

1. Describe the five basic management functions.

Answer:

The five basic management functions, as proposed by Henri Fayol, are widely recognized and form the foundation of modern management theory. These functions provide a framework for effectively managing an organization and achieving its goals. The five functions are:

1. Planning: Planning involves setting organizational goals and determining the best course of action to achieve them. It includes defining objectives, developing strategies, and creating detailed action plans. Planning helps managers anticipate future challenges, allocate resources effectively, and establish a roadmap for success.

Example:

- A marketing manager creates a detailed marketing plan that outlines the objectives, target audience, strategies, and tactics for a new product launch.
- A project manager develops a project plan that includes a timeline, resource allocation, and milestones to guide the team in completing a complex project within a specific timeframe.

2. Organizing: Organizing focuses on structuring and arranging the resources of an organization to accomplish its goals. This function involves tasks such as defining roles and responsibilities, establishing reporting relationships, grouping activities into departments or teams, and designing the overall organizational structure. Organizing ensures that the right people, resources, and processes are in place to execute the plans effectively.

Example:

- A human resources manager organizes the recruitment process by defining job roles, responsibilities, and qualifications, and establishing a systematic process for attracting, selecting, and onboarding new employees.
- An event planner organizes a conference by coordinating logistics, such as venue selection, catering, scheduling speakers, and managing registration.

3. Leading: Leading involves influencing and inspiring people to work towards the organization's objectives. This function encompasses activities such as motivating employees, providing guidance, resolving conflicts, and communicating the organization's vision and values. Effective leadership helps create a positive work culture, fosters teamwork, and encourages employee engagement and productivity.

Example:

- A team leader motivates and inspires team members by recognizing their achievements, providing guidance and support, and fostering a positive work environment to enhance team performance and collaboration.
- A CEO delivers a compelling vision and communicates the company's strategic direction to employees, inspiring them to align their efforts towards shared goals.

4. Controlling: Controlling is the process of monitoring and evaluating the organization's performance to ensure that it is on track towards its goals. It involves establishing performance standards, measuring actual performance, comparing it with the set standards, and taking corrective actions if necessary. Controlling helps managers identify deviations from the planned course, address issues promptly, and maintain accountability within the organization.

Example:

- A production manager monitors manufacturing processes, regularly inspects product quality, and takes corrective actions to ensure that the final products meet the desired standards.
- A financial manager reviews financial statements, analyzes budget variances, and implements cost-control measures to ensure that the company's financial performance remains on track.

5. Coordinating: Coordinating involves synchronizing and harmonizing the efforts of different individuals and departments within the organization. It includes activities such as aligning tasks, integrating processes, and facilitating collaboration among various teams. Coordinating ensures that different parts of the organization work together efficiently and effectively towards common objectives, promoting synergy and optimizing overall performance.

Example:

- A project manager coordinates the efforts of different teams, such as design, development, and testing, to ensure that they work together seamlessly and meet project deadlines.
- An operations manager coordinates with suppliers, logistics providers, and distribution centers to streamline the supply chain and ensure timely delivery of products to customers.

These five functions are interrelated and interdependent, and successful managers must be proficient in all of them to effectively manage their organizations and achieve sustainable success.

2. Briefly explain the functions of an industrial enterprise, and how managers contribute to these functions.

Answer:

An industrial enterprise is a business entity involved in the production of goods or the provision of services within the industrial sector. It typically operates in a manufacturing or production environment and encompasses activities such as resource acquisition, production processes, quality control, and distribution of products. The functions of an industrial enterprise can be broadly categorized as follows:

1. Production: This function involves transforming raw materials, components, or inputs into finished goods or services. It includes activities such as manufacturing, assembly, packaging, and quality assurance. Managers play a crucial role in overseeing production processes, optimizing efficiency, ensuring product quality, and implementing continuous improvement initiatives.

2. Operations Management: Operations management focuses on the effective management of resources, processes, and systems to ensure smooth operations. It includes activities such as capacity planning, inventory management, scheduling, and logistics. Managers contribute by devising efficient operating procedures, optimizing resource allocation, implementing technology solutions, and streamlining supply chain operations.

3. Human Resources Management: This function involves managing the organization's workforce, including recruitment, training, performance evaluation, and employee relations. Managers play a critical role in hiring skilled personnel, fostering a positive work environment, promoting employee development, and ensuring compliance with labor regulations.

4. Sales and Marketing: The sales and marketing function involves identifying customer needs, promoting products or services, generating sales, and building customer relationships. Managers contribute by developing marketing strategies, setting sales targets, managing distribution channels, analyzing market trends, and monitoring customer satisfaction levels.

5. Financial Management: Financial management encompasses activities related to budgeting, financial planning, cost control, financial reporting, and investment decisions. Managers contribute by preparing budgets, analyzing financial data, managing costs, optimizing financial resources, and making informed financial decisions to ensure the financial health of the industrial enterprise.

