, the volume will be substantial.
2. **Process type:** The capacity is also impacted by the process's automation or manuality. The capability of manual procedures is poor. To boost capacity, more people must be hired, but even then, there will be differences in the final goods, performance, etc. The production volume in automated procedures will be consistently high.
3. The kind of technology used additionally, the technology used affects capacity. High-end technology will result in better items being produced quicker and with less waste. The availability of resources like space, electricity, etc. has an impact on capacity as well.
4. **Worker skill level:** If employees are more motivated and well-trained, production will rise.
5. **Raw material accessibility:** Raw material accessibility will also have an impact on capacity.
6. **External factors:** Capacity is also impacted by governmental regulations, tax thresholds, manufacturing caps, etc.

Ways to Change Capacity

There are two main categories of capacity modification strategies: short term and long term.

Rapid-Fire Techniques

In the near term, these techniques will alter the capacity or amount generated. However, they cannot be used as long-term solutions to change the organization's capabilities. The following are quick ways to change capacity:

1. **Inventories:** Businesses may keep producing when there is no demand, building up stock. This may be used when demand is higher.
2. **Labor:** Businesses recruit workers when there is a high demand and let them go when there is a low demand. Additionally, they could provide overtime compensation for extra hours worked or permit flexible hours during times of low demand.
3. **Multiple talents:** Some businesses help their staff acquire a variety of abilities. This is advantageous because it allows for the handling of variable demand via employment rotation.
4. **Process redesign:** Occasionally, altering the tasks performed at each workstation might address varying demand.
5. **Subcontracting:** Many businesses outsource a portion of their work. For instance, several businesses outsource the production of their goods during periods of high demand. After the product is created, it is examined and given a brand name.
6. **Maintenance:** To avoid affecting production during times of high demand, several businesses postpone regular maintenance to times of lower demand.

Long-term strategies

Capacity changes take a long time using these approaches. They come in two varieties:

1. Increased capacity
2. A reduction in capacity

Capacity Expansion: This strategy demands a substantial financial investment in the form of more land, new equipment, additional labor, etc. Once again, they may be of two types:

Once every five or more years, increase: This approach is used when a corporation has to borrow money from outside sources to expand. Despite the significant investment needed, the business is certain that in the next years, supply will always exceed demand.

Enlarge a Little Yearly: The benefit is that the business may invest without taking on significant debt since internal revenue is often created. When a business anticipates that demand will gradually rise each year, it follows this technique.

Capacity Contraction: When a business believes that one of its products has reached the end of its useful life, it may opt to diversify or stop producing the product. The technology and expertise are then sold or transferred to other businesses. It is also possible to devote less bandwidth to the company's other goods. For process design, a work center's capacity is a crucial factor. In most cases, capacity is expressed in terms of the number of hours of labor or machine availability. An efficiency factor for capacity that accounts for failure and maintenance downtime should be used. Let's use the following instances to demonstrate this.

Planning and Controlling Production's Primary Duties

The following are the primary tasks involved in production planning and control:

1. **Order preparation:** Once a sales department order is received, PPC's job officially starts. This order is subsequently transformed into a "work order" or "shop order" and sent to the different departments involved for action planning.
2. **Material planning:** Following receipt of the order, the PPC determines the raw materials needed for manufacturing, taking into consideration the capability of different production shops, the bill of materials, stock on hand, and lead time for procurement.
3. **Routing:** Routing refers to choosing the order of steps in the production of a good or service. Most scheduling and dispatching operations are built on this approach, which is predetermined. "Routing is the selection of the path or route over which each piece is to travel in being transformed from raw material into finished product," claim Kimball and Kimball.

Following are some actions involved in routing:

1. Choosing the production volume
2. choosing the workers, equipment, and materials that will be utilized to produce it
3. Choosing the kind, quantity, and order of manufacturing processes
4. Choosing the location for the production to take place

A route sheet is created when routing or process planning is done. This is accomplished in the following way:

1. The product is examined in light of each of its component pieces. The choice is then made on which parts will be created and which will be bought.
2. It is decided what standards, what grade, what quality, and how much material would be utilized in manufacturing.
3. On the route sheet, the number of production processes and their timing are established.
4. Each operation's processing time as well as the kind and quantity of machinery required for production are calculated.
5. The production lot size is chosen taking into account the orders from the consumers as well as the expected rejects and spoilage throughout the manufacturing process.
5. Estimating: This entails figuring out how long each process will take to complete. It also results in the fixing of performance requirements for both humans and robots.
6. Scheduling: The quantity of work to be completed, the time each component of the job will begin, and the sequence in which the work will be completed are all determined by scheduling, according to Spriegal and Lanburgh.

Consequently, scheduling involves the following tasks: assessing the plant's or department's production quality and pace.

1. Time allotted for each operation
2. The job will be given to the plant according to a schedule and in the correct order. It establishes the precise times when the process will begin and end.

When the following details are provided, the scheduling function starts:

1. The customer's order specifies the delivery date.
2. Duration of the assembly and subassembly processes
3. The manufacture of component components will take time.

How long it takes to make purchases

The amount of time needed to move the items from one station to another, examine them, etc.

Order of Priority

When the plan is created, the necessary preparations are often made for unanticipated situations such power outages, strikes and lockouts, worker absences, urgent orders of really important items, etc.

Loading: This entails distributing tasks to machines based on their capacities and the importance of the tasks that need to be completed in order to make the best use of the equipment. The following actions are part of it:

Getting Machine Loads Ready

Setting the exact dates for the different processes and the order in which they will be conducted coordinating delivery dates with the sales department and updating them on the progress of the schedules

Dispatching: In the context of routing and scheduling, dispatching refers to the creation and distribution of work orders and production instructions to the relevant departments. The work order that the different departments have received gives them the go-ahead to begin the project in accordance with the timeline. "Dispatching involves the meeting of schedules by proper utilization of machines, work environments, materials, and workers, as designed by the routing," claim Spriegal and Lansburgh. Thus, individuals whose responsibility it is to ensure that orders are sent to the shop, materials are at the job site, tools are provided, job cards are issued, and, in general, that all necessary steps are taken to ensure that the schedules will be properly carried out, are included in the dispatching unit of the planning department [9], [10].

Progressing: This entails monitoring the manufacturing process, gathering information from multiple manufacturing facilities, tracking work progress, and comparing progress to the plan.

Speeding up and following up: To follow up is to check to verify whether the task is being done in accordance with the plan, the given orders, and the given directions. It makes sure that the correct people or jobs get the supplies, tools, and equipment at the right time and location. Follow-up is the process through which deviations from the plan are identified and the progress and execution of the plan are periodically assessed. The causes of this divergence are then identified, and steps are taken to get rid of them from the plan.

Inspection: Inspection is the process of evaluating if requirements have been satisfied by comparing the real to the stated or anticipated specifications. Process inspection and product inspection both include inspecting the process or the product, respectively.

Cost Control: Production planning and control is in charge of cost management and cost reduction via value analysis, waste reduction, and other methods.

Additional Activities: Other duties that must be completed in addition to the aforementioned production planning and control duties include developing cost estimates for products, establishing standards with the aid of the industrial engineering department, capacity planning, making purchasing decisions, creating specifications for raw materials, process improvement, etc. Taking remedial action is another duty. The production manager may adjust the route and establish flexible and realistic times if he believes that the scheduling is restrictive and unrealistic or that the routing is flawed. The goal should be to use the plant's capacity as effectively and efficiently as possible. Workload, equipment, and human resources should all be established scientifically.

The work schedules may sometimes be disrupted by unusual events like strikes, power outages, or equipment failure. The production manager should modify the times and account for delays in such circumstances. Evaluation of the performance of those working in the production department is another duty of the production manager.

CONCLUSION

In conclusion, Layout design is a crucial step in operations management that helps businesses to organize buildings, machinery, and resources as efficiently as possible. Organizations may design layouts that improve productivity, efficiency, and resource usage by using an organized approach. A better work atmosphere, reduced costs, and greater operational efficiency are all benefits of effective layout design. Organizations may design layouts that improve operational effectiveness, productivity, and safety by using the layout planning process. A well-planned layout enhances accessibility, streamlines material flow, cuts down on unneeded movement, and makes the most of available space. It promotes efficient resource allocation, simplified procedures, and a positive workplace atmosphere.

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CHAPTER 9

BENEFITS OF PRODUCTION PLANNING AND CONTROL

Dr. Lakshmi Prasanna Pagadala
Associate Professor, Master in Business Administration (General Management),
Presidency University, Bangalore, India.
Email Id: lakshmi.prasanna@presidencyuniversity.in

ABSTRACT:

Production planning and control (PPC) is a critical function in operations management that involves the coordination and management of resources, activities, and processes to ensure efficient and effective production operations. This abstract provides an overview of the benefits of production planning and control, highlighting its significance in optimizing production processes, improving productivity, reducing costs, and enhancing customer satisfaction. It explores key advantages such as improved resource utilization, better inventory management, enhanced scheduling, increased operational flexibility, and improved decision-making. Production planning and control offers numerous benefits to organizations. Improved resource utilization is one of the key advantages, as PPC enables organizations to allocate resources such as labor, equipment, and materials optimally. This results in increased productivity, reduced idle time, and better cost management.

KEYWORDS:

Cost Reduction, Customer Satisfaction, Efficiency Improvement, Inventory Optimization, Lead Time Reduction, Production Scheduling.

INTRODUCTION

You would have learned that it is the hub of every production organization after studying about the roles of "production planning and control. “The advantages of an efficient production planning and control system are many for a business. These advantages are:

1. Better product quality
2. Improved use of resources
3. Inventory reduction
4. Shortening of the production cycle
5. improved customer service as a result of delivery timeframes being met
6. Reduced manufacturing costs will result in higher profitability.
7. Higher market share as a result of goodwill brought about by more affordable and better goods.
8. When compared to rivals that have a worse PPC system, it offers the company a competitive edge.
9. Gaining goodwill in the marketplace is a consequence of the company's dependability.

Production Management

So far, we've learned what production planning and control is, along with its major purposes, benefits, and advantages. We'll learn more about production control right now.

Input/Output Management

Input/output control is one component of production control. The idea is that a work center's intended work output shouldn't ever exceed its planned work intake. When the input is more than the output, the work center experiences backlogs, congestion, inefficient processing, and intermittent work flow to downstream work centers. Finding the root of upstream issues and modifying capacity and inputs as necessary would be the control procedure [1].

Shop Floor Management

Control of manufacturing activities is another name for shop-floor control. Any manufacturing company's heart is in its operations. A system for using data from the shop floor and data processing files to manage and convey status information on shop orders and work centers is referred to as a shop floor control system in the APICS glossary.

The following are the main duties of shop floor control:

1. Giving each store order a priority
2. Keeping track of work-in-progress data
3. Keeping track of shop order status
4. Actual output data is provided for capacity control.
5. Supplying data for accounting and inventory reasons
6. measuring the effectiveness, efficiency, and productivity of both humans and equipment.

As opposed to those falling under a "x" connection, which might be mutually exclusive, the departments that fall under a "A" relationship should be grouped together. This allows the layout designer to put multiple organizational divisions for maximum usage.

