Course: Production & Operations Management (8509)
Semester: Autumn, 2021
ASSIGNMENT No. 1

Q. 1 What is Production and Operation Management? How could you analyze the problems of production management? Discuss with examples.

The very essence of any business is to cater needs of customer by providing services and goods, and in process create value for customers and solve their problems. Production and operations management talks about applying business organization and management concepts in creation of goods and services.

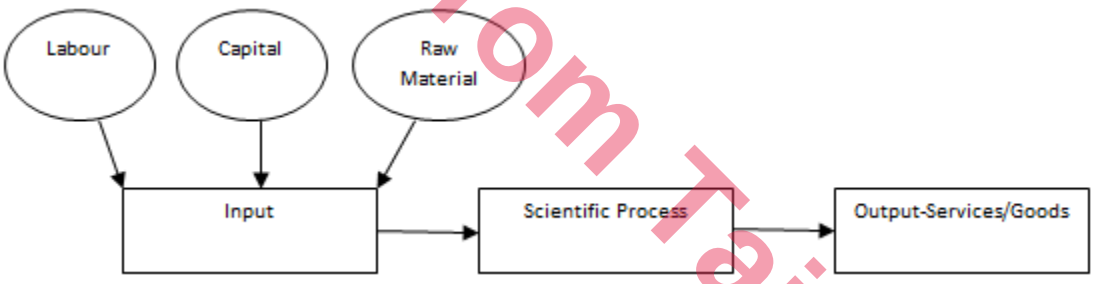
Production

Production is a scientific process which involves transformation of raw material (input) into desired product or service (output) by adding economic value. Production can broadly categorize into following based on technique:

Production through separation: It involves desired output is achieved through separation or extraction from raw materials. A classic example of separation or extraction is Oil into various fuel products.

Production by modification or improvement: It involves change in chemical and mechanical parameters of the raw material without altering physical attributes of the raw material. Annealing process (heating at high temperatures and then cooling), is example of production by modification or improvement.

Production by assembly: Car production and computer are example of production by assembly.



Importance of Production Function and Production Management

Successful organizations have well defined and efficient line function and support function. Production comes under the category of line function which directly affects customer experience and there by future of organization itself.

Aim of production function is to add value to product or service which will create a strong and long lasting customer relationship or association. And this can be achieved by healthy and productive association between Marketing and Production people. Marketing function people are frontline representative of the company and provide insights to real product needs of customers.

An effective planning and control on production parameters to achieve or create value for customers is called production management.

Operations Management

As to deliver value for customers in products and services, it is essential for the company to do the following:

1. Identify the customer needs and convert that into a specific product or service (numbers of products required for specific period of time)
2. Based on product requirement do back-ward working to identify raw material requirements
3. Engage internal and external vendors to create supply chain for raw material and finished goods between vendor → production facility → customers.

Operations management captures above identified 3 points.

Production Management v/s Operations Management

A high level comparison which distinct production and operations management can be done on following characteristics:

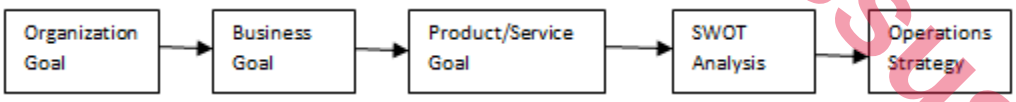
- **Output:** Production management deals with manufacturing of products like (computer, car, etc) while operations management cover both products and services.
- **Usage of Output:** Products like computer/car are utilized over a period of time whereas services need to be consumed immediately
- **Classification of work:** To produce products like computer/car more of capital equipment and less labour are required while services require more labour and lesser capital equipment.
- **Customer Contact:** There is no participation of customer during production whereas for services a constant contact with customer is required.

Production management and operations management both are very essential in meeting objective of an organization.

Operation Strategy

Operational strategy is essential to achieve operational goals set by organization in alignment with overall objective of the company. Operational strategy is design to achieve business effectiveness or competitive advantage.