In each of these functions, managers play a vital role by providing leadership, making strategic decisions, setting goals and objectives, allocating resources effectively, coordinating activities, motivating employees, monitoring performance, and ensuring that the organization operates efficiently and achieves its objectives. They are responsible for planning and executing strategies, managing risks, fostering innovation, and adapting to changes in the business environment to drive the success and growth of the industrial enterprise.

3. Discuss the different types of organizational structures and explain the advantages and disadvantages of each type (use sketches).

Answer:

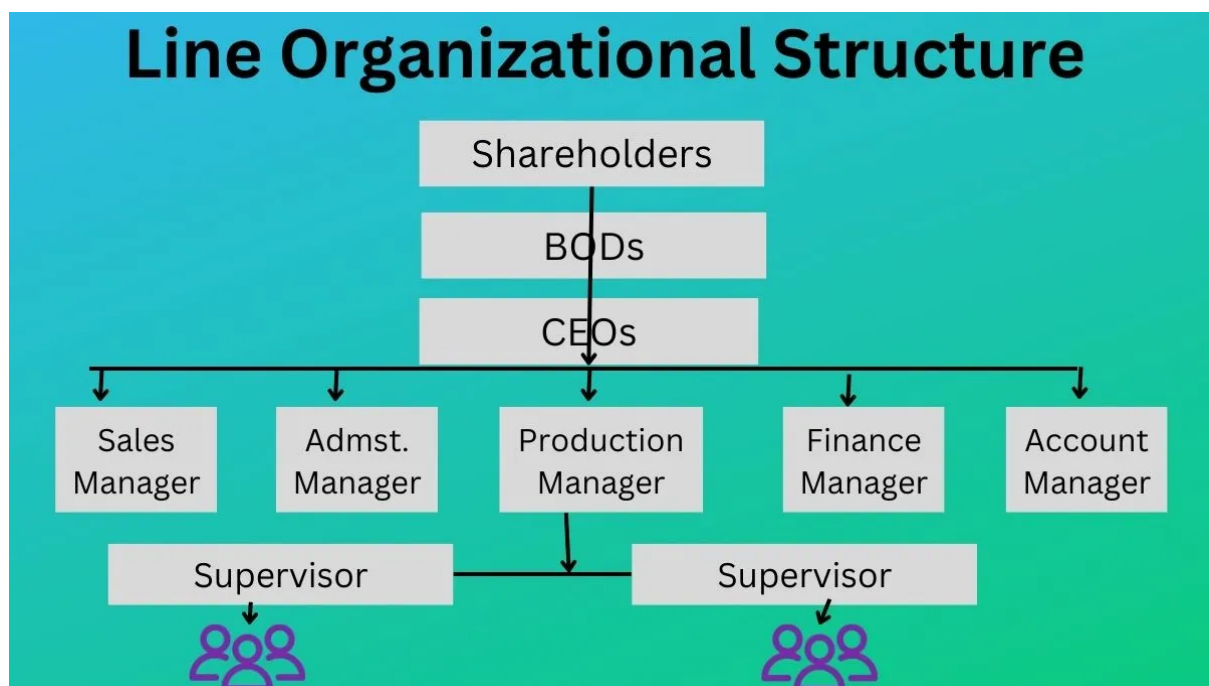
There are several types of organizational structures commonly used in businesses. Each structure has its own advantages and disadvantages, and the choice of structure depends on

factors such as the size of the organization, its goals, the nature of its operations, and the desired level of hierarchy and coordination. Here are four common types of organizational structures:

1. Line Organizational Structure: Line organizational structure is a structure where the authority flows directly from top to bottom or from the top management to the employees and responsibility goes upward. It follows a hierarchical chain of command, with clear lines of authority and responsibility. It consists of direct vertical relationships which connect the task and position of each level with those above and below it.

Line structure is one of the easiest and oldest forms of organizational structure. Here, the hierarchy of authority is clearly defined and all decision-making power is vested in top positions i.e. top managers.

This organizational structure is also called simple structure, military structure, and hierarchal structure. It is first developed and used by a military organization which is why it is also called military organizational structure.