DISCUSSION

Assembly Line Balancing

We already know that a line arrangement is better for large volume continuous manufacturing. Another name for this is an assembly line.

1. The issue with production planning on an assembly line is:
2. calculating the final product's line's production rates
3. achieving this production pace with the right staff composition

This is done to save expenses and provide a uniformly-paced, controlled flow of material through a series of procedures. This is performed using a technique known as assembly line balance [2]–[4]. Imagine that in a queue, one procedure takes ten minutes and the next takes only two. The rate of production in this line will therefore be one unit every 10 minutes, meaning that a line's production rate is always equal to the rate of the operation that moves along most slowly.

Every 10 minutes, the operator of the second operation will be idle for 10 - 2 = 8 minutes. This is a significant time waster. Assembly line balancing seeks to minimize this downtime between tasks

so that the tasks may be completed as quickly as feasible. Assembly line balancing is the phrase used to describe the process of 'balancing' groupings of activities to equalize their production rates.

However, before moving on, we need understand what "work centers" are. We discovered that a work center is a place in a company where productive resources are arranged and work is carried out. The work center might be a single machine, a collection of equipment, or a location where a certain kind of work is carried out. These work centers are set up in a job-shop format according to function, or in a flow, assembly line, or group technology cell arrangement according to product [5], [6].

Let's use this example to learn about assembly line balance.

A belt-driven lawn mower assembly line has been created by M/s Caterpillar Inc., a garden equipment manufacturer. Let's create the precedence diagram using the above details.

Plans for Scheduling

Why is scheduling crucial to the planning and management of production? This is because it gives the company the ability to

1. Observe deadlines
2. reduce lead time
3. Reduce setup costs and setup time.
4. Reduce work-in-process stock
5. maximize the use of both machines and labor

The practice of "job scheduling," also known as work center scheduling, is widespread in business. Here, we'll focus on the most significant ones.

Job Ordering

task sequencing, sometimes referred to as priority sequencing, is the process of choosing which task to start first and the order in which subsequent works should be executed on the machine or at a work center. The criteria used to determine a work order are known as priority rules. Jobs are often organized in accordance with processing times, due dates, or arrival order. This technique may be used to forward and backward sequencing as well as limited and infinite loads [7], [8].

The following bases are often used for sequencing:

1. Observing customer or downstream operating deadlines
2. Reducing the flow duration
3. Reducing work-in-process stock
4. Reducing worker and machine idling time

One machine may handle a number of tasks, or there may be 'n' jobs and n machines, among other possibilities. There are several techniques of sequencing for every circumstance. The crucial ones will be taught here.

Scheduling with One Machine and Several Jobs

Jobs may be ordered in the first scenario using any of the guidelines listed below:

1. Shortest Operation Time Method is another name for the Minimum Process Time Method. In accordance with this guideline, the task with the shortest process time is scheduled first, then the work with the next-lowest process time, and so on.
2. The work with the earliest due date is completed first using the due date approach.
3. Jobs are scheduled using the "first come, first served" technique, which takes into account the order in which they are received by the business.
4. The task with the longest processing time is attended to first using the longest process time approach, which is precisely the opposite of the MINPRT method.
5. approach of Minimum Slack per Operation or Dynamic Slack/Remaining Operation: In this approach, Dynamic Slack is calculated first. .By the time of the remaining operation, this is split. If not specified, RO will be assumed to be one. Under this system, the job's final schedule is determined by ranking. Jobs allocated Rank 1 and attended first are those with the lowest DS/RO values. Rank 2 is given to the next higher value, and so on.

Depending on the typical work lateness and the typical number of jobs in the system, it will be possible to determine which specific rule is better suited for a certain circumstance. The shorter time a project takes to complete, the better, since this ensures client happiness, optimal machine performance, less idle time, etc.

The following example will help us comprehend each of the aforementioned approaches.

Index Approach

This is a backward-scheduled, finite task loading approach. A given job-machine combination's lowest time or cost requirement is regarded as the basis, and the indices for the other combinations are created based on the base index. The time available and the capacity of the individual machines are taken into account while assigning, and neither should ever be exceeded. Let's use this example to learn this technique.

Job or Assignment Loading

In the majority of job shops, a task may be performed at more than one work station. Then, decisions must be made between options, and tasks are assigned to the job-machine combination that is the most efficient in terms of time and money. A quantitative approach called assignment or task loading methodology maximizes our choice of job scheduling. A combinatorial optimization approach called the Hungarian Method aids in resolving the assignment issue. Harold Kuhn created this approach in 1955, and James Munkres refined it in 1957. The topic of this method's research is beyond the purview of this course.

Bar or Gantt charts

Henry Gantt developed this approach in 1917 for use in production planning, scheduling, and management. It is a kind of bar chart where the tasks and times are plotted. It is used to coordinate a variety of planned tasks as well as for project planning. The time period, which may be expressed in hours, days, weeks, or months, is on the 'X' axis of a Gantt chart. The 'Y' axis, or vertical axis, is where the activities are plotted.

Using Gantt charts, you can:

1. To display the order of task progress, use scheduling or progress charts.
2. Load charts are used to show how work is distributed across computers or workgroups.

Keep track of the actual time spent and delays, if any, using record charts. Gantt charts need to be updated on a frequent basis, for example, when work begins later than expected, goes on beyond its scheduled end date, or moves slower than expected. It can be necessary to start corrective action in case of unanticipated circumstances, which would call for modifications to Gantt charts.

Gantt chart advantages

1. With a little training, even a supervisory staff member can create them since they are so straightforward and affordable.
2. It is possible to easily see the chosen times and work schedules for each task.
3. Updates and modifications may be performed rapidly and with little financial outlay.
4. Standard sizes for these chart boards are readily accessible on the market, which significantly reduces the expense of building bespoke Gantt chart boards.

Negative aspects of Gantt charts

1. Jobs cannot be interconnected or dependent on one another.
2. Jobs' costs cannot be eliminated.
3. There are no other options for completing the project.

Gantt charts may take on a variety of shapes and forms, depending on the requirements.

The Gantt chart is used by smaller work shops and specific divisions of larger ones to organize and monitor projects. Following is an example of a Gantt chart that will teach us how to create and read them. Planning for production before production begins and shop floor execution meet at an SFC. The SFC must be able to satisfy the needs of both a small organization, which may have just one facility, and a multi-facility corporation, where control must be maintained across co-located facilities down to individual workstations inside a facility. To accommodate such a wide range of demands, ahierarchical architecture is needed. The tiers of the hierarchical structure are as follows: enterprise, factory, cell, station, and equipments. Scheduler, dispatcher, and monitor are the three fundamental roles that each level of the hierarchy is split into.

It is well recognized that establishing shop floor control is challenging to do since it requires monitoring the proper execution of manufacturing operations in accordance with plans, accounting for any delays, and developing real-time system interruption management skills. Modern shop floor management systems must be reactive, meaning they must be able to respond rapidly and appropriately to disturbances, whether they are internal to the system being managed or external.

Batch manufacturing

A number of similar products are manufactured and produced in a batch with the aim of fulfilling a single order or a continual demand. Batch production is an option:

1. Once only, or recurrently at irregular intervals as and when need dictates,
2. Again at set intervals in order to meet an ongoing need. The following is a list of the key characteristics of batch-type production systems:
3. Because the end product may be standardized and produced in batches, economy of scale can be obtained to some degree.
4. Similar to work shop production, machines are grouped according to their functions.
5. To take advantage of product uniformity, semiautomatic, special-purpose automated machines and semiautomatic material-handling systems are often used.

6. The various product batches should be worked on by skilled workers.
7. There is a lot of inventory because of the plan style and material handling regulations.
8. The drawback is that the irregular size and non-repetitive nature of ordered items make production management and planning challenging.

Prediction Methods

Sales and its long-term planning are at the center of all commercial and industrial activity. Future sales must be known in order to predict how a firm will perform. Because all other operations in a concern rely on the concern's revenues, sales forecasting is thus the most crucial one. We must first comprehend the definition of forecasting before we can comprehend the meaning of sales forecasting. "Forecasting is a systematic attempt to probe the future by inference from known facts," asserts Allen.

C.E. Business forecasting, according to Saltan, is the computation of likely occurrences to prepare for the future. Forecasting, therefore, is the process of predicting the future with the aid of current information. It consequently comprises looking forward in business and the notion of predetermination of events, followed by financial ramifications as in the case of budgeting.

Forecasting sales involves determining the value or number of units of a product or group of items that will be sold in the future. Forecasting sales is based on a predetermined time frame. It is typically built to last a year. A sales forecast is "an estimate of sales in dollars or physical units for a specified future period under a proposed marketing plan or program and under an assumed set of economic and other forces outside the unit for which the forecast is made," according to the American Marketing Association. The prediction might be for the full range of products or just a specific item.

The descriptions given above make it abundantly evident that sales forecasting is nothing more than a guessing that is based on historical data, current conditions, and potential outcomes. Sales forecasting, which involves the following operations, entails the creation of an efficient system to project sales for a certain time.

Market analysis

1. Analysis of sales data in relation to salesmen's assessments of potential customers in their particular markets.
2. Combining these two procedures to calculate the number of sales and presenting the information to senior management for review and, if required, approval.
3. Making note of the past and being conscious of the present, sales forecasting aids in forecasting the future.

Sales forecasting enables you to analyse previous and present sales levels to boost the company's yearly growth, which in turn enables you to evaluate the business in light of industry standards. In order to conveniently monitor pricing and operating costs and hence raise profits, it also helps to set policies. Sales forecasting helps you identify small issues before they escalate into bigger issues.

The whole production system is built on the idea of sales forecasting, which is a crucial activity in the sphere of manufacturing. The planning of production operations takes into account sales projections. All marketing operations, including purchasing, selling, advertising, sales promotions,

storage, and packaging, are organized appropriately. Therefore, it can be claimed that sales forecasting is the fundamental foundation of planning, whether it is for marketing, manufacturing, finance, or people. As a result, precise sales forecasting is required for the company to successfully fulfill its overall goals. It is advised to frequently examine previously predicted sales forecasts in order to make necessary adjustments to the organization's strategy. The foundation for budgeting, another crucial instrument for managing corporate affairs, is sales forecasting.

Goals for Sales Forecasting

There are two different sorts of goals for sales forecasting:

1. Short-term goals
2. Long-range goals
3. Short-term goals

Short-run forecasting is the process of predicting revenues for a year or a shorter time frame. The following are the short-term goals of sales forecasting:

Creation of a sui production strategy: The creation of a sui production policy is the primary goal of short-term sales forecasting. It is essential to ensure that future production of products is available in accordance with the demand prediction and that issues with under- or overproduction do not occur.

Regular supply of raw materials: Planning for a regular supply of raw materials for manufacturing based on anticipated sales over a short time is the second goal of forecasting. It assists in preserving the production's flow and lowering the expense of keeping inventory.

Best machine utilization: One of the key goals of sales forecasting is to use the available machines to the fullest extent possible, ensuring that there are no barriers to increased production in the event of rising demand and that there are no idle machines in the event of falling demand.

Determining the best pricing policy: The organization's price policies are heavily influenced by the sales projection, such that during a recession the price may not go up and during an inflationary time the price may not go down.