Operational strategy is planning process which aligns the following:



In this global competitive age organization goal tend to change from time to time therefore operations strategy as a consequence has also be dynamic in nature. A regular SWOT analysis ensures that the organization is able to maintain competitive advantage and business leadership.

Strategic Management Process for Production and Operation

For success of organizational strategic objective, strategic planning has to trickle down to various function areas of the business. In order to build strategy management process a sequential process as below is followed

Competition Analysis: In this step company evaluates and studies current competition in the market and practices that are followed in the industry for operations and production vis-vis company policies

Goal Setting: Next step involves narrowing down the objective towards which the organization wants to move towards.

Strategy Formulation: The next step is breaking down of organizational goals into operations and production strategies.

Implementation: The final step is to convert operations and production strategies into day to day activities like production schedule, product design, quality management etc.

As organizations are always customer-centric, production and operation strategy for organization are built around them

Productivity

Measurement of formulated operations and production strategy is important to maintain alignment with the organization objectives. In simple terms productivity is defined as sum of total output per employee or per day. Productivity of company is dependent on industry and environmental conditions in which it is operating.

Two essential part of productivity are labor and capital. In scenario of limited resources, optimum and efficient utilization of labor and capital will generate favorable productivity. Productivity measurement also enables company to identify areas which require improvement or special focus. Also productivity provides ready report card to measure status against company's production objective.

Productivity measurement can be classified in three categories based on the inputs used for calculation. Partial productivity ration of output is compared to one of resource used for example, labor productivity where output is compared to the labor wages.

Total productivity measure takes into consideration sum of all input factors which are used for the output.

In the modern age technology plays an important part in productivity.

Wastivity

Another important factor is the case of production is wastivity. Not 100% of input would be converted to output, there is going to waste during production. Wastivity is reciprocal of productivity. Classic examples of wastivity are defective products and services which either have to be re-cycle or disposed of completely. Other example is idle capacity of material, man-power equipment etc.

Q. 2 What is product design? Discuss and analyze the evaluation of product design with examples.

The definition of product design describes the process of imagining, creating, and iterating products that solve users' problems or address specific needs in a given market.

The key to successful product design is understanding the end-user customer, the person for whom the product is being created. Product designers attempt to solve real problems for real people by using empathy and knowledge of their prospective customers' habits, behaviors, frustrations, needs, and wants.

Ideally, product design's execution is so flawless that no one notices; users can intuitively use the product as needed because product design understood their needs and anticipated their usage.

Good product design practices thread themselves throughout the entire product lifecycle. Product design is essential in creating the initial user experience and product offering, from pre-ideation user research to concept development to prototyping and usability testing.

But it doesn't end there, as product design plays an ongoing role in refining the customer experience and ensuring supplemental functionality and capabilities get added in a seamless, discoverable, and non-disruptive manner. Brand consistency and evolution remain an essential product design responsibility until the end of a product's lifespan.

And it's much more than just what users see on their screens. System design and process design are critical behind-the-scenes components that eventually drive users to see and interact with the interface design.

"Industrial design is the professional practice of designing products used by millions of people worldwide every day. Industrial designers not only focus on the appearance of a product but also on how it functions, is manufactured and ultimately the value and experience it provides for users."

Before the mass-production era of manufacturing, craftspeople built products primarily by hand. This meant there were fewer products available for sale and that they cost more. Then, the industrialization of manufacturing allowed businesses to mass-produce products inexpensively.

To help sell their products to the millions of people who could now afford them, manufacturers enlisted the help of industrial designers to create products that were not only functional but also aesthetically pleasing.

Over time, a subset of industrial design has evolved into its own category: product design. This is because industrial design today connotes physical products such as furniture and household appliances. In contrast, product design can refer to any product—even digital, virtual products such as software apps.

UX designer

User-experience and interaction designers focus on refining a product based on how their research into user behavior suggests people will get the most satisfaction from using the product. UX designers aim to increase users' happiness.