☐ Advantages

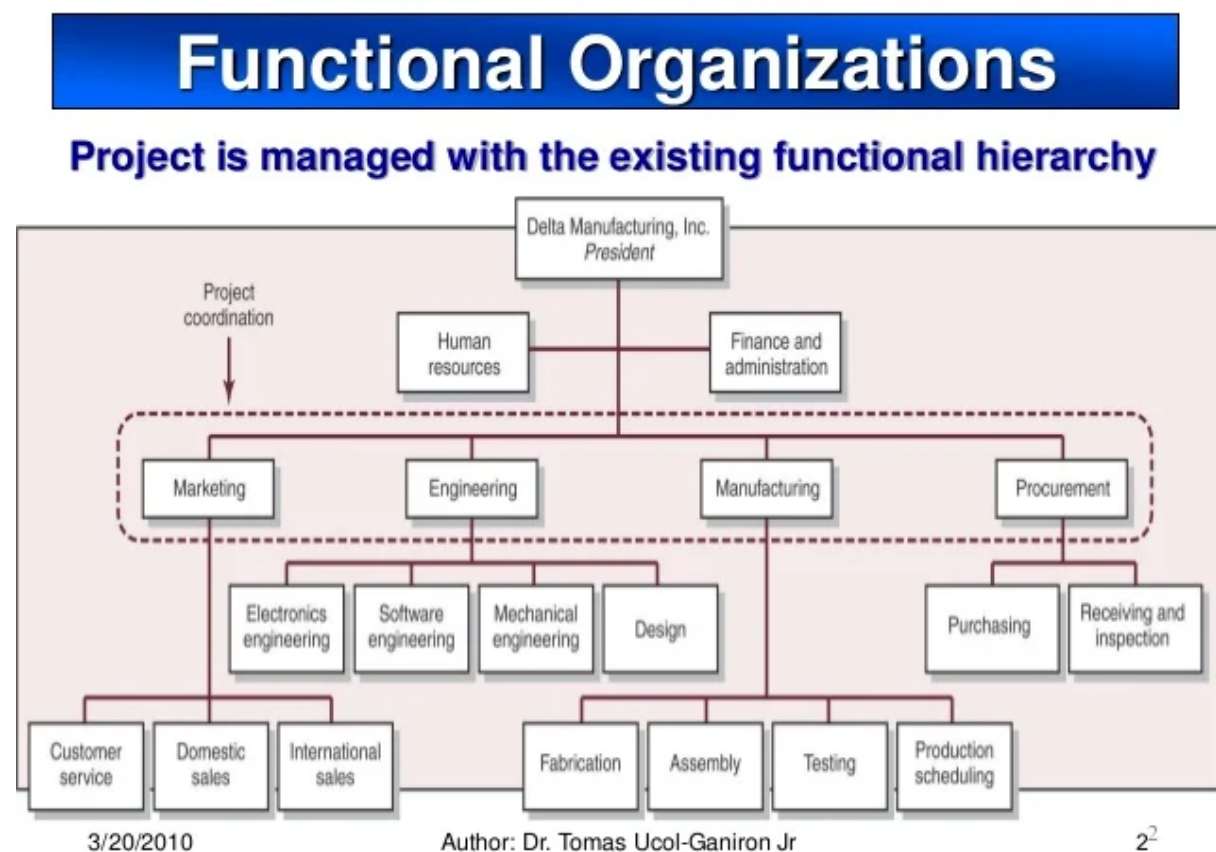
- Clear and simple structure with a well-defined chain of command.
- Fast decision-making due to centralized authority.
- Clear accountability and easy communication.

☐ Disadvantages

- Limited specialization or functional expertise.
- Potential for overburdening top management with decision-making.
- Communication and coordination challenges across different departments.

2. Functional Organizational Structure: A functional organization is the most common type of organizational structure. This is where the organization is divided into smaller groups based on specialized functions or areas of expertise, such as marketing, finance, operations, and human resources, IT. This departmentalization allows greater operational efficiency because the employees have their skills and knowledge to be shared within the group. The basis of this functional organization structure is an arrangement where a worker has different managers for different areas of the organization operation. Each department operates independently, focusing on its specific function. Since this type of structure has many departments, it could also have several reporting structures as well.

In a functional organization structure, the reporting relationships are grouped based on the specialty or functional area. Separate areas are established to take care of different concerns.



☐ Advantages

- Clear specialization and expertise within each department.
- Efficient use of resources and economies of scale within functional areas.
- Enhanced career development opportunities within specialized functions.

