Master of Business Administration

(MBA)

PRODUCTION, OPERATIONS AND SCM

Semester-II

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Learning Outcomes

The student will able to understand

Unit 1

- Understanding how to optimize production processes to enhance efficiency, minimize waste, and reduce costs.
- Familiarity with the integration of technology such as Enterprise Resource Planning (ERP) systems.
- Developing negotiation skills to effectively communicate with vendors, negotiate favourable terms and conditions, and achieve mutually beneficial agreements that optimize value for the organization.

Unit 2

- Acquiring knowledge of the principles and concepts related to facility layout and design.
- Learning how to assess and plan for the capacity requirements of a facility.
- Establishing key performance indicators (KPIs) and metrics to evaluate vendor performance, track performance against targets, and identify areas for improvement

Unit 3

- Understanding the criteria and methods for selecting vendors, including evaluating factors such as price, quality, reliability, reputation, and compatibility with organizational goals.
- Understanding the importance of building and maintaining positive relationships with vendors.
- Learning about warehouse operations, inventory control methods, and techniques for optimizing inventory levels, storage space utilization, and order fulfilment processes.

Unit 4

- Understanding the role of logistics within the broader supply chain context
- Understanding the design and optimization of distribution networks including the selection of distribution centres.
- Understanding the design and optimization of distribution networks, including the selection of distribution centres, routing strategies, and network configuration to minimize transportation costs and lead times.

Unit 5

- Understanding the regulatory frameworks governing international trade, including import/export regulations, customs procedures, tariffs.
- Learning techniques for managing global inventory effectively, including demand forecasting, safety stock optimization, inventory visibility, and coordination with suppliers and distributors across multiple regions.
- Developing a comprehensive understanding of the complexities and challenges associated with managing global supply chains, including factors such as geopolitical risks, cultural differences, regulatory requirements, and market dynamics.

PRODUCTION, OPERATIONS AND SCM
SYLLABUS

UNIT I

INTRODUCTION TO PRODUCTION, OPERATIONS MANAGEMENT AND PRODUCT PLANNING DEVELOPMENT

Introduction, Meaning and Importance of Production and Operations Management, Nature of production/ operation, Functions of production/operations Manager, Operations in Services sector, Historical Development of Operations Management, Productivity, Designing an Operating/production system, Operations Strategy, Production Budget, Current Issues in Operations Management, Concept of product, Importance of Product Planning and Development, Difference between Goods and Services, Objectives of product planning and development, Successful product development, Challenges of product development, new product development strategy, new product development process, Product life Cycle, Factors to be considered in new product planning.

UNIT II

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UNIT III

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UNIT IV

INTRODUCTION TO LOGISTICS MANAGEMENT

Introduction, Importance of Logistics Management, Objectives of Logistics Management, Activities Included in Logistics, Logistics Value proposition, Integrated Logistics, Logistics Costing, Logistics Performance Measurement, Designing Distribution Networks, E Business Models, Concept of Warehouse and Stores Management, Warehouse Management, Storehouse Operations, Material Handling, Packaging, Scrap/ Waste Disposal, Transportation Management, Transportation documentation, concept of Supply Chain Management - Importance of Supply Chain Management, Evolution of Supply Chain Management, SCM practices, Designing Supply Chain, Supply Chain and Competitive Performance

UNIT V

GLOBALIZATION IN BUSINESS

Introduction of Globalisation of Business, Global Logistics, Global Logistics Strategies, Global Logistics Management Process, Global Supply Chain Management, Process of Global SCM, Global Sourcing, Global Distribution, Free Trade Zones, concept of Information Technology in Production and Supply Chain Management, Role of IT in Logistics Management, Computer Aided Design (CAD), Computer Aided Manufacturing (CAM), Flexible Manufacturing System (FMS), Computer Integrated Manufacturing (CIM), Just in Time (JIT), Layout Design Procedure, Procurement Software, Logistics Information Systems, Enterprise Resource Planning (ERP), Material Resource Planning (MRP)

UNIT I

INTRODUCTION TO PRODUCTION, OPERATIONS MANAGEMENT AND PRODUCT PLANNING DEVELOPMENT

STRUCTURE

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1.1 LEARNING OBJECTIVE

After completion of this unit, student will be able to:

- Understand about the operations management.
- Know about the importance of production and operations management.
- Know about the concept of production.
- Understand the difference between goods and services.

1.2 INTRODUCTION

Production/operations management is the process, which combines and transforms various resources used in the production/operations subsystem of the organization into value added product/services in a controlled manner as per the policies of the organization. Therefore, it is that part of an organization, which is concerned with the transformation of a range of inputs into the required (products/services) having the requisite quality level. The set of interrelated management activities, which are involved in manufacturing certain products, is called as production management. If the same concept is extended to services management, then the corresponding set of management activities is called as operations management.

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1.3 MEANING AND IMPORTANCE OF PRODUCTION AND OPERATIONS MANAGEMENT

Meaning

Every organization has management principles. And the application of that principle to production function is the term "production management." This management concept involves planning, scheduling, supervising and control of the activities that concern the production of goods to meet the needs of consumers and also generate profit for the business. Production Management involves using resources judiciously, to create acceptable products. In this case, raw materials are being transformed into value-added products efficiently. The production manager is also in charge of this area of the business. In other words, decisions such as quantity, quality, price, design, packaging style and material for the product, among others, are made by the production manager. He also ensures that the output matches the specifications.