Regular labor availability is the next goal of sales forecasting. Trained personnel and non-technical workers should be scheduled so that there is no staffing shortage during peak times and that they are not idle due to a lack of production work. Therefore, production planning guarantees labor availability.

Forecasting short-term financial needs: The organization's financial needs are based on the amount of output and the level of sales. Sales projections allow for the well-in advance provision of money on accep terms in accordance with the demands of the business. Finance costs will be kept to a minimum. Sales projections assist in determining the sales objective for various market groups as well as in implementing controls and incentives. With the provision of sui incentives, the workforce at work is managed.

CONCLUSION

In conclusion, Significant operational performance, cost savings, customer happiness, and overall organizational success are all benefited by production planning and management. Organizations may optimize production processes, improve resource usage, and make educated choices that

promote efficiency and competitiveness in today's changing business environment by employing efficient PPC systems and practices. Organizations may react swiftly and efficiently to shifting market circumstances, demand variations, or interruptions because to operational flexibility obtained by PPC. Adaptability and agility are supported in the face of changing corporate environments. Additionally, data-driven decision-making, process enhancements, and ongoing optimization are made possible by the insights provided by production planning and control.

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CHAPTER 10

A BRIEF INTRODUCTION ABOUT THE TYPES OF FORECASTING

Dr. Akhila Udupa
Associate Professor, Master in Business Administration (General Management),
Presidency University, Bangalore, India.
Email Id: akhila.udupa@presidencyuniversity.in

ABSTRACT:

Forecasting is a critical process in business and operations management that involves predicting future trends, demand, or events based on historical data and other relevant information. This abstract provides an overview of the types of forecasting techniques used in various industries and contexts. It explores different categories of forecasting, including qualitative, quantitative, time series, causal, and judgmental methods, highlighting their characteristics, applications, and advantages. Qualitative forecasting methods are subjective approaches that rely on expert opinions, market research, and surveys to predict future outcomes. These methods are useful when historical data is limited or unreliable, and they provide insights into market trends, customer preferences, and industry developments.

KEYWORDS:

Causal Forecasting, Delphi Method, Economic Forecasting, Exponential Smoothing, Judgmental Forecasting, Leading Indicators.

INTRODUCTION

Long-term forecasting is the process of predicting revenues for a period longer than a year. The long-term forecasting goals are:

Calculating future financial needs: The cornerstone for predicting long-term financial needs is long-term sales forecasting. By calculating the cash and credit sales ratio, cash inflow may be fairly accurately forecasted. It aids in organization-wide credit policy planning. It also determines capital expenditures and long-term requirements.

Planning of plant capacity: Planning plant capacity in line with demand or sales predictions is the long-term goal of sales forecasting. It is possible to decide whether to build a new plant or expand the capacity of the current plant if sales projections show that plant capacity will fall short of future demand. Planning for permanent employees based on sales projections is another long-term goal of sales forecasting. This will ensure that the best personnel is available to operate the production efficiently. For this aim, management might choose the method of training, hiring, etc.

Budgetary control over expenditures: In order to anticipate sales, all activities must be projected. Various budgets for the organization's revenue and expenses must be produced for this purpose. Any discrepancy between the budgeted and actual performance is then eliminated [1], [2].

Long-term production planning: Long-term production strategy may be planned with the use of long-term sales forecasts. The final product should satisfy the requirements and additional requirements. Additionally, it will assist the organization with securing long-term financing.

Reserve and dividend policies: The earnings of the company may be predicted using long-term sales forecasting based on the gross profit margin on sales. The dividend policy might be predetermined since the amount of profits reserve policy affects a variety of management choices. Because long-term business strategies are sometimes incorrect, management should exercise additional caution when anticipating and analyzing long-term sales forecasts.

Forecasting Strategies

The statistical components of forecasting are not covered here. The topic of discussion is restricted to learning about the many forms of forecasting and how, when, and why they are done. There are two fundamental inquiries that need to be made whenever judgments concerning managing or regulating inventories for production need to be made:

It is conceivable for the decision-maker to explain in terms of probability scenarios in a condition of certainty, when the demand and supply are both known and predic. However, under uncertain circumstances, this is not feasible, and this is where subjective probability comes into play. It is evident that uncertain circumstances tend to recur, which strengthens our understanding of them and causes them to move towards certainty. Dealing with uncertainty is made much easier by forecasting [3], [4].

The operations plan is created using demand projections. Since it is difficult to make frequent changes to the plans, accuracy of the plans and projections become crucial. Since you can't predict the future with accuracy, you plan. As a result, forecasting and planning should be seen as having a tight connection, and approaches should be selected to satisfy planning's requirements for accuracy.

An operations manager creates a strategy for the materials needed and submits it to the materials management division to start the procurement process. Based on his estimate of the time it will take for the material to arrive which relies on the lead time for ordering and delivery the materials manager takes action for procurement. Therefore, while the materials manager projects lead times, the operations manager projects needs. The forecasting process has an impact on every area of logistics. Therefore, forecasting has an impact on all facets of production planning, control, and inventory management.

Forecasting is useful for:

1. Increasing consumer contentment
2. reduction of safety stockpiles
3. decrease in stock outs
4. reducing datedness
5. improved negotiation
6. higher costs
7. increased production efficiency

Forecasting does have certain limits, however. It is important to keep in mind the following before beginning any forecasting: Forecasting is more accurate for shorter periods.

1. For bigger groups, forecasting is more precise.
2. Error should be allowed for when forecasting.
3. A reliable database is necessary for predicting.

4. Techniques for forecasting should be tried and true.
5. Forecasting procedures

The fundamental procedures for predicting are as follows:

Step 1: Determine the goals in the first step. It might range from attempting to cut down on idle time via proper task scheduling or design adjustments to keep up with the shifting demand.

Step 2: Establish the forecasting window of time. Short-run predictions are preferable for the best use of already available facilities, whereas long-run projections are preferable for capacity planning.

Step 3: Determine the best forecasting approach based on the goals and time period. Multiple models could sometimes be used at once. For instance, a quarterly prediction may be used for capacity planning and inventory planning, and a forecast for the next term may be beneficial for shop floor planning.

Step 4: Gather the necessary data/information. Past data is gathered for time series analysis, while surveys are used to gather primary data for market research.

Step 5: Put management's planning and control choices into action.

Step 6: Regularly analyze predictions by evaluating their dependability and error rates, then make necessary revisions.

DISCUSSION

Numerous factors may be used to categorize forecasting. Here, you can discover some of the most popular forecasting techniques.

1. Classification Based On Duration of the Term

Long-range planning is done using long-term forecasts. The timeframe is often three years or more and includes topics such product line sales, supply and demand throughout a five-year plan, etc.

Short-term forecast: It is used to make plans for the next days, weeks, or months. It includes topics like the demands for the next month, season, etc.

Mid-term prognosis: It lasts between one to three years and addresses things like financial concerns, sales plans, potential demand, etc.

2. Classification based on Circumstances

Situations may be used to categorize forecasting. Based on this, forecasting may be divided into the following categories:

Forecasting in case of certainity: This entail projection of demand based on a certain criterion which is generally the ultimate product e.g. For instance, the amount of girders, cement, bricks, and other materials needed during each week of work may be forecasted.

Forecasting in Unclear Conditions: This type of forecasting is used when there is little or no information available about the final product or future demand. The material planning for maintenance on recently installed equipment would be an illustration of this. In these

circumstances, forecasting is based on an informed evaluation of assumptions, often by an expert committee. In this context, Delphi methods, gross effect matrices, etc. are helpful [5], [6].

Forecasting in a risky situation: Consider the grocery store's inventory of goods. Based on historical trends and the prediction that these trends will continue, a fixed quantity of food is kept on hand. There is danger in this circumstance. Techniques from statistical operational research are useful in these circumstances.

Classification Based On Forecasting Themes

The subjects of forecasting may also be used to categorize forecasting. Based on this, forecasting falls under one of the categories below:

Demand forecasting: This considers an organization's lead times, inventory levels, and past and future demand. The most important forecasting for inventory management is this one.

Forecasting supply: This considers factors that have an impact on supply, including information on existing manufacturers and suppliers, technological and societal changes, product lead times, changeover periods, etc.

Price forecasting: Based on data acquired and examined on supply and demand, price forecasting entails predicting both long-term and short-term prices.

Demand Types

An operations manager must determine how much of a given item is needed for creating the finished product before a materials manager can decide how much of that item should be acquired. He requires some extra essential knowledge about each item in the inventory for this. Any one of the following three categories of requests may be present in an item:

Dependent Demand: When the usage of a product is based on the planned production of the bigger component or parent product of which it is a part, that product is said to display dependent demand characteristics. The exact amount of inputs needed may be calculated from the bill of materials if the whole amount of end product to be made over the course of a period is known. Even if the demand for the finished product may have been predicted, dependent demand should not be predicted but rather carefully estimated. For instance, two wheels are required to create a motorbike. It is possible to predict how many bikes will be created, but based on that number, it is also necessary to estimate how many wheels would be needed. This need is dependant [7], [8].

Independent Demand: Items are considered to have a "independent demand" if the demand cannot be reliably estimated from the production schedule and bills of materials. Such demand cannot be properly estimated, only projected. Since customer preferences and requirements differ, the market demand for a consumer durable is independent of any foreseeable factor. Consumers are free to choose what, where, and when they will purchase. Similar to this, the spare parts needed for regular maintenance and operation of a machine may be completely probabilistic and unrelated to any one particular aspect.

Iron ore, coal, limestone, and manganese ore, for instance, have dependent demands in an iron-making plant, but furnace oil, refractory bricks, gallery lights, and conveyor belts have independent demands.

Although relatively straightforward, knowing the difference between dependent and independent requests is crucial for the inventory management. It aids him in determining what inventory management procedure should be used for the particular item demand that is sporadic: Particularly relevant to logistics and transportation companies is the third group. When overhauling a vehicle, parts are changed according to their level of wear and tear, with the criterion being whether or not they might be used safely for another overhaul life. The choice is often subjective and is based on a list of spares that are typically changed throughout each overhauling operation. The need for these parts is sporadic since the equipment's life affects its wear pattern [9], [10].

Forecasting Strategies

There are several forecasting strategies that fall into two basic categories: qualitative techniques and quantitative ones.

Qualitative approaches

Using various statistical methods, views and preferences are further quantified using qualitative methodologies. The most often used qualitative methods are:

1. root systems
2. Forecasting by consensus
3. Delphi approach

Market Analysis

Grassroots approach: It is the simplest forecasting technique. Estimates and views serve as the basis for the final prediction, which is then derived from these estimates via review and debate. Its simplicity and inclusion of everyone who matters give it an edge. For instance, by integrating the data from each salesperson, who is in charge of the sales in his or her area, the total sales forecast may be created. The grossroots approach, however, has the drawback of being quite subjective. It could take a while and is heavily impacted by current events.

Consensus approach: It holds that collective projections would be more accurate than those made by any one person via open debate.

Delphi technique: In the 1950s, the Rand Corporation created it. This approach involves choosing a panel of experts whose opinions are distilled from their replies to a number of questions. In unknown circumstances, it is especially important. Since the identity of the person is often hidden, there is learning for the group members as well, but there is also no impact of peer pressure or domineering people.