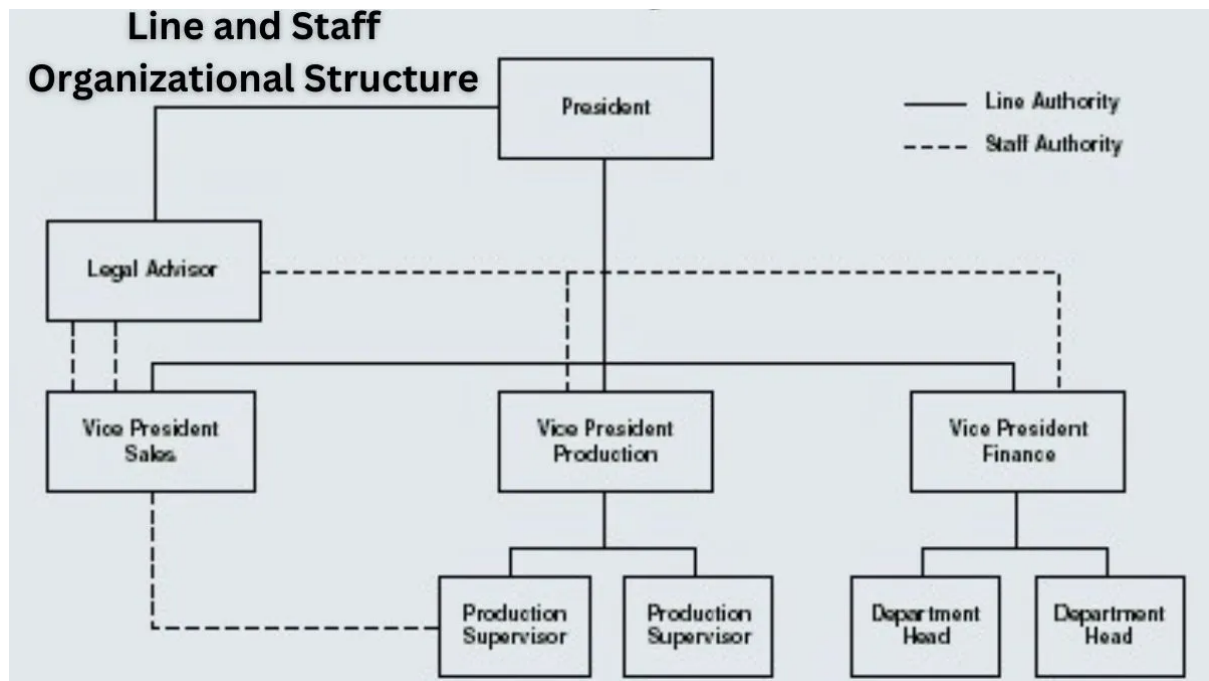
☐ Disadvantages

- Limited communication and coordination between functional departments.
- Slow decision-making and difficulty in adapting to changing market conditions.

- Potential for conflicts and lack of focus on overall organizational goals.

3. Line and Staff Organizational Structure: A line and staff organizational structure is a combination of line and functional organizational structures. It includes both line departments responsible for core activities and staff departments that provide specialized support and advice. Where line organizational structure includes a clear hierarchy of authority where authority flows from top to bottom and responsibility from bottom to top. Whereas, the functional organizational structure includes the creation of different departments based on the type and nature of work.

The main goal of this organizational structure is to create a balance between line and functional organization. Meaning that it tries to minimize the drawbacks of both structures and increase their strength so as to become an effective organizational structure.



☐ **Advantages**

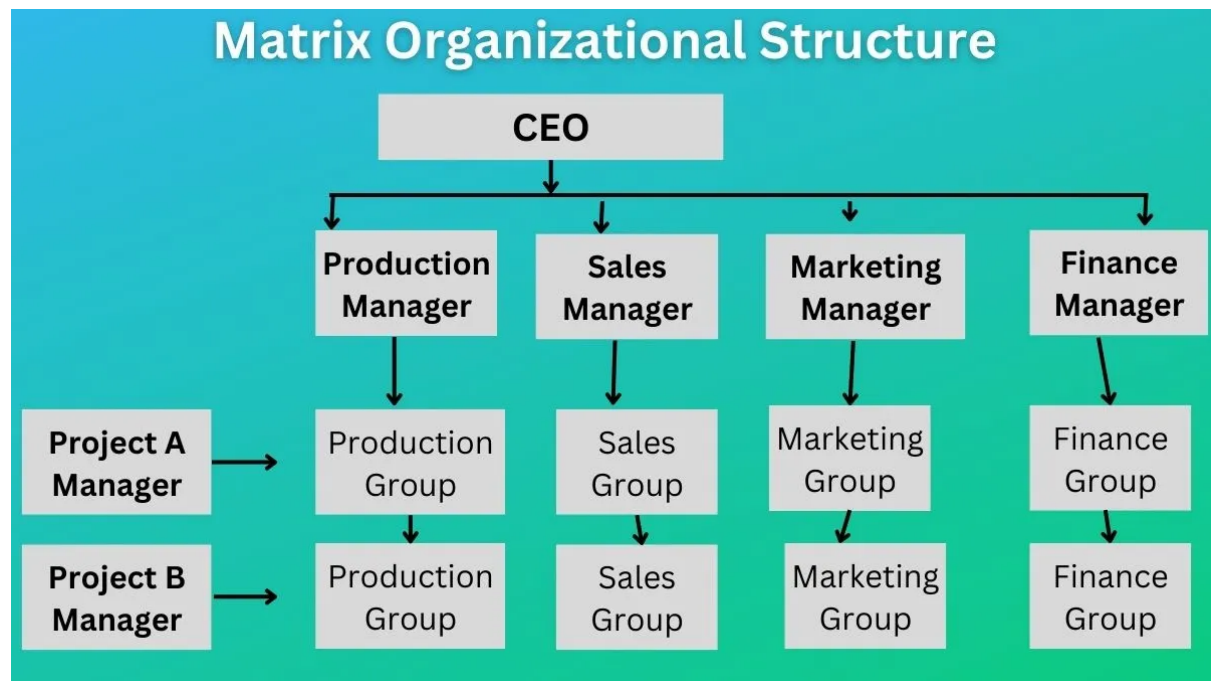
- Specialized expertise provided by staff departments to support line functions.
- Clear accountability and authority in line departments.
- Efficient utilization of resources by leveraging staff support.