Graphic designer

The most artistic job within product design is creating the graphics, icons, logos, and other visual elements of the product experience. Their purview is as broad as selecting a color scheme to as narrow as tweaking individual pixels.

Motion/animation designer

If the product experience involves elements "moving"—be it slick transitions or a user-controlled avatar—these specialists work on this extremely complicated part of the design. They don't create the art, but they bring it to life.

User research

In a large enough product design organization, they are solely focused on understanding customers. Interviewing, running usability studies, presenting prototypes and mockups for feedback, and building out demographics and personas that fall under their purview.

Data analyst

These designers focus on user research and other data to identify ways to improve a product's layout, feature set, and visual aesthetic. In other words, their primary role is a scientific one, but they are also designers.

Prototyper

Prototypers are the product team members who bring the team's ideas to a tangible state to help the company quickly validate with users the product's features and other characteristics. In a company that makes physical products, prototypers will hand-craft mockups. For digital companies, the prototyping team will develop wireframes or other virtual mockups.

Product designer

Of course, in many cases, a company will hire a person to handle several of the roles above and others under a product designer job. Other companies will handle some of the bigger picture, strategic elements of developing new product ideas. There, other professionals in the organization take responsibility for things like—user research, UX design, information architecture, etc.

The details of the product design process will vary from company to company, but these professionals tend to follow a similar philosophy or framework when it comes to design thinking. As Cam Sackett explains, the design-thinking process involves several steps:

1. Empathize with people
2. Define the problem
3. Ideate a solution
4. Build a prototype
5. Test the solution

Sackett also points out that the design process doesn't necessarily move in a linear path, although arranged linearly. Sometimes the results learned in a given step lead the team back to repeat or refine an earlier step.

The product design process never truly stops, even once a product reaches maturity. That's because technology and how users interact with it keep evolving.

Take the ever-increasing importance of mobile devices. For years, mobile apps and phone-friendly websites had limited capabilities, while the bulk of the user experience required a full computer.

But product designers have had to keep pace with shifting usage patterns, bringing more and more functionality to smaller screens to meet the real-world usage preferences of customers. And with each new technological innovation, product design must determine its potential impact on the user experience and adjust accordingly.

Lean Product Design

Bringing innovative products to market as quickly as possible is the bedrock of Lean, Agile, and other popular approaches to software development. But Lean Product Design goes one step further, introducing rapid iterations to the pre-coding product development phase.

The process identifies the product's key value proposition and differentiators, speedily introducing a working-yet-limited product to spark the feedback loop immediately and begin generating sales or queue up interesting prospects to establish and quantify product-market fit.

The journey to product introduction

Facilitating this expeditious journey to product introduction requires lots of cross-functional interactions and collaboration. It's not uncommon for product designers to partner with product managers or business-side experts for the initial concept development before joining forces with a lone developer or small team to generate working prototypes and early versions of the product.

These Lean teams succeed because they share a common goal and both welcome and incorporate user feedback swiftly. The focus on reducing waste—a holdover from Lean's manufacturing origins—applies in these cases to maximizing resource utilization and not sweating the small stuff until the major components are proven to resonate with users, solve their problems, and create value and satisfaction.

Lean Product Design only works in organizations that embrace continuous learning and accept that they already know everything. Moving forward with unknowns and unanswered questions doesn't always sit well in larger enterprise settings. In these settings, they build, measure, and learn in the face of well-plotted master plans. The plans stretch out years into the future.

Chunking out larger solutions into smaller, discrete products or features may calm some of that trepidation. It gives stakeholders a chance to see progress and watch how the continuous feedback loop and rapid iterations result in solutions that truly meet the market needs in short order. It may feel risky at first, but Lean Product Design is actually a far safer bet than building a huge product over months or years with zero external input until it ships or moves into a beta program.

Q. 3 How a manager involves employees in TQM process to control the quality of product? Discuss with examples.

Total Quality Management is defined as a continuous effort by management to upgrade and improve the processes and systems to ensure superior quality products. Every organization has to take care of its customers. Their feedbacks are essential. Total Quality management creates processes and systems based on customer feedbacks and various researches which eventually help in the development of organization.