Using a historical analogy This connects the prediction to an earlier forecast. This approach is particularly pertinent when new items are being introduced since it allows for forecasting based on the past performance of a related product. You just need to go on any book-selling website to get a barrage of emails with all types of book offers! The goods, which fall under the same broad genre of books, are available for purchase by customers. The history of the kettle might also be used as a growth model by a company that currently manufactures kettles and wants to start manufacturing electric kettles.

Method of market research It is frequently used by corporations to anticipate sales of new items or of old products in new areas. It is based on surveys that have been done. To test market hypotheses,

data is gathered using a range of methods, including surveys, interviews, questionnaires, etc. You most surely would not have avoided phone calls asking you about your preferences for newspapers, your money, your habits, etc.

1. Using quantitative methods
2. These methods fall under one of the three categories below:
3. Analyses of time series
4. Causative connections utilizing cause-and-effect models

Simulation

Method for time series analysis: The time series approach forecasts the future using previous data. The concept of time is included in this approach. There are many lengths of time: brief, medium, and long. Short term is often used to describe a time period of less than three months, medium term is generally used to describe a time period of three months to two years, and long term is more than two years.

Box-Jenkins method

Demand from the previous period: It is the most basic approach based on previous demand. It may not always be reliable since it does not account for seasonal variations.

Using a simple average, it evens out erratic oscillations. This approach of forecasting might be helpful when a product's demand is neither increasing nor decreasing quickly and does not exhibit seasonal patterns. Nevertheless, this approach also disregards seasonal variations.

Weighted moving average method: It is helpful to prevent random variations caused by the characteristics of seasonal demand. Each moving average database component is given a weight, so long as the total weights are precisely equal to 1.

Method of exponential smoothing the disadvantage of the techniques described up to this point is that the oldest observation is abandoned and the new prediction is computed when each new piece of data is introduced to the techniques. Additionally, current events are often a stronger predictor of the future than those from the past.

Trend projections: This approach projects current trends into the future by fitting a trend line to the data points.

Analysis of regression: A functional connection between two or more correlated variables is referred to as regression. The link is built using data that has been seen. To check whether the data are linear, or at least look to be linear, the data are first plotted. This approach is helpful for both broad planning and long-term forecasting of significant events.

Shiskin time series: Julius Shiskin invented this technique. A time series is divided into trends, seasonal patterns, and irregular patterns using this technique. Three years or more of historical data are required. It is excellent at spotting turning moments in business sales.

Box Jenkins method Despite being one of the most complex statistical approaches accessible, this strategy is remarkably accurate. It uses the Bayesian posterior distribution to fit the model to the time series and connects a class of statistical models to the data.

CONCLUSION

In conclusion, the many forecasting methodologies include time series, causal, qualitative, quantitative, and judgmental approaches. Each technique has its own qualities, uses, and benefits. Organizations may create accurate and informed forecasts by choosing the right forecasting approach or mix of techniques, which will enhance planning, operational effectiveness, and overall company success. Organizations may enhance their decision-making, prepare for future demand, manage inventories and resources efficiently, and react proactively to market changes by combining various forecasting strategies. The selection of a forecasting technique is influenced by the data's accessibility, the variable's type, and the industry's or context's particular needs.

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CHAPTER 11

CAUSAL RELATIONSHIPS USING CAUSE EFFECT MODELS

Dr. Nalin Chirakkara
Associate Professor, Master in Business Administration (General Management),
Presidency University, Bangalore, India.
Email Id: nalinkumar@presidencyuniversity.in

ABSTRACT:

Causal relationships play a significant role in understanding the cause-and-effect dynamics between variables in various fields, such as economics, social sciences, and engineering. This abstract provides an overview of causal relationships using cause-effect models, highlighting their importance in identifying and understanding the impact of one variable on another. It explores the concept of cause and effect, the construction of cause-effect models, and the advantages of using such models in research and decision-making. Cause-effect models are analytical frameworks that represent the relationships between variables and help establish causal connections. They are constructed based on theories, empirical evidence, and statistical analysis. These models enable researchers and analysts to identify and quantify the influence of one variable on another, allowing for deeper insights into complex systems.

KEYWORDS:

Causal Inference, Causal Modeling, Causal Relationships, Correlation, Dependent Variable, Explanatory Variables.

INTRODUCTION

This approach focuses on the system that supports and influences the forecasted item. For instance, advertising, the existence of rivals, or quality may have an impact on sales. The following techniques are used to forecast utilizing cause-effect models. Co-regression analysis the economics method

Input-output evaluation

End-use evaluation

Regression using corelation: It resembles the time series approach. It only differs in that it has many variables. The premise is that the occurrence of other events affects the prediction.

Using econometrics

When making long-term projections, it is seen to be highly helpful and accurate. Its foundation is a set of econometric models that describe a certain economic activity. Typically, all of the regression equation's parameters are calculated at once. Although it was quite costly to construct, this model is incredibly precise. Analysis of aggregate demand often uses it. Its foundation is mathematical statistics, a theory that explains how to draw conclusions about a population from a sample. Typically, there aren't many companies in a given sector, thus choosing a representative

sample from a cross- of those companies is of little help. Another issue is that businesses cannot ignore the random factors in the connection that has to be taken into account but is probabilistic rather than accurate [1], [2].

Models of input-output

They emphasize the businesses' sales to the government or other businesses. They predict the change in sales that a product sector could anticipate as a result of changes in other industries' buying patterns [3], [4]. Analysis of final usage Statistics that move in the same direction as the series being predicted are taken into consideration. For instance, a rise in the price of gasoline would result in a future decline in automobile sales.

Model simulations

It is possible for the forecaster to make assumptions about the internal variables and external environment in simulation models, which are dynamic models that are often computer-based. The forecaster may inquire, for example, "What would happen to my forecast if price increased by 10%?" depending on the model's variables. What impact would a GDP decline of 3% have on my projection? However, these investigations are seen to belong in the domain of experts rather than operations. These techniques integrate statistical techniques with economic ideas [5], [6]. improved labor utilization more employee motivation

Four different sorts of layouts are available:

1. Product design
2. Process flow
3. a fixed position layout project
4. Group or cellular arrangement

In order to create an overall, family-level plan for a month or quarter based on the management's objectives for manufacturing, sales, and inventory levels, production planning is a cross-functional process. In order to provide management thoughts on the number of materials and other resources to be collected, aggregate planning is an operational activity that develops a cumulative plan for the production process far in advance. Production scheduling may be defined as the distribution of the available production resources throughout time in an effort to optimally meet a set of requirements. There are several forecasting techniques accessible in business to improve leadership and competency. The sorts of forecasting techniques to utilize depend on the kind of data and level of accuracy the company needs.

DISCUSSION

Material Requirement Planning and Control

A computerized inventory management system called material needs planning and control was developed to assist production managers in organizing and submitting requests for goods of high urgency. Components of final products, such as raw materials, component components, and sub accumulations, are dependent demand items. Depending on how much of the completed product is produced, they will need different amounts of inventory. For instance, dependent demand inventory items at a plant that makes bicycles would include aluminum, tires, seats, and bike chains [7], [8].

The 1940s and 1950s saw the development of the most important MRP and control systems for inventory management. To transfer data from a bill of materials for a specific final product into a production and buying plan for constituents, they used mainframe computers. Unexpectedly quickly, MRP and control expanded to take over information feedback loops, allowing production employees to alter and update system inputs as necessary. Manufacturing resources planning II, often known as MRP II, was the second iteration of MRP and included tools for promotion, finance, accounting, engineering, and human resources to the planning process. Enterprise Resources Planning is a related view that emerges from MRP. In order to link diverse operational domains throughout a whole commercial company, this uses computers.

In order to generate needs for components and raw materials, MRP works in the opposite direction from a production plan for completed goods. The MRP process begins with an agenda for finished goods, which is translated into an agenda for the subassemblies, component parts, and raw materials needed to create finished goods within the allotted time frame. Three questions may be answered by MRP: "What is needed?How much is required?", "When is it required?"'

Inventory needs are changed by MRP to planning periods to ensure that production is completed on time while lowering inventory levels and related carrying costs. MRP systems may, however, be time- and money-consuming to install. They may become pricey as a result for small firms. Furthermore, the information that comes out of an MRP system is of the same caliber as the information that enters into it. To assess the likely advantages of MRP, businesses should maintain an orderly record of current and correct bills of materials, component numbers, and inventory data [9], [10].

Materials management explained

The control and management of stock and materials in a manner that ensures the greatest possible return for a firm is referred to as materials management. Determining the procurement, location, storage, accounting, and transportation of stock is a part of materials management. The moving of stock through different production, storage, and distribution operations is referred to as transportation of stock.

Planning, coordinating, and managing every operation that is primarily related to the input and outflow of materials into a firm is what materials management is all about. The scope of materials management varies per organization and may involve waste management, buying, inventory control, and store management in addition to production planning, material planning, and control.

Materials management tasks

The following tasks are often included in materials management:

1. Purchasing
2. Procurement
3. Distribution
4. Warehousing

When it comes to materials management, the company must walk a fine line between its budgetary constraints and the demands of its internal clients, or employees. The direct engagement of supply and procurement managers, as well as supervisors, in carrying out different supply duties is

necessary for effective materials management. The following are some materials management tasks performed in different supply regions that have a direct impact on stock:

1. Upkeep of an allowance list
2. Order processing for issues
3. Receipt processing
4. Compilation and balancing of the physical inventory
5. keeping up with stock records

Management of materials is crucial

The buying mix is involved in materials management. It has to do with acquiring materials and having the capacity to predict what will be in stock at the shop and what will be delivered on demand. The shop manager is primarily responsible for carrying out these duties, and it is his responsibility to ensure that the delivered items live up to client expectations. Materials management's primary responsibility is to make sure that the stores and supply manager streamlines the company's demand, sales, and problems so that the manager can recognize when the company is running low on stock and prevent using its buffer stock.

Planning for Materials Requirements

Planning is the first step in any procedure. Planning and calculating the quantities and delivery dates of the items to be delivered in the current situation is necessary based on the demand. The term "materials requirement planning" refers to the concept of time-phased priority planning. A computer-based production management system, according to McGraw Hill, is "a system that uses sales forecasts to ensure that necessary parts and materials are available at the right time and in the right place." MRP is an effective method for managing and planning production inventory. It aids us in choosing our purchases in light of:

1. What must be purchased.
2. How much has to be acquired.
3. When ought it to show up.

The MRP system's output would be

1. current order releases with certain delivery due dates to the purchasing department and/or previously chosen suppliers
2. The meanings of key phrases that are often used are planned order releases for the next time periods.

Dependent Demand: This occurs when the demand for one product is closely correlated with the demand for another. The thing might be a part, a raw material, or a sub-assembly. It should be kept in mind that although demand for an organization's final output is often projected, demand for raw materials and component components is computed rather than forecasted. The typical assumption is that demand for the inventory item would increase gradually and continuously. However, in practice, rather than in continuous units, the demand for the raw materials and components in a production setting may come in significant increments. Demand that is lumpy is the term for it. The huge increments can be the amounts required to produce a certain batch of the finished product. When dealing with inventory circumstances characterized by lumpy demand, MRP is the best course of action.