☐ **Disadvantages**

- Potential conflicts and power struggles between line and staff departments.
- Communication challenges and coordination issues across different departments.
- Potential for confusion and role ambiguity within the organization.

4. Matrix Organizational Structure: A matrix organizational structure involves a flexible and dynamic arrangement where employees report to both a functional manager and a project or product manager. It promotes cross-functional collaboration and flexibility in resource

allocation. The matrix design keeps open communication between teams and can help companies create more innovative products and services. Using this structure prevents teams from needing to realign every time a new project begins



☐ **Advantages**

- Efficient utilization of resources by leveraging expertise across functions.
- Enhanced communication and coordination between different departments.
- Flexibility to adapt to changing project requirements.

☐ **Disadvantages**

- Complexity in reporting relationships and potential for confusion.
- Increased need for coordination and potential for conflicts between managers.
- Time-consuming decision-making due to multiple stakeholders.

It's important to note that these sketches provide a simplified representation of the organizational structures, and in practice, organizations may have variations or combinations of these structures. The choice of the most suitable structure depends on various factors, including the organization's goals, size, industry, and the desired level of coordination and specialization.

4. Discuss briefly productivity and the methods of productivity improvement in manufacturing industries.

Answer:

Productivity refers to the measure of efficiency in which inputs are transformed into outputs. In the context of manufacturing industries, productivity is crucial for achieving optimal utilization of resources, maximizing output, and maintaining competitive advantage. It is often measured by the ratio of output to input, such as the number of units produced per labor hour or the value of goods produced per unit of capital invested.

To improve productivity in manufacturing industries, various methods and strategies can be employed. Here are some common approaches:

1. Process Optimization: Analyzing and optimizing manufacturing processes can lead to significant productivity improvements. This involves identifying bottlenecks, eliminating waste, streamlining workflows, and enhancing the overall efficiency of operations. Techniques like Lean manufacturing and Six Sigma can be employed to identify and eliminate non-value-added activities and improve process flow.

2. Automation and Technology: Adopting automation and advanced technologies can enhance productivity by reducing manual labor, increasing accuracy, and improving production speed. Automated systems, robotics, computer numerical control (CNC) machines, and advanced software systems can streamline operations and improve overall efficiency.

3. Employee Training and Skill Development: Investing in employee training and skill development programs can lead to increased productivity. Providing workers with the necessary knowledge, skills, and tools to perform their tasks efficiently and effectively can improve output quality, reduce errors, and minimize production time.

4. Supply Chain Management: Effective supply chain management practices can enhance productivity in manufacturing industries. This involves optimizing inventory management, improving supplier relationships, minimizing lead times, and coordinating logistics to ensure timely availability of materials and components for production.

5. Continuous Improvement and Kaizen: Embracing a culture of continuous improvement and implementing Kaizen methodologies can drive productivity gains. Encouraging employees to identify and implement small incremental improvements in processes, workflows, and systems can lead to significant cumulative productivity improvements over time.

6. Quality Management: Ensuring high quality in manufacturing processes and products can contribute to productivity improvements. By implementing robust quality control measures, conducting inspections, and actively addressing quality issues, manufacturers can minimize rework, reduce waste, and improve overall productivity.

7. Performance Measurement and Key Performance Indicators (KPIs): Establishing performance measurement systems and tracking relevant KPIs can help identify areas for

improvement and monitor progress. By regularly measuring and analyzing productivity metrics, manufacturers can focus on areas that require attention and make informed decisions to drive productivity improvements.

It's important to note that the specific methods employed for productivity improvement may vary depending on the industry, organization size, and specific operational characteristics. A comprehensive and tailored approach that addresses the unique needs and challenges of the manufacturing industry is essential for achieving sustainable productivity growth.

5. Explain the 4 types of plant layout used in manufacturing industries, and list the factors that stimulate plant Layout problems.

Answer:

Plant layout refers to the arrangement of machinery, equipment, and other resources within a manufacturing facility. It plays a crucial role in optimizing workflow, minimizing material handling, improving productivity, and ensuring efficient utilization of space. There are four main types of plant layouts commonly used in manufacturing industries:

1. Product or Line Layout

In a product or line layout, the equipment and workstations are arranged in a sequential order that follows the production flow. Each workstation is dedicated to a specific operation or task related to the production of a particular product or product line. The materials flow in a straight line from one workstation to another.

☐ **Advantages**

- Streamlined and efficient production flow.
- Reduced material handling and transportation time.
- High volume production with low unit costs.

☐ **Disadvantages**

- Limited flexibility to accommodate changes or different product lines.
- Susceptible to disruptions if one workstation breaks down.
- Workstation imbalance if tasks have significant variability.