Managers play an important role in Total Quality Management:

Initiating and implementing total quality management programs require great amount of planning and research. Managers need to get trained in various TQM practices before implementing the same. There are costs involved with the entire process of total quality management. It is the manager's responsibility to allocate budgets for

TQM at the beginning of every financial year. Remember, you can't crib later on. Read a lot about total Quality management.

You need to be convinced first why quality is such an important parameter in every business. If you yourself are not convinced, it would be very difficult for you to convince other departments for implementing TQM. Know who your customers are? Understand your target market carefully. Go out, meet customers and find out as to what all they expect from your brand. Customer feedbacks play an important role in formulating strategies for total quality management. As a manager; you need to work closely with the senior management, human resource professionals to develop foolproof implementation strategies. Remember, a manager has to act as a bridge between the senior management and the entire workforce.

The role of a manager is to act as a facilitator at the workplace. It is your duty to assist employees in implementing TQM. As a manager, it is your responsibility to select and appoint right individuals who can work as line managers and take charge of the entire project. The employees, you select ought to be reliable and diligent and should be capable enough to handle a crucial project like total quality management. It is the manager's responsibility to assign resources for total quality management, allocate time for various training programs and appreciate employees who come up with various improvement ideas and strategies which would help the organization deliver superior quality products. Further train your subordinates to ensure smooth implementation of TQM without any obstacles.

A manager must communicate the benefits of total quality management to all other members of the organization. Call employees on a common platform and address the benefits and importance of total quality management. Make them understand how successful implementation of total quality management programs would yield high quality products which would not only benefit the organization but also the employees associated with the same. Why do we always think of outsourcing trainers? Why can't we train employees on our own? Believe me, as a manager if you train your employees, the results would be better rather than an unknown face coming and loading them with information. Do not forget, a trainer needs to be prepared for every question. Do your homework carefully.

Remember, a manager is always a strong source of inspiration for other employees. You need to practice total quality management yourself before expecting others to believe in the same. Customer feedbacks should be carefully monitored and taken into consideration while formulating company's major strategies. Provide frequent reports to staff members highlighting scope of improvement.

Both Six Sigma and Total Quality Management are effective tools for quality management but a thin line of difference does exist between them. Although the methodologies and procedures involved in both the two appear quite similar but there are certain major differences.

Six-Sigma is a relatively newer concept than Total Quality Management but not exactly its replacement. The basic difference between Total Quality Management and Six Sigma is that TQM delivers superior quality manufactured goods whereas six sigma on the other hand results in better results. Total Quality management

refers to continuous effort by employees to ensure high quality products. The process of Six Sigma incorporates many small changes in the systems to ensure effective results and better customer satisfaction.

Total Quality Management involves designing and developing new systems and processes and ensures effective coordination among various departments. New Processes are developed based on various customer feedbacks and researches.

The main focus of Total quality management is to maintain existing quality standards whereas Six Sigma primarily focuses on making small necessary changes in the processes and systems to ensure high quality. The process of Total quality management does reach to a saturation level after a certain period of time. After reaching the saturation stage, no further improvements in quality can be made. Six Sigma on the other hand seldom reaches the saturation stage by initiating a next level quality process.

The process of Total quality management involves improvement in existing policies and procedures to ensure high quality. **Six-Sigma focuses on improving quality by minimizing and eventually eliminating defects from the system**. The process of total Quality management ensures that every single member associated with the organization is working towards the improvement of existing processes, systems, services and work culture for long term quality products/services. Six Sigma, on the other hand focuses on first identifying and eventually removing various defects and obstacles which might come in the way of organization's success. In a layman's language total quality management emphasizes on improving the existing policies and making necessary changes in the systems to ensure superior quality products and services. Organizations practicing Six Sigma are focused on removing errors and defects to ensure high quality products.