Lead Time: The amount of time necessary to perform a task from beginning to end is known as the lead time. There are two types of lead times in manufacturing: manufacturing lead time and ordering lead time. The ordering lead time includes the amount of time needed from when the purchase request is made until the material is delivered to the retailers. The lead time for manufacturing is the amount of time needed for the component to be created or processed through the series of machines to produce the finished product. MRP takes into account all of these lead delays. After taking the item's lead time into account, the order placement dates are derived from the dates the material is needed. Each order should be delivered precisely at the moment it is required by the next production step when it is released within the time frame specified by the MRP output.

There are three MRP prerequisite inputs.

The following three inputs are necessary for MRP to function:

1. Production Master Schedule
2. of Contents
3. File of Inventory Records

1. The creation of an aggregate plan, which serves as the foundation for the master production schedule (MRP), is based on the anticipated receipt of a certain volume of orders for a particular family of goods over the planning period. To estimate the aggregate demand for the product family, many forecasting methods are applied. Because the entire production volume cannot be modified quickly without incurring major unanticipated expenditures, the plan must be set in stone for a fair amount of time. Every manufacturing volume uses a certain combination of labor, supplies, and machinery. When the output rate is altered, a new optimum mix must be obtained by altering the rate at which the different resources are used. Long-term change may be achievable, but it is challenging to make effective short-term changes. The aggregate plan serves as the foundation for the master production schedule. It converts the overall strategy into a set of particular items to be produced in a certain amount of time.

Each company has a different time frame for MPS. It depends on the kinds of items utilized, how much is produced, and how quickly the materials are delivered. The planning horizon refers to the time period that the MPS covers. The master production schedule is often changed weekly, within a six-to-twelve-month aggregate plan, to meet changing sales demand as well as internal scheduling-related issues.

Bill of Materials: A product's bill of materials is a list of all the materials and the amounts of each that are needed to make it. This is done to determine the precise material needs for a certain production plan over a specified time frame. It is also known as the product tree or the product structure file.

Inventory Records File: This contains item-by-item inventory records that list the item, the quantity in stock, and a wealth of additional details about each item in the inventory.

1. The MRP method
2. The MRP Method

The MRP procedure is shown in the flowchart above. In order to construct the MRP system, the MPS, bill of materials, and inventory data are basically utilized.

Every item that has to be produced or constructed requires both some independent demand items and some dependent demand items. The prediction and MRP specifications for the independent demand items. The bill of materials and the relationships between the goods are used to determine the dependent demand items. Assume, for example, that each unit of product A needs one unit of product B and two units of product C. If 1,000 units of product A to be produced, this means that 1,000 units of B and 2,000 units of C are also necessary. In addition to determining the precise demand in this way, MRP may rearrange the requirement for B and C if the time for A is altered.

The period between the middle of the 1980s and the middle of the 1990s was marked by escalating technological and price rivalry, global and cross-functional business units, overall quality ideas, increased customer emphasis, and attempts to increase customer happiness. Manufacturers had to contend with intense price pressure brought on principally by heightened competition and easy access to products on a worldwide scale. Furthermore, supply chain competence was the basis for competitiveness. Businesses understood they needed top-notch business procedures, highly skilled personnel, and integrated software systems to provide outstanding customer service financially across a complicated global supply chain. All of this compelled the manufacturers to develop the MRP systems further and connect them with other production and administrative processes. Manufacturing resource planning, as it is often called, is this renaissance.

The MRP system discussed above has certain shortcomings. As follows:

1. It was unable to account for capacity variations.
2. Due to its inability to translate the operation/production plan into financial terms, this system was unable to perform financial planning or control.
3. It was unable to replicate circumstances; for example, under this approach, it was impossible to provide solutions to "what if" queries posed by management.

Initially, a module for planning capacity needs was created and connected to the original MRP module. The majority of the planning activities were included into a single planning and scheduling package with further development of the master production schedule idea. A closed loop MRP system was the name given to this comprehensive set. This system was created to meet the material needs, which also covered the extra planning duties of sales and operations. After the plans are approved, they are put into action. Input-output measurement, thorough scheduling and dispatching, reporting on projected delays from the plant and suppliers, supplier scheduling, etc. are a few of these. The phrase "closed loop" suggests that each of these components is not just a part of the larger system but also that the execution functions offer feedback so that the planning is always accurate. The capacity variable was fixed as a result. However, the financial component of managing a firm was still not fully integrated. The creation of MRP-II is the next stage in the evolutionary process. The closed loop MRP system now has two more possibilities thanks to this new technology. They were the capacity for simulation and the financial interface. Ollie Wight gave the program the name manufacturing resources planning to represent the concept that the program was including a growing number of company employees.

The meaning of MRP-II

An information system that combines all manufacturing and associated applications, such as decision support, MRP, accounting, and distribution, is known as MRP-II, or manufacturing resources planning. It is a technology that enables businesses to give financial and planning data while also optimizing resources, purchasing, and production processes.

The American Production and Inventory Control Society, Inc. claims that MRP-II is a technique for efficiently organizing all of a manufacturing company's resources. It should cover unit-based operational planning, dollar-based finance planning, and include simulation capabilities to address "what if" scenarios. Business planning, sales and operations planning, production scheduling, planning for material and capacity needs, and the implementation of capacity and material support systems are all included. Financial reports, including the business plan, buy commitment report, shipping budget, and projected dollar values for inventories, are connected with the output from these systems. A direct development and expansion of closed-loop MRP is MRP-II. To achieve overall quality and continuous improvement, businesses like Nissan have included MRP-II into their production planning processes along with fundamental shifts in their management philosophies.

Controlling and Planning for Material Requirements

Process MRP-II

The MRP-II system spans the whole organization and addresses sales, manufacturing, engineering, inventory, and cash flows. Order entry is the main control focus of an MRP system. All of the production processes begin after an order is submitted. These consist of:

1. Cost estimates: Based on the data in the other modules, cost builds may be requested.
2. Inventory management: The product's current stock as of the order.
3. What components, and in what quantities, are required to make the product?
4. Inventory control: Which components specified by the BOM are available, and in what quantity? This much cannot be purchased.
5. What components stated in the BOM must be purchased, how much must be purchased, and by when must they arrive?
6. Controlling and allocating employees and resources is part of production scheduling.
7. Accounting: Against the order, an invoice and shipping documentation are created. Periodic and partial shipments are permitted; nevertheless, they will reduce the order quantity.

There are various modules that make up this system. They describe what they have in common.

1. Module for master planning: The demand for this module is derived from the yearly business plan, aggregate plan, demand, client orders, and predictions. It makes it possible to plan strategically and schedule tasks in advance. It provides information on the current availability of goods and raw resources across time.
2. The materials planning module/inventory module allows for online transactions for store receipts and issues and keeps track of the stock of materials. It also keeps a record of the precise requirements, such as the part or subpart number, drawings, manufacture and purchase information, use frequency, location, etc. Additionally, it allows for the analysis of inventory, including the amount of excess and obsolete stock, ABC/XYZ/FSN analysis, physical inventory reconciliation, material allocation for internal orders, etc. Printing of purchase requisitions, stores receipt vouchers, goods receipt notes, and occasionally purchase orders is also possible in this module.
3. The bill of materials and the master production schedule are used in the materials and capacity planning module to calculate the quantities needed for different raw materials, components, subassemblies, assemblies, etc. Additionally, it generates MRP reports and

allows for the comparison of the production schedule with the accessibility of essential resources. Aspects like machining capabilities, fabricating capacities, assembling capacities, finishing capacities, testing capacities, packing capacities, etc. are also included in this module.

4. Purchase orders are produced either in the materials planning module or the purchasing module. Additionally, this module manages supplier data, evaluates vendor performance, ratings vendors, and correlates it for contract negotiations and order placement.
5. This module, often known as the shop floor control module or the engineering data module, is in charge of maintaining production information. It records a work order from the moment it is started until it is finished and organizes the actions that need to be done in order to manufacture a certain product. All of the variables, including labor, material, and overhead costs, are tracked and documented. In order for the next run to be regularly updated, it contains comments from the shop floor on how the work has gone to all levels of the schedule. Additionally, it keeps track of maintenance data, including frequency, components needed, machine state and life expectancy, repair logs, etc.
6. Cost accounting module: This module does costing and computes the absorbed overhead of materials and labor. Financial reports are also produced, including statistics on purchase price trends, work-in-progress costs, and overheads for each work center.

The modules listed above are not sufficient on their own. In the industry, combinations of these modules' derivatives are employed. For instance, major corporations might have distinct material control and inventory modules, separate shop floor control modules, and separate engineering data modules. Identification of the company's needs and module design in accordance with them are areas of competence.

An ABC analysis of an MRP system's needs reveals that it depends on the

1. 75% of individuals have skill.
2. 15% data accuracy
3. 10% computer system

When a system is put into place, it simplifies business operations by providing information for planning, responding to changes, meeting delivery deadlines, and keeping expenses in check. Very tiny manufacturing businesses might use MRP to maintain a smooth production flow.

CONCLUSION

In conclusion, causal connections Understanding the relationship between one variable and another in a variety of domains may be accomplished with the use of cause-and-effect models. Researchers may discover the underlying cause and effect dynamics by building these models and examining the correlations between variables, which improves decision-making, policy development, and predictive modeling. Cause-and-effect models provide a framework for comprehending complex systems and phenomena, allowing for the application of evidence-based strategies and the improvement of both theory and practice. These models allow researchers to reach more conclusive results and make well-informed forecasts since they take various variables into account and account for confounding variables. Cause-effect models help to better understand complex systems by establishing the causal links that lead to more successful interventions, superior designs, and better results.

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CHAPTER 12

JUST IN TIME FOR MANUFACTURING AND INVENTORY

Dr. Pramod Pandey
Associate Professor, Master in Business Administration (General Management),
Presidency University, Bangalore, India.
Email Id: pramodkumar@presidencyuniversity.in

ABSTRACT:

Just-in-time (JIT) is a manufacturing and inventory management philosophy that aims to optimize efficiency, reduce waste, and improve productivity by producing and delivering goods or services at the exact time they are needed. This abstract provides an overview of the just-in-time concept, highlighting its key principles, benefits, and applications in various industries. It explores the principles of JIT, such as minimizing inventory, reducing lead times, and emphasizing continuous improvement. It also examines the advantages of implementing JIT, including cost savings, improved quality, and enhanced customer satisfaction. Just-in-time focuses on eliminating waste and streamlining processes throughout the supply chain. By minimizing inventory levels, JIT reduces carrying costs, avoids overproduction, and minimizes the risk of obsolescence. It emphasizes the importance of efficient material flow, synchronized production schedules, and close collaboration with suppliers and customers.

KEYWORDS:

Inventory Management, Kanban System, Lean Manufacturing, Pull System, Quality Control, Reduced Lead Times, Single-Piece Flow.