2. Process or Functional Layout

In a process or functional layout, similar machines or processes are grouped together based on their function or operation. Each department or section is dedicated to a specific process, such as cutting, assembly, finishing, etc. Materials move between departments as they undergo different processes.

☐ **Advantages**

- Flexibility to handle different product lines and process variations.
- Efficient utilization of specialized equipment and resources.

- Allows for better supervision and control within each department.

☐ **Disadvantages**

- Increased material handling and longer transportation distances.
- Potential for bottlenecks and congestion at shared resources.
- Lack of direct coordination and communication between departments.

3. Fixed Position or Location Layout

In a fixed position or location layout, the product being manufactured remains stationary, and the equipment and resources are brought to it. This layout is typically used for large and heavy products, such as ships, aircraft, or buildings, where it is not feasible to move the product during the manufacturing process.

☐ **Advantages**

- Efficient utilization of resources and reduced material handling.
- Allows for close monitoring and customization of the product.
- Minimizes the need for large production areas.

☐ **Disadvantages**

- Requires careful coordination and scheduling of resources.
- Potential for congestion and limited accessibility in the work area.
- Challenges in maintaining workflow and ensuring efficient material flow.

4. Combined or Group Layout

A combined or group layout is a hybrid approach that combines elements of both product and process layouts. It involves creating cells or work areas where machines and equipment are arranged in a way that supports the workflow of a specific product or product family. Each cell handles a group of operations or processes.

☐ **Advantages**

- Improved coordination and communication within each cell.
- Flexibility to handle different products or product families.
- Reduced material handling and improved workflow within the cells.

☐ **Disadvantages**

- Complexity in designing and managing the layout.
- Potential for coordination and synchronization issues between cells.
- Requires careful planning and optimization of cell sizes and configurations.

➤ **Factors that stimulate plant layout problems include**

1. Expansion or Growth: When a manufacturing facility expands or experiences growth, the existing layout may become inadequate to accommodate increased production capacity or new equipment, leading to layout problems.

2. Changes in Product Design or Mix: Introduction of new products or changes in product design can affect the layout requirements. Different products may have different production processes or equipment needs, necessitating layout adjustments.

3. Technological Advancements: Advances in technology and automation may require modifications to the layout to accommodate new equipment, robotic systems, or advanced machinery.

4. Space Constraints: Limited available space can present challenges in designing an efficient layout, especially when attempting to balance the need for production areas, storage, material handling, and employee workspaces.

5. Safety and Ergonomics: Layout problems can arise when safety regulations or ergonomic considerations need to be addressed. Ensuring a safe and ergonomic work environment may require modifications to the layout to optimize workflow and minimize hazards.

6. Cost Reduction: Organizations may seek to reduce costs by improving layout efficiency. This can involve minimizing material handling, reducing transportation distances, or optimizing the use of resources.

7. Customer Demand and Market Changes: Changes in customer demand, market trends, or product preferences may require adjustments to the layout to support increased production, new product lines, or shifting priorities.

Addressing these factors and proactively managing plant layout problems is crucial for ensuring smooth operations, maximizing productivity, and maintaining competitiveness in manufacturing industries.

6. Consider yourself as a member of a feasibility study team, which is established to determine the general and specific plant location of an electric cable, cement and spring water-producing companies. Therefore, explain the influencing factors considered on determining the general and specific plant location of the companies. (N.B. Please choose two companies and explain only for them).

Answer:

As a member of the feasibility study team, I will consider the influencing factors for determining the general and specific plant location for two companies: the electric cable company and the cement company.

1. Electric Cable Company

a. Proximity to Raw Materials: The electric cable manufacturing process requires various raw materials, such as copper or aluminum wires, insulation materials, and coatings. Locating the plant in close proximity to reliable suppliers of these raw materials can reduce transportation costs and ensure a steady supply chain.

b. Access to Skilled Labor: The electric cable industry requires a skilled workforce with expertise in manufacturing processes, electrical engineering, and quality control. Therefore, locating the plant in an area with access to a skilled labor pool or nearby educational institutions can ensure a qualified workforce.

c. Infrastructure and Transportation: A well-developed infrastructure, including reliable power supply, transportation networks (road, rail, and port access), and access to utilities such as water and wastewater treatment facilities, is essential for efficient operations and distribution of electric cables to customers.

d. Market Proximity: Locating the plant in or near the target market can reduce transportation costs and delivery times. Proximity to major urban centers or industrial zones with a high demand for electric cables can provide a competitive advantage.

2. Cement Company

a. Availability of Raw Materials: Cement production requires large quantities of raw materials, primarily limestone, clay, and gypsum. Locating the plant near abundant sources of these materials reduces transportation costs and ensures a stable supply chain.

b. Energy Sources: Cement production is energy-intensive, requiring significant amounts of electricity and fuels, such as coal or natural gas. Access to affordable and reliable energy sources is crucial in selecting a suitable plant location.

c. Transportation Infrastructure: Cement is a bulky and heavy product, so proximity to transportation infrastructure, including roads, railways, and ports, is essential for efficient distribution to construction sites and customers.

d. Environmental Regulations: Cement production can have environmental impacts, such as air emissions and waste generation. Selecting a location that complies with environmental regulations and has access to appropriate waste management and emission control facilities is crucial.

e. Market Demand: Locating the plant in close proximity to areas with high construction activity and strong demand for cement can reduce transportation costs and provide a competitive edge in meeting customer needs.

f. Labor Availability: Cement production requires a skilled and semi-skilled workforce. Locating the plant in an area with access to a qualified labor pool or the potential for workforce development can ensure smooth operations.