Total Quality management is a less complicated process than Six Sigma. Six-Sigma involves specially trained individuals whereas total quality management does not require extensive training. The process of Six Sigma creates special levels for employees who are only eligible to implement the same. Employees trained for Six Sigma are often certified as "Green Belts" or "Black Belts" depending on their level of proficiency. Six-Sigma requires participation of only certified professionals whereas total quality management can be referred to a part time activity which does not require any special training. Six-Sigma can be implemented by dedicated and well trained professionals.

Six-Sigma is known to deliver better and effective results as compared to total quality management. The process of Six Sigma is based on customer feedbacks and is more accurate and result oriented. Customer feedbacks play an important role in Six Sigma. Experts predict that six sigma will outshine total quality management in due course of time.

Q. 4 What is man machine analysis and why it is important? Discuss that how man machine analysis is conducted to get desired results.

The analysis of man-machine systems aimed at first at the optimization of displays and controls to create better working conditions. The general approach was then machine-centred. Gradually it appeared necessary to

reverse this attitude into a man-centred approach. Instead of analysing man as an operator it seems now indispensable to study the operator as a man which implies an anthropological approach.

The structure of the operator's activities has to be examined. In this connexion it is important to lake into account his vision of the situation resulting from the implementation of his work. The operator has to be considered as a whole, as a complete system receiving information not only from the object he is working at but also through different channels connecting him with the environment as well as from signals coming from himself. Sometimes these non-instrumental signals achieve a greater importance than the instrumental ones. However, the drafting of a comprehensive psychological theory of human activity taking fully into account its structure needs further studies.

a system consisting of a human operator or group of operators and a machine, by means of which the operator p erforms a task involving, for example, the production of material goods, the management of some type of operat ion, or the processing of information. Human labor in a man-machine system is based on interaction according t o received information with both the object of labor or control and the machine through the mediation of control elements.

Interest in man-machine systems arose in the mid-20th century, when systems of various kinds became with inc reasing frequency the objects of technical planning and design. The effectiveness of these systems, which includ ed those for the control of production, transportation, communications, and space flights, was largely determine d by the activity of the human operators. The combination of human abilities and capabilities of a machine or co mplex of technological devices significantly increases the effectiveness of control. Although there is a joint perf ormance of control functions by the human operator and machine, each of the two components of the system is governed in its work by its own unique rules. The effectiveness of the system as a whole is determined by the ex tent to which characteristic features of the operator and machine, both limitations and potentials, are identified a nd taken into account when building the system. These features are most fully identified in the process of coordi nating the external, that is, technological, means of action and the internal means of action, that is, means inhere nt to the operator. Coordination includes the construction of information and conceptual models.

The information model is a representation, organized according to a definite system of rules, of the states of the object of labor or control, the man-machine system itself, the environment, and the procedures for acting upon t hese states. Physically speaking, information models are built using data display equipment. With an informatio n model at hand, the operator uses his own knowledge and experience to formulate a conceptual model—the ag gregate of his own ideas about the goals and objectives of the labor activity and about the states of the object of labor, the man-machine system itself, the environment, and the procedures for acting upon the states.

One of the key problems in constructing man-machine systems is the optimal distribution of functions between t he operator and technological devices, that is, determining which operations must be performed by the operator and which by the machine to ensure the required effectiveness. There are two basic variations in the distribution of functions. In the first, the operator merely monitors the machine performing the task and confirms the result;

in the second, the operator and machine must perform certain motions jointly. Here, a result cannot be obtained without joint operation. The first variation is a type of parallel organization of interaction between the operator and machine, while the second reflects a sequential, or stepwise, organization. In choosing one variation or the other, consideration must be given to methodological factors relating to the social function of man as the doer of labor and to the practical recommendations of management science, including recommendations on the organization of control at the higher levels of the system. Assessments from engineering psychology and results from studies on the psychophysiological functions of man should have an important place in these considerations. According to current ideas, an efficient, and even an optimal, distribution of functions should be based on quantitative evaluations of the quality of task performance by the operator and by the machine and on evaluations of the effect of this quality on the overall effectiveness of the system.