INTRODUCTION

Before the 1980s, American businesses did not pay much attention to the Japanese manufacturing method. The Japanese began establishing their dominance in other sectors, such autos and electronics, in the 1980s after gaining a sizable market share in 'basic' industries like steel in the 1970s. The Americans were struck by the full force of the Japanese challenge. Businesses like Xerox noticed that the retail pricing for tiny copiers stated by the Japanese were at or even its own expenses. Ford discovered that a Japanese vehicle with a similar price to the Ford Escort in the USA cost $1800 less. When these businesses looked into the issues, they discovered that the Japanese were able to produce their goods at far cheaper prices because to their production efficiency [1], [2].

To see and understand what they were doing, research teams travelled to Japan. They discovered that the Japanese adhered to a distinct production strategy known as "just-in-time," or more formally, JIT. A management approach known as "just-in-time" aims to reduce production waste by creating the appropriate component at the right time and location. JIT may also be referred to as an approach to operations management. Its two goals are as follows:

1. Reducing waste
2. For increased output

By lowering inventory levels, lowering variability, enhancing product quality, lowering manufacturing and delivery lead times, and lowering other expenses, JIT increases profitability and return on investment. Instead of buffer inventories, unused capacity is employed in a JIT system to guard against potential issues [3], [4]. JIT is most often used in manufacturing processes that repeat the same components and products over and over again. Linking work centers creates flow processes, which provide an equal, balanced flow of materials across the whole manufacturing process, much like an assembly line.

Lower and upper interior door panels, as well as other interior trim items like arm rests, are produced at the Textron Automotive Trim Division Plant in Michigan for Daimler Chrysler vehicles and minivans. The high volume, high mix production process at the facility calls for 134 door panels, 37 extra interior components, nine various color schemes, and 12 different types of fabric. The business thought they were excellent since they had received several quality and safety awards. However, their issue was that they had an excessive amount of inventory for completed items and work in progress. The excess clogged up the manufacturing process and took up valuable floor space. The business had to rent space at another site to manufacture the rear side panels for the Chrysler minivans due to the surplus inventory [5], [6].

The JIT philosophy was then implemented by the firm. WIP decreased by more than 60% as a result, and the average time to complete a product decreased from eight to ten hours to two hours. Due to the decrease in inventory, more than 10,000 square feet of space were made available, and the firm was able to end the lease on the facility used to manufacture the rear panels for the Chrysler minivan and add it to its production line. Lot sizes have decreased by 80% over time, while mold change times have decreased by 50%. The corporation has set a goal of fifteen minutes in two years, while the present mold change time is twenty-one minutes.

Success with lean manufacturing at the facility has given them the ability to pursue additional business. They currently have a deal in place with General Motors to get interior trim goods from them. All of this is located within the same facility! The Toyota Production System, which served as the foundation for JIT, was created by Toyota in the 1950s. By the early 1970s, JIT was a mainstay at many Japanese factories.

The idea of JIT is based on the notion that inventory is bad. However, it goes beyond just a way to lower inventory. It is a technique for creating just what is required at the time it is required.

Fundamentally, JIT is founded on two principles:

1. Getting rid of garbage
2. courtesy toward others.

1. Waste Elimination

Any action that does not bring value is considered waste. Anything in excess of what is absolutely essential is waste. Any action that increases the cost of anything without adding value, such transporting and storing, results in waste. The 'famous seven wastes' were named as follows by well-known management expert Shigeo Shingo, who pushed the use of JIT in manufacturing:

Overproduction waste

1. Waste of time waiting Waste of resources for travel
2. Stocks wasted

3. Motion waste is the creation of faults.
4. Inefficient processing

In other words, waste comprises overstock, scrap, and rejections, unnecessary processing of the materials, transit, and waiting time for the availability of resources, as well as overhead associated with setup and inspection delays.

2. Regard for people

This principle acknowledges that people must be actively engaged for a system to function. They must also cooperate to achieve a shared objective. Building teams takes a lot of time and work in a JIT setting. On the shop floor, teams rather than individuals conduct the work. Teams are given the assignment of assembling the complete component rather than assigning each worker on the assembly line a specific job. More responsibility is handed to the workforce. Observable in JIT businesses are the following:

Increased Work Scope

Along with doing their responsibilities, employees should provide suggestions for how to perform better, conduct regular maintenance on their equipment, and take care of their own housekeeping duties. Similar components are often categorized into families, and the equipment needed to produce those families is clustered together to create work cells. This lowers inventory, the need for people, and the time spent moving between activities and queuing. Workers' skill levels will, however, rise as they operate more equipment and processes. This strengthens their devotion to the organization and job security.

DISCUSSION

Factory layout

The structure of the factory should promote teamwork by grouping related processes into small cells in order for JIT to function. It helps materials handling in addition to making communication between employees simpler. Another intriguing observation is that Japanese manufacturers prefer to construct small, specialized plants versus big, vertically integrated factories [7], [8]. In and around Toyota City, there are twelve Toyota factories. They find it challenging to handle vast companies and its officials. Most Japanese factories employ between 30 and 1,000 people.

Automation and redesigned processes

Automating repetitive tasks or eliminating them from processes eliminates monotonous work. As a result, the working atmosphere is improved for the employee.

Empowering of Workers

The ability to halt the queue is provided to the employees. As a result, they take on the role of inspectors and are liable for the caliber of their work. Additionally, they have the power to control work flow and uphold quality at the source. Both management and employees must adopt new perspectives on their job as a result of these developments. Factory layouts and other physical JIT modifications may be implemented in a certain amount of time. The process of changing the workplace culture is continual and takes longer.

This involves inspecting incoming material for quality and specification conformance after it has been received and tallied. If discovered in good condition, it is recorded and added to the inventory. Following that, this is sent to shop floor sub-assembly operation 1, where it becomes the shop floor inventory. Sub-assembly operation-1 is followed by work-in-process inventory. Sub-assembly operation 2 follows, and so on until the final assembly.

Incoming material is provided directly at the point of use on the shop floor when JIT is used, eliminating the need for receiving inspection entirely and shifting quality control for that material to the supplier. This gets rid of the extra shop floor inventory. JIT necessitates a substantial simplification of shop floor production procedures. Rather of relying just on the manufacturing of sub-assemblies, production scheduling need to be based entirely on units of the final product.

Inventory JIT Process

The management of JIT is singularly focused on lowering work-in-process inventory. Why is inventory necessary is a topic that is often posed. The response often specifies a production practice-related limitation, such as setup times, product quality, or machine accessibility. The efficiency of solving these issues is increased.

Companies that have adopted JIT have had incredible success. From the verge of bankruptcy, Harley Davidson emerged to reclaim its market dominance. At its Waltham Plant, Hewlett-Packard claimed a $16 million decrease in inventory and a 65% decrease in production floor area. Corning managed to cut the wait time for clients from five weeks to just a few days while maintaining a 98% on-time delivery rate.

JIT's benefits include: Shorter setup times

Economics requires a big lot size if the setup time is lengthy. The setup time may be cut down, allowing for lower lot sizes and greater production time. Shorter periods of time may be used to produce a variety of goods. Inventory holdings may be decreased, capacity can be increased, and the business can react to changes in demand more rapidly. Changing the process, adding flexible automation, or altering the setup technique may all reduce setup time. One benefit of quick setup times is that they make it easier to identify subpar components early on, enabling the underlying cause of a problem to be fixed. In fact, JIT supporters believe that a single lot is the perfect size.

Enhancement of quality

Pressure to enhance quality rises when inventory is decreased. If there is no inventory to serve as a buffer, when a component is faulty, it can stop the following process. Doing things correctly the first time is crucial.

Poor quality has a big effect on how much a product costs. Clear requirements and documented testing for conformity are part of any excellent quality system. JIT also stresses design for manufacturing and process capacity. The capacity of a process to produce components that meet the required criteria is referred to as process capability. When designing a product, manufacturers' capabilities are taken into consideration. This is known as "design for manufacturability." Often, to do this objective, design and production processes are combined [9], [10].

The following are some advantages of raising quality:

1. fewer reworks
2. less space reserved for scrap
3. reduced handling
4. Allow setups
5. Using fewer substitute tools and materials

The steps in the Manufacturing Process

Only if a step in the manufacturing process increases the value of the final product and removes those that don't, it should be included. For instance, the double handling of goods when they are transported from one work center to the stockroom and again from the stock room to another work center increases cost without increasing value. By altering the product's design, the process stages may sometimes be minimized. Another example is the activity of receiving inspection seen in most conventional industries. Materials are supplied directly to the line at the point of use in a JIT production.

The focus is on Upkeep

Equipment must be in excellent shape in order to continuously create high-quality components. Japanese industries do not have new machinery; instead, they just have well-maintained machinery that performs better. A JIT plant has the discipline to regularly schedule maintenance time. Worker participation is required for maintenance tasks. As a result, the likelihood of unexplained faults is lower since the operators have a greater understanding of their machinery. Additionally, it enables operators to increase the process' capacity.

Inventory reduction

JIT-induced inventory reduction results in a significant decrease in throughput time and labor productivity for the company. All of these will immediately convert into lower production costs, which will raise earnings for the business.

Increasing Supplier Diversity

A reasonable number of suppliers make up the JIT supply base, and engagement with them is encouraged. The goal is to increase suppliers' comprehension of the business' requirements so that the materials they provide meet the required standards. JIT places an emphasis on consolidating all orders for a certain item from a single source and lowering the number of suppliers. In order to supply higher-quality goods and dependable delivery at reasonable prices, emphasis is placed on creating partnerships and longer-term connections. Purchasing can better manage its suppliers and plan delivery by minimizing the number of providers. It may result in savings for the provider, which might then be passed on to the customer in the form of cheaper prices. This strategy has been quite effective for the Japanese. They managed to outbid their American rivals in terms of quality and price by assembling a close-knit family of suppliers known as keiretsu.

JIT has a number of drawbacks while being quite effective in cutting lead times and work-in-process. As follows:

1. JIT has mostly proven effective in manufacturing using an assembly line.
2. JIT calls for a production plan.
3. When there are fewer goods produced, JIT is more efficient.

To ensure that there is "something to pull," JIT still needs some work in progress. As a result, each workstation must keep some finished work that may be retrieved by the subsequent workstation. Because the system relies on smaller, more frequent delivery, suppliers must be close by.

'Kanban' System

Japanese for "signboard" is "kanban." It is the term used to describe little cards that are fastened to containers that contain a set amount of a single component number. Consider two work centers, A and B, in order to comprehend the Kanban method. A production facility creates a component that is stored in a bin. The components in the bin are used in Work Center B. When the trash can is empty, work center A knows to replenish it. The Kanban indication is this empty bin.

What Separates JIT and MRP Systems

The MRP system is a push system, which means that production at one work center relies on its specific production schedule; it is created and 'pushed' to the next production stage without taking into account whether the second stage requires it or not. However, JIT is a pull system, meaning that pieces are only taken from the previous work station when necessary. A push system, like MRP, begins with a prediction of consumer demand, after which it estimates production lead times. Excess inventory and longer lead times are the results of inaccurate projections and estimations. JIT's flaw is that it leaves no opportunity for even a minute mistake in judgment. Smaller batch sizes and almost no inventory provide no space for uncontrollable force majeure situations. The administrative expenditures of MRP are substantial. For success, it depends on technology and good use of it. But since JIT is such a simple technique, maintaining it nearly never costs anything. The only investment is human commitment. Since there is almost no inventory, inventory turns are exceedingly high. JIT system is certain to be successful when there is human commitment.