It's important to note that these factors are not exhaustive, and other considerations, such as government regulations, taxes, incentives, and regional factors, may also influence the decision-making process. A comprehensive analysis of these factors will help the feasibility study team determine the most suitable general and specific plant location for the electric cable and cement companies.

7. A company manager is demanding to determine what forecast method to use. Based on the following historical data calculate the following forecast and specify which forecasting technique is best for the company.

<i>Month</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	<i>7</i>	<i>8</i>	<i>9</i>	<i>10</i>	<i>11</i>	<i>12</i>
<i>Actual demand</i>	62	65	67	68	71	73	76	78	78	80	84	85

- Calculate the weighted three-month moving average using weights of 0.5, 0.3 and 0.2 accordingly for periods 4-12.
- Calculate the single exponential smoothing forecast for period 2-12 using initial forecast of 60 and alpha 0.5.
- Calculate the MAD, MSE and MAPE for the forecast made by each technique in period 4-12, which forecasting method do you prefer?

Answer:

- The weighted three-month moving average using weights of 0.5, 0.3 and 0.2 accordingly for periods 4-12.

Month	Actual demand	3-Month Weighted Moving Average
1	62	
2	65	

3	67	
4	68	$(67*0.5 + 65*0.3 + 62*0.2) / 1.0 = 65.4$
5	71	$68*0.5 + 67*0.3 + 65*0.2 = 67.1$
6	73	$71*0.5 + 68*0.3 + 67*0.2 = 69.3$
7	76	$73*0.5 + 71*0.3 + 68*0.2 = 71.4$
8	78	$76*0.5 + 73*0.3 + 71*0.2 = 74.1$
9	78	$78*0.5 + 76*0.3 + 73*0.2 = 76.4$
10	80	$78*0.5 + 78*0.3 + 76*0.2 = 77.6$
11	84	$80*0.5 + 78*0.3 + 78*0.2 = 79$
12	85	$84*0.5 + 80*0.3 + 78*0.2 = 81.6$

b. The single exponential smoothing forecast for period 2-12 using initial forecast of 60 and alpha 0.5.

Month	Actual demand	Rounded Forecast $\alpha = 0.5$	Absolute deviation $\alpha = 0.5$
1	62	60	2
2	65	$60 + 0.5*(62-60) = 61$	4
3	67	$61 + 0.5*(65-61) = 63$	4
4	68	$63 + 0.5*(67-63) = 65$	3
5	71	$65 + 0.5*(68-65) = 66.5$	4.5
6	73	$66.5 + 0.5*(71-66.5) = 68.75$	4.25
7	76	$68.75 + 0.5*(73-68.75) = 70.875$	5.125
8	78	$70.875 + 0.5*(76-70.875) = 73.438$	4.562
9	78	$73.438 + 0.5*(78-73.438) = 75.719$	2.28
10	80	$75.719 + 0.5*(78-75.719) = 76.860$	3.14
11	84	$76.86 + 0.5*(80-76.86) = 78.43$	5.57
12	85	$78.43 + 0.5*(84-78.43) = 81.22$	3.78

c. The MAD, MSE and MAPE for the forecast made by each technique in period 4-12.

Case 1: For part a)

Month	Actual demand	3-Month Weighted Moving Average	Forecast Error value	error square	(Actual _i -Forecast)/Actual _i)
1	62				
2	65				
3	67				
4	68	$(67*0.5 + 65*0.3 + 62*0.2) / 1.0 = 65.4$	2.6	6.76	0.038
5	71	$68*0.5 + 67*0.3 + 65*0.2 = 67.1$	3.9	15.21	0.054
6	73	$71*0.5 + 68*0.3 + 67*0.2 = 69.3$	3.7	13.69	0.051
7	76	$73*0.5 + 71*0.3 + 68*0.2 = 71.4$	4.6	21.16	0.061
8	78	$76*0.5 + 73*0.3 + 71*0.2 = 74.1$	3.9	15.21	0.05
9	78	$78*0.5 + 76*0.3 + 73*0.2 = 76.4$	1.6	2.56	0.021
10	80	$78*0.5 + 78*0.3 + 76*0.2 = 77.6$	2.4	5.76	0.03
11	84	$80*0.5 + 78*0.3 + 78*0.2 = 79$	5	25	0.0595
12	85	$84*0.5 + 80*0.3 + 78*0.2 = 81.6$	3.4	11.56	0.04
Sum			31.1	116.91	0.4045