No uniform classification of man-machine systems has yet been made. Human functions in such systems that reflect a fundamental change in the technological method of linking man and machine may serve as the distinguishing criterion. “Labor,” wrote Marx in describing automated production, “is now not so much part of the process of production as it is a role whereby man assumes the attitude of controller and regulator in relation to the process of production. Instead of being the main agent of the production process, the worker assumes a place alongside the process”. There are five basic classes of man-machine systems. In the first, the human operator is included in the technological process, to which he must constantly attend. He is guided in his work by instructions, which cover virtually all possible situations and solutions. Operators at transfer lines and operators who receive and transfer information are part of this type of man-machine system. In systems of the second class, operators monitor and control a process. Operators in radar systems and traffic controllers in transportation systems are part of these systems. The third class of man-machine systems requires the operator to issue commands to robots, manipulators, and machines that amplify human muscular energy. In systems of the fourth class, the operator acts as an investigator. Decipher clerks and computer operators are examples of operators in this class. In systems of the fifth class, the operator is called upon to make management decisions. Organizers, planners, and executives work with systems in this class. In the second, fourth, and fifth classes of systems, the operator can set up a dialogue with the machine. Here, the operator and machine alternate in performance of the task.

Study of man-machine systems can and must be carried out as an investigation of the functional whole. Treating the human being as a special component in a technical system makes it possible to increase the effectiveness of the system. This approach, however, is not without limitations; by treating man as a “black box,” both the social nature of labor and the role of man as the doer of labor are overlooked. The relation between man and machine is above all a relation between the doer of labor and the implement of labor.

The basic difficulty in studying man-machine systems lies in the need to combine research from such different branches of science as physiology, engineering, psychology, human-factors engineering, and cybernetics, each of which has its own methodology and terminology.

Q. 5 Explain Transportation Method. Discuss the mechanism of Transportation Method with examples.

Mode of transportation (or transportation mode) refers to different ways by which goods or people are transported from one place to the other through land, air or sea. The other modes are via pipelines (for gas/oil transfer), cable (internet, energy supply), and space (satellite).