Internet Techniques

In the areas of building, maintenance, manufacturing, and the purchase of computer systems, among other things, network scheduling is a strategy used for planning and scheduling major projects. By identifying key components and coordinating different aspects of the whole project, it is a technique for eliminating difficulty areas like production, delays, and interruptions.

1. To finish a project on time or according to schedule, a network is used in two fundamental planning and control strategies. These are the Critical Path Method and the Programme Evaluation Review Technique.
2. A project is characterized as a collection of connected tasks that must be carried out in a certain sequence in order to be completed.
3. A project's work may be broken down into three stages, each of which corresponds to one of the management tasks: planning, scheduling, and controlling.

Setting the project's goals and underlying assumptions are part of the planning process. It also includes a list of the duties or tasks that must be carried out in order to finish the project in question.

In this phase, the amount of labor, equipment, and materials needed for the project are also decided in addition to estimates of costs and time for the different tasks.

Scheduling: This entails arranging the tasks in accordance with the priority they should be given and deciding the following:

1. The times when each action will begin and end
2. the crucial route where the tasks need extra care.
3. The latitude and float for the side pathways.
4. Controlling: This stage is carried out after the planning and arranging. Included are the following:
5. Creating regular progress reports
6. reviewing the development
7. evaluating the project's status
8. making management choices about resource allocation, updating, and crashing, etc.

CONCLUSION

In conclusion, A strong mindset that encourages effectiveness, waste reduction, and increased production is just-in-time. Organizations may gain a lot by using JIT's concepts and practices, including cost savings, higher quality, and more customer happiness. However, thorough planning, process reform, and a dedication to continual improvement are necessary for a successful deployment. In today's changing company climate, adopting JIT concepts may promote operational excellence and aid in long-term success. It takes careful planning, process reform, good communication, and a dedication to continuous improvement to implement just-in-time techniques. JIT concepts have been successfully used in a variety of sectors, including manufacturing, logistics, healthcare, and services. Businesses that successfully adopt JIT may increase operational efficiency, save costs, and gain a competitive advantage in the market.

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CHAPTER 13

AN OVERVIEW OF CRITICAL PATH METHOD

Mr. Ram Srinivas
Assistant Professor, Master in Business Administration (General Management),
Presidency University, Bangalore, India.
Email Id: ramsrinivas@presidencyuniversity.in

ABSTRACT:

The Critical Path Method (CPM) is a project management technique used to plan, schedule, and manage complex projects by identifying the critical activities that determine the project's overall duration. This abstract provides an overview of the Critical Path Method, highlighting its principles, advantages, and applications in project management. It explores the key concepts of CPM, including activity sequencing, duration estimation, and critical path determination. It also examines the benefits of using CPM, such as improved project scheduling, resource allocation, and risk management. The Critical Path Method involves breaking down a project into individual activities, determining their dependencies, estimating the duration of each activity, and identifying the critical path. The critical path represents the sequence of activities that determine the project's minimum duration. By focusing on the critical path, project managers can prioritize activities, allocate resources efficiently, and manage project schedules effectively.

KEYWORDS:

Activity Duration, Dependency Relationships, Early Start Time, Early Finish Time, Float, Slack Time.

INTRODUCTION

The following is the iterative process for finding the critical path:

Step 1: Make a list of every task, followed by an arrow diagram. Each work is denoted by an arrow, the direction of which indicates the order of the jobs. There is no relevance to the arrows' length. According to the predecessor, successor, and concurrent relationships inside the job, the arrows are arranged [1], [2].

Step 2: Identify the deterministic normal time for each action above the arrow.

Step 3: Determine the earliest start time and earliest end time for each event, then record the results in the. Calculate the latest start and completion times as well. Using this information, we determine the most recent time Lj for each event j and enter it in the.

Step 4: On the arrow diagram, tabulate the different timings, including regular time, earliest time, and latest time.

Step 5: By subtracting the oldest start time from the latest start time, get the total float for each activity.

Step 6: In the network diagram, find the essential activities and draw double-line arrows connecting them to the starting and ending events. The crucial route is provided by this.

There are two start and end times for each activity: the oldest start time and the most recent finish time. The following tips are used to compute them.

We take into account the activity's tail event to determine the earliest timing. Let ESi, the project's start time, be equal to 0. To get the earliest finish time, multiply the beginning time by the standard time. The maximum of the earliest end time for the head event of the preceding activity determines the earliest beginning time for the tail event of the subsequent activity. Similarly, we take into account the activity's head event to determine the most recent time [3], [4].

The project's goal time provides the latest end time for the head event of the final activity. Subtracting the average time for that activity will give you the latest start time. The minimum of the latest start time for the tail event of the preceding activity determines the latest end time for the head event of the subsequent activity.

Technique for Program Evaluation and Review

Given that anticipated activity periods are considered to be known with certainty, the network approaches that have been examined so far may be categorized as deterministic. However, a variety of tasks rely on judgment, whether they are part of a study project or the design of a gear box or a new machine. Given that time values are prone to random variances, it is challenging to determine a valid time estimate in light of evolving technologies. PERT was created for situations like this, when the actions are non-deterministic in nature. PERT is a probabilistic approach as a result, with a probability distribution used to determine activity times. Three alternative time estimations were generated for each activity to create this distribution of activity times, and they are as follows:

1. A hopeful time estimate Probably time estimate
2. Negative time estimate

Optimistic Time Estimate: If everything goes according to plan, this is the shortest amount of time needed to finish the task. There is an extremely little likelihood that an activity will be finished sooner than its optimistic completion time. To or an is used to indicate it. Time estimates most likely: It alludes to an estimation of how long the action normally takes. This is based on typical delays. It is the probability distribution's mode. It is indicated with a tm or m.

Pessimistic Time Estimate: If everything goes wrong, this is the amount of time a task would need. It is indicated with a tp or b. The three-time values in question are as follows.

DISCUSSION

Quality Management

In the current condition of company, quality is recognized as the most important attribute to attract, keep, and grow the consumer base. Customer satisfaction is the most crucial aspect of every firm, and quality management is the most effective technique. The personification of ideas, techniques, and applications is the greatest stage of progress in time's quality management. The world of industry has seen a lot of real-life success stories during the last several years [5], [6].

The basis for a company's effective operation is planning and achieving outstanding quality. As a result, it becomes essential to comprehend and control a range of organizational actions in order to create objectives and make the best use of available resources. Superior management practices used by firms determine the competency and effectiveness of resource acquisition and use. The

system must monitor, review, and advance numerous metrics related to business operations as a result of quality management. The way a company handles quality-related issues affects how business processes are connected, how their metrics are calculated, and how successful the company is. As there are many competing goals, such as increased customer service quality, low inventory, cheap unit costs, etc., it takes a lot of creative thinking to balance the intentions of the business's employees with the needs of its customers [7], [8].

Quality Ideas

In general, quality refers to the "features," "characters," or "attributes" of a product, service, or comparable provision. The qualities or characteristics of the product or service should be such that they satisfy the demands of the users, or the consumers.

Consider a wristwatch as an example:

1. Must provide a precise time
2. Must be robust and weather-resistant
3. Easy to change the time, date, etc.
4. The dial needs to be simple to read.
5. Should be cost-effective and provide value for the money.
6. Should satisfy any other requirements, such as design and appearance, casing and casing material, band, cost, dependability, maintainability, etc.
7. Should meet any perceived demands, such as those of class, the brand image, etc.

Any lack of these qualities or attributes might cause buyers to either decide not to buy the goods or, if they have already done so, to complain about it. This implies that poor quality will result in unhappy customers and quality complaints. Therefore, it is essential to guarantee and maintain the quality of a product or service for attracting and keeping clients in a company in order to meet the expectations of a customer.

It is incorrect to believe that quality in products or services for clients entails anything additional. In actuality, quality is a crucial component of any product or service that encourages a client to purchase it in order to meet his demands. Since clients have specific demands, quality must be developed and maintained in all goods and services. The American Society for Quality has said that quality is "the totality of features and characteristics of a product or service that bear on its ability to satisfy the given needs" (already noted). As a result, in order to meet the demands of a buyer, or the client, quality must constantly be embedded into the goods or services [9], [10].

Product "conformance to customers' requirements" ensures product quality. This need of compliance to client specifications gives rise to dimensions of quality, which should fully define and explain the condition of quality. The following criteria must be established and maintained in the quality management process in order for the product to meet client specifications:

Customer requirements must be accurately recorded, articulated, and specified in the form of a quality specification, leaving no room for ambiguity.

1. Specifying high standards for achievement
2. Preparing and creating sui quality qualities for the goods or services
3. Measuring and inspecting for specification compliance or non-compliance

4. Preserving the qualities by sui methods and actions, and addressing non-conformance via remedial and preventative measures.

These aspects of a quality management system are regarded as requirements for making sure that products are consistently produced with high-quality standards. This cycle of activity phases in the quality management system.

So, if quality is defined generally as the specifications that a customer provides in order for a need to be met, then the responsibility of quality management should be to ensure that the specification is followed. As a result, quality may be defined as the adherence to a specification, where that specification is derived from the customer's stated demands. Given that quality is the way by which consumers' needs are met and satisfied, its significance has grown quickly as company and industry competitiveness has risen. In order to win over consumers' trust and increase market share in competitive markets, it has become crucial for company operations to constantly provide the necessary quality in goods and services. Because client confidence is the foundation for developing reputations and brands in the marketplace, businesses across the globe are focusing more and more on quality concerns to make sure that their goods and services satisfy customer expectations.

Design and confirm the capacity to produce, i.e. The method The difficulties of quality thus pertain to the planning, production, and fulfillment of complete specifications of products or services that meet the demands of the client in terms of features, characteristics, timeframes, appropriateness, safety, maintainability, usability, and affordability. In a competitive market, manufacturing at least cost without losing any quality would imply providing value for the money invested to purchase the product or service. Without a question, this is the biggest problem confronting the industry today, yet overcoming it is now essential to the success of every company or sector. Setting quality goals after understanding the needs and specifications of the users, planning a process that is cost-effective, producing as planned with the fewest variations in properties, measuring conformance, taking corrective and preventive actions to reduce non-conformance, working toward continuous improvement, and delivering on time are the steps for maintaining this quality. Setting proper quality targets and creating the goods and processes to fulfill the demands and expectations of the consumers have become essential for success in light of the intense competition and changing business environment.

The charismatic CEO of General Electrics, a big US corporation, Jack Welch, implemented three measures to turn the business around: quality, services, and globalization. GE undertook a quality drive to redesign the processes in order to prevent mistakes and defects from happening in the first place. Traditional quality programs focused primarily on identifying and fixing quality flaws, but this was often too little, too late to ensure an efficient and cost-effective operation of the firm in the face of international competition. With the help of services efforts, GE transitioned from a manufacturer of highly designed goods to a supplier of customer-focused, high-value, high-quality engineering solutions to customer challenges and demands. As a result of globalization, GE has been searching for a broad market with competitive goods and services to meet the demands of consumers throughout the world. These ideas, which helped GE turn things around, are not original, but they were pursued in the appropriate way and from the company's proper viewpoint. In genuine spirit and intent, these ideas are 'Total Quality Management' principles. The power of these "Total Quality" efforts is so enormous that, if properly implemented and led by a visionary leadership, it might take a large business-like GE just two to three years to reach its current level of strength and glory.