MAD = Sum of Forecast Error value / n

= 31.1/ 9

= 3.456

MSE = Sum of error square / n

= 116.91/9

= 12.99

MAPE = Sum of ((Actual_i-Forecast) * 100% / Actual_i) / n

= 0.4045 * 100% / 9

= 4.49%

Case 2: For part b)

Month	Actual	Rounded Forecast	Absolute error	(Actual _i -Forecast)/Actual _i
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	demand	$\alpha = 0.5$	deviation $\alpha = 0.5$	square)
1	62	60			
2	65	$60 + 0.5*(62-60) = 61$			
3	67	$61 + 0.5*(65-61) = 63$			
4	68	$63 + 0.5*(67-63) = 65$	3	9	0.044
5	71	$65 + 0.5*(68-65) = 66.5$	4.5	20.25	0.063
6	73	$66.5 + 0.5*(71-66.5) = 68.75$	4.25	18.06	0.058
7	76	$68.75 + 0.5*(73-68.75) = 70.875$	5.125	26.266	0.067
8	78	$70.875 + 0.5*(76-70.875) = 73.438$	4.562	20.812	0.058
9	78	$73.438 + 0.5*(78-73.438) = 75.719$	2.28	5.198	0.029
10	80	$75.719 + 0.5*(78-75.719) = 76.860$	3.14	9.86	0.039
11	84	$76.86 + 0.5*(80-76.86) = 78.43$	5.57	31.025	0.066
12	85	$78.43 + 0.5*(84-78.43) = 81.22$	3.78	14.288	0.044
Sum			36.207	154.759	0.468

$$\begin{aligned}
 \text{MAD} &= \text{Sum of Absolute deviation} / n \\
 &= 36.207 / 9 \\
 &= 4.023
 \end{aligned}$$

$$\begin{aligned}
 \text{MSE} &= \text{Sum of error square} / n \\
 &= 154.759 / 9 \\
 &= 17.195
 \end{aligned}$$

$$\begin{aligned}
 \text{MAPE} &= \text{Sum of } ((\text{Actual}_i - \text{Forecast}) * 100\% / \text{Actual}_i) / n \\
 &= 0.468 * 100\% / 9 \\
 &= 5.2\%
 \end{aligned}$$

Now, based on the MAD, MSE, and MAPE values found above in the calculation parts, the three-month weighted moving average method outperforms exponential smoothing with $\alpha = 0.5$ in terms of forecast accuracy. Which means that, based on the given MAD, MSE, and MAPE values, the three-month weighted moving average method yields

smaller values for these metrics compared to exponential smoothing. In forecasting, smaller values for these metrics indicate better accuracy. Therefore, in this specific scenario, the three-month weighted moving average method is considered to provide more accurate forecasts than exponential smoothing.

The weighted moving average allows for flexibility in assigning weights to historical data, making it suitable for capturing trends and seasonality. In contrast, exponential smoothing is simpler and more adaptable to dynamic patterns. However, for the specific dataset provided, the three-month weighted moving average method provides more accurate forecasts. Factors such as data stability and computational complexity should also be considered when choosing a forecasting method.

8. For three years the monthly preventive maintenance expenses of an organization's vehicles is as given below, and the vehicles failures rate has seasonal nature. The expected annual preventive cost is 3600 ETB, based on the recorded data, forecast the next year monthly expense in order to verify the monthly budget ahead of time.

Answer:

In order to forecast the next year monthly expense , first we have to calculate each months seasonal index as follows:

Seasonal Index = [Average (Year 1 - Year 2) Monthly demand] / [Average Monthly demand]

**January = 181.67 / 264.86
= 0.686**

**February = 198.33 / 264.86
= 0.749**

Month	Year 1 (demand in ETB)	Year 2 (demand in ETB)	Year 3 (demand IN ETB)	Average (Year 1 - Year 2) Monthly demand IN ETB	Average Monthly demand	Seasonal Index	Year 4 Seasonal Forecast (demand in ETB)
January	170	180	195	181.67	264.86	0.686	206
February	180	205	210	198.33	264.86	0.749	225

March	205	215	230	216.67	264.86	0.818	245
April	230	245	280	251.67	264.86	0.950	285
May	240	265	290	265	264.86	1.001	300
June	315	330	390	345	264.86	1.302	391
July	360	400	420	393.33	264.86	1.485	446
August	290	335	330	318.33	264.86	1.202	361
September	240	260	290	263.33	264.86	0.994	298
October	240	270	295	268.33	264.86	1.013	304
November	230	255	280	255	264.86	0.963	289
December	195	220	250	221.67	264.86	0.837	251

Forecast for Year 4 with expected annual preventive cost of 3600 ETB, can be calculated as follows :

Seasonal forecast demand = (expected annual preventive cost (demand)) / 12 * (Seasonal Index)

**Year 4 January forecast demand = 3600 ETB / 12 * 0.686
= 206 ETB**