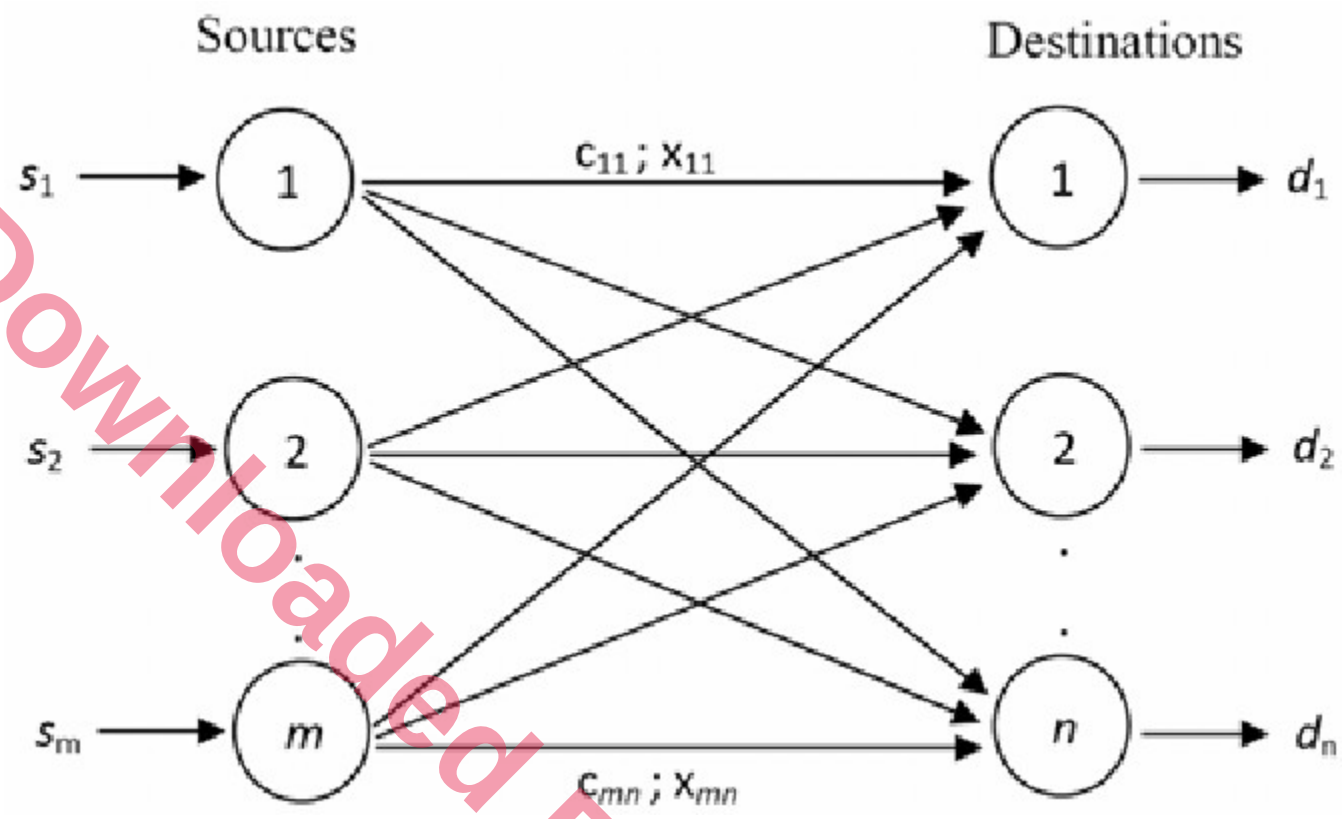
The Transportation Method of linear programming is **applied to the problems related to the study** of the efficient transportation routes i.e. how efficiently the product from different sources of production is transported to the different destinations, such as the total transportation cost is minimum.

Operations Research (OR) is a state of art approach used for problem-solving and decision making. OR helps any organization to achieve their best performance under the given constraints or circumstances. The prominent OR techniques are,

- Linear programming
- Goal programming
- Integer programming
- Dynamic programming
- Network programming

One of the problems the organizations face is the transportation problem. It originally means the problem of transporting/shipping the commodities from the industry to the destinations with the least possible cost while satisfying the supply and demand limits. It is a special class of linear programming technique that was designed for models with linear objective and constraint functions. Their application can be extended to other areas of operation, including

- Scheduling and Time management
- Network optimization
- Inventory management
- Enterprise resource planning
- Process planning
- Routing optimization



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transportation problem arc and node diagram

The notations of the representation are:

m sources and n destinations

(i , j) joining source (i) and destination (j)

c_{ij} → transportation cost per unit

x_{ij} → amount shipped

a_i → the amount of supply at source (i)

b_j → the amount of demand at destination (j)

Transportation problem works in a way of minimizing the cost function. Here, the cost function is the amount of money spent to the logistics provider for transporting the commodities from production or supplier place to the demand place. Many factors decide the cost of transport. It includes the distance between the two locations, the path followed, mode of transport, the number of units that are transported, the speed of transport, etc. So, the focus here is to transport the commodities with minimum transportation cost without any compromise in supply and demand. The transportation problem is an extension of linear programming technique because the transportation costs are formulated as a linear function to the supply capacity and demand.

Transportation problem exists in two forms.

1. Balanced
2. Unbalanced

Balanced

It is the case where the total supply equals the total demand.

Unbalanced

It is the case where either the demand is greater than the supply, or vice versa.

In most cases, the problems take a balanced form. It is because usually, the production units work, taking the inventory and the demand into consideration. Overproduction increases the inventory cost whereas under production is challenged by the demand. Hence the trade-off should be carefully examined. Whereas, the unbalanced form exists in a situation where there is an unprecedented increase or decrease in demand.