However, this aspect of quality which includes customer-focus, value-added goods and services, and a vision of globalization and top-tier quality was established through many years of toil by several "Quality Masters," including business executives and academics. They developed many ground-breaking tools and techniques to put into practice their recommendations for overcoming the shortcomings in the approach to maintain quality in all areas of company activities. These pioneers of the quality movement carefully examined what was ailing a company's performance and what needed to be done to eradicate the ills. They all agreed that "Quality" was the primary factor in achieving better company performance and that "total quality" was the path to this greatness. This will make an effort to provide some background on the "why and how" of the quality idea that these quality pioneers established through time and how it was incorporated into the contemporary business process as a vital instrument for success.

Business and Quality

A company is considered to exist for its consumers, not the other way around. Therefore, meeting the wants and expectations of the client is a fundamental responsibility of the business process. It should be obvious at this point based on previous discussions that ensuring a product or service's quality, utility, affordability, and availability is the only way to attract and keep customers. This requires integrating and ensuring quality into all related business processes, whether direct or indirect. Business processes cannot function independently to satisfy any one of a company's interests since they are interdependent on one another. For instance, the finance department is related to the collection of money from the sales proceeds and other sources to ensure timely availability of this resource for funding projects, expansion, paying wages, meeting material bills, etc. The purchasing department is related to production to meet the schedule of production, which in turn is related to marketing depending on their ability to sell. These functions must act jointly by creating cross-functional processes with a focus on customers and quick responses to customer needs in order to meet the needs of customers and other stakeholders in the company in a timely and appropriate manner. This is the fundamental idea of contemporary quality management, which has been spread through the overall quality management philosophy.

Numerous studies in the USA showed the importance of quality in obtaining better business results, which prompted them to embrace overall quality as a strategy for the revival of American businesses in the 1980s. The Malcolm Baldrige National Quality Award was established in the USA in 1987 to encourage enterprises to implement complete quality in their business process management in acknowledgment of this requirement. It has been conclusively shown that quality determines the market share of the firm thanks to the success of Japanese businesses in a cutthroat industry. Beginning in the 1960s, the Japanese developed a complete quality culture, outpacing everyone else in the drive for industrial expansion. Quality advancements also affect costs, market share, and ultimately profitability, which encourages more investment and expansion. As a result, quality supports a business's core objective, which is to create prosperity and wellbeing for all of its stakeholders, including customers, workers, suppliers, shareholders, the general public, and the government. There are several companies in India today that have achieved success in business because of quality, like Maruti Udyog Ltd., Infosys, TCS, Tata Steel, Tata Motors, Hero-Honda, and many more.

Productivity and morale at work

Quality and Profitability Seen from Above

To achieve these many benefits of quality, however, the company must maintain quality throughout all operations, processes, and activities, which is referred to as "total quality" inside the firm. Quality, however, is not a fixed benchmark; in order to hold onto or further expand the market, quality must also continue to improve as consumers' expectations rise and the level of competition increases. The desire for continual improvement in all business activities is, therefore, the unique trait of the entire quality program.

The quality attributes of a product or service have an impact on its market value. Enhancements in functionality, features, dependability, and maintainability will set the product or service apart from the competition. Because quality boosts a company's reputation, alters how consumers perceive the value of a product or service, builds a brand, and boosts profitability, it makes the most commercial sense. Sony Corporation, Toyota Motors, Microsoft, Infosys, and other companies are examples of those that have benefited from this quality mindset. Today's consumers often base their purchase choices on a product's value for the money that it offers. Additionally, this value results from the dedication to excellence and ongoing progress.

The difficulty facing contemporary commercial organizations is managing competition. Meeting and surpassing customer expectations by managing continually improving quality is the most efficient way to manage competition. A company may stand out from the competition by focusing on a number of quality-related factors. For instance:

1. High-quality product design
2. Ongoing development
3. Outstanding customer service
4. More operational flexibility and diversity
5. Quicker reaction time to consumer demands

Traditional functional structures and quality setups are often insufficient to handle business process management. The pursuit of overall quality, which includes quality in all business-related areas, aids in the simultaneous improvement of all these factors. A "total quality programme" that addresses these aspects of a company that are relevant to quality has altered how businesses operate. Cross-functional processes, which operate horizontally across all linked departments, have replaced the conventional approach of controlling business processes by functional structure. Such quality-focused process structure aims to improve customer service while fostering efficiency to enable quick responses and organizational flexibility. 6.3 provides a perspective on who, what, and how the current business process and systems are driven in order to improve customer happiness and financial performance.

At this point, it should be mentioned that both the manufacturing and service sectors of companies may benefit from this strategy for achieving better business outcomes via process restructuring, cross-functional process collaboration, and an emphasis on customer satisfaction. Because every sort of company, whether it be manufacturing or service-based, has a unique group of consumers, and meeting their wants and expectations is crucial to the success of the firm. As a result, adopting a whole quality strategy in business operations for both manufacturing and services has become the norm. More and more service sector organizations are embracing the whole quality approach

by reshaping their business processes in accordance with TQM practice as a result of the fast expansion of the service sectors in emerging economies. Leading service sector companies, including those in the IT, financial, telecommunication, healthcare, and retail industries, are redesigning their business processes in accordance with the total quality management principles in order to win over customers by offering value-added goods and services in a fiercely competitive market. .They may build their business processes to meet the demands of the client, whether they are related to quality, timeliness, or cost, by adopting a complete quality strategy. IT behemoths like Infosys and TCS in India swiftly incorporated TQM into their company operations after realizing the need of it in a cutthroat industry, and they rapidly rose to the position of world leaders in the provision of top-notch IT services. Both of these businesses have received recognition and awards for their superior quality both in India and internationally. As a result, the complete quality approach to business processes is not limited to the manufacturing sector alone. Instead, it is now being discovered to be equally important and applicable to all service sectors, where the customer needs and expectations are more varied and crucial to the success of the company. Quality must be included into every kind of business activity that involves customers at either end of the process chain since customer satisfaction is what determines whether a firm succeeds or fails. As a result, quality is no longer a functional approach to business management.

Quality Control

TQM is a top-down culture that depends on the support and participation of the top management to be successful in a business. The company and its employees follow the leadership's aim for overall quality. In a TQM organization, top management is in charge of promoting a set of business values, a vision, and a purpose, on the basis of which a quality policy is created and implemented throughout the whole firm. The leadership's established vision, purpose, and values provide quality planning direction and serve as the cornerstone for all quality management processes and systems. They serve as the foundation for the management's creation of the quality statement or quality policy.

The company's general goal and direction with respect to the quality management system for its goods and services are described in the quality policy, which is a declaration of intent. Since the contemporary quality management system places a high priority on customer satisfaction, this statement should speak to consumer demands and interests as well as ongoing product and system development as a method of meeting and exceeding customer expectations. The participation of individuals in achieving quality objectives is one trait of an effective quality management system. Therefore, the quality statement has to motivate the organization's workforce to show their dedication and engagement.

An example of a quality policy statement is:

1. "The firm will seek to manufacture and provide superior-quality products and services to its consumers by comparing its quality standards to those of global leaders, investing in cutting-edge technology, and putting its employees through top-notch training.
2. The methods of achieving the quality targets will be a devoted and competent staff, collaboration, a customer-first work culture, and innovation. The slogan will be customer pleasure and joy at all costs.
3. It should be emphasized that the quality policy statement includes an element of purpose, which implies that such a statement aids the organization in determining the procedures

and activities it will take to achieve its objectives. Therefore, for direction and clarity, a good policy statement should meet these criteria.

4. Values, vision, and purpose must be understood in the context of quality strategy since they are crucial elements of the process of developing quality policy.

Values: An organization's underlying views about what matters and what should motivate progress toward its goal are referred to as its values. Values should be followed across the firm and shown by all workers, regardless of rank or position, and they should dictate what should be the attitude toward and policies for customers, employees, and other stakeholders. Integrity, business ethics, openness in transactions, putting the needs of the customer first, credibility, and trustworthiness are a few examples of key principles. The ability to make decisions about the direction a trip should go is provided by values.

To establish a new firm or enter a new market, a value-based company won't compromise its integrity, ethics, or the interests of its customers. The responsibility of leadership in the company is to choose values and spread them across the workplace culture in order to develop a totalquality culture. The company's quality policy should sufficiently illustrate the principles that it will use to achieve its quality objectives. For instance, the quality policy statement's collaboration and customer-first work culture mirror the value system.

Vision: The development of a vision statement is crucial to the operation of leadership. The organization's emphasis in operating, notion of its future, where it wants to go, and how it will get there should all be clearly expressed in the vision statement. The aim of a vision statement is to unite and motivate everyone toward a shared goal, turn all actions into narrowly defined objectives, and foster passion in the workplace. Therefore, leadership should have a keen eye for the future, respect for the quality culture, and knowledge of human psychology and competitive dynamics while creating a vision. Unusual vision statement would be:

By 2010, with new market penetration, the release of new and modern products, and the provision of top-notch goods and services to the consumers with guaranteed satisfaction, we will be the nation's industry leader in our chosen sector of business. Our trademarks will be value addition, exemplary customer service, and constant product and service improvement. A vision statement has to be specific about what, when, and how it will happen; it ought to excite the employees of the firm; and it ought to relate to the requirements of the clients. All members of the organization should be made aware of the vision statement, which should unite them for the organization's future course.

Mission: The company's purpose and the part it wishes to play in wider social, economic, national, or environmental aspects are all outlined in the mission statement. Because it describes what business the firm wants to be in and why, the mission is often also referred to as the "purpose" of the organization. Therefore, depending on the kind of company, the mission statement will vary greatly.

For instance, a bank may describe its purpose as follows: To be in the financial services industry, to provide its clients competitive financial services, to foster societal economic success, and to contribute to overall national development. A school can declare that its purpose is to "foster national progress through the development of professional skills and entrepreneurial spirit." Both statements, however, include the kind of company they want to start, why, and how they plan to contribute to a larger cause.

The vision and purpose provide the benchmarks that the quality policy will use to set direction and quality objectives. They give the framework on which the quality policy should be developed, and this quality policy serves as the beginning point for the organization's path toward comprehensive quality. Leadership entails creating a vision, goal, and quality policy that inspires and encourages the workforce.

CONCLUSION

In conclusion, The Critical Path Method is a powerful project management tool that facilitates complicated project planning, scheduling, and management. Project managers may successfully manage project timelines, prioritize work, and allocate resources by identifying the important activities and establishing the critical route. The use of CPM results in better project scheduling, resource allocation, and risk management, all of which help a project be completed successfully. Construction, engineering, information technology, and manufacturing are just a few of the areas and businesses where the Critical Path Method has found widespread use. It is an invaluable tool for project managers looking to complete projects on schedule and under budget due to its capacity to improve project scheduling, resource allocation, and risk management.

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