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The output of the production process is either goods intangible products or service that are intangible products or both goods Categorizing this, organizations that produce intangible and services. Products are called Manufacturing organization and that provide service are called service organization. However, some lies in between i producing product as well as providing service. Production Management when applied to service industry is often called as Operations Management. The term 'Production and the Operations management' is being increasingly replaced by simply Operations management, as the production function relating to the manufacturing organizations has become a part of the operations. Operations management is the broad term which includes manufacturing as well as service organizations. However, in general Production Management and Operation Management could be used simultaneously for both manufacturing and service organization.

Importance of Operations Management

- **Helps in achievement of objectives:** Operations management has an effective role in the achievement of pre-determined objectives of an organization. It ensures that all activities are going as per plans by continuously monitoring all operations of organization.
- **Improves Employee productivity:** Operation management improves the productivity of employees. It checks and measures the performance of all people working in the organization. Operation manager trains and educate their employees for better performance.
- **Enhance Goodwill:** Operation management helps in improving the goodwill and presence of the organization. It ensures that quality products are delivered to all customers that could provide them better satisfaction and makes them happy.
- **Optimum utilization of resources:** Operation management focuses on optimum utilization of all resources of the organization. It frames proper strategies and accordingly continues all operations of the organization. Operation managers keep a check on all activities and ensure that all resources are utilized on only useful means and are not wasted.
- **Motivates Employees:** Operation management helps in motivating the employees towards their roles. Operation managers guide all peoples in performing their roles and provide them with better atmosphere. Employees are remunerated and rewarded according to their performance level.

1.4 NATURE AND FUNCTIONS OF PRODUCTION/OPERATIONS MANAGEMENT

Nature of Production Management

1. **Results in Value Addition:** Production management is a key tool available with an organization which assist in value addition. It is a process which enables in producing high-quality products by purchasing raw materials from the right source, in right form, at right price and in right quantity. These quality goods provide better satisfaction to customers thereby improving goodwill of an organization.

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2. **Inter-Disciplinary Approach:** It is an inter-disciplinary approach which is derived from several disciplines and subjects. Different subjects like statistics, mathematics, economics, engineering, sociology and human psychology have contributed toward the development of production management approach.
3. **Part of General Management:** Production management is an essential component of General management. It is a tool which assist managers in planning, organizing, coordinating and controlling all activities related to the production of products and services.
4. **Transformation Process:** It is a process of transformation in which raw materials are converted into finished products that are ready for consumption by consumers. Production management focuses on economical production of products avoiding any wastage of raw materials used.
5. **Operative Function:** Production management monitors day to day operations of business for ensuring long-term continuity. It supervises all production activities on daily basis for checking out whether all resources are efficiently utilized.
6. **Both Art and Science:** It can be treated both as an art as well as science. Production management is termed as art as it is the one which assign, coordinates and monitors all work activities of an organization. Whereas, it is a science as it manages all machines and technical aspects helping in production activities.
7. **Management of Service Sector:** Production management not only manages the activities related to production of tangible products. It is a process which monitors the service sector also where intangible products are provided to customers as per their needs.

Functions of production management

Production management attempts to utilize 6M's: Men, Machines, Money, Methods, Materials, and Market in order to better serve consumer needs. Its fundamental goal is to produce products and services in the right quantity, quality, on a schedule, and for optimum money. Production management makes it simple to adopt various technologies and innovative changes in the workplace. Production management is in charge of supervising and controlling all employees involved in the company's production processes in order to ensure

1. **Selection of product and design**
   Production management helps the organisation select the right product for production and also choose a relevant design for the product. This becomes imperative for the survival of organisations to possess a good understanding of their consumers in order to create products that fully satisfy needs. Products need to go through a detailed evaluation in order to meet customer needs while also remaining cost-efficient.
2. **Production planning and control**
   Choosing the correct production processes for a particular product also becomes important. Decisions must be taken in order to choose the correct type of machines and technology, the capital investment required, and so on. It entails planning prior

to production. Decisions like the quantity of production, the flow of processes, and so on are all planned out. Routing is the term used for charting out the sequence of operations for a smooth workflow.

Production control is overseen by the production manager. The actual process is compared and contrasted with the blueprint in place so that all necessary diversions from the original plan can be mapped out and any loopholes in the original plan can be spotted and corrected.

Scheduling is done to set up benchmarks as to when starting and when to complete a particular production activity. Inventory and cost control also need to be taken care of. The allocation of materials, labour, and other processes is called the production schedule.

3. **Machine maintenance and replacement**
   Production management takes care of the maintenance and replacement of machines and equipment to ensure the efficient and smooth working of production processes. This is taken care of by the production manager and the team to prevent speed breaks and halts in production.

1.5 OPERATIONS IN SERVICES SECTOR

Though the primary function of both manufacturers and service providers is to satisfy customer needs, there are several important differences between the two types of operations. Let's focus on three of them:

- **Intangibility:** Manufacturers produce tangible products—things that can be touched or handled, such as automobiles and appliances. Service companies provide intangible products, such as banking, entertainment, or education.
- **Customization:** Manufactured goods are generally standardized; one twelve-ounce bottle of Pepsi is the same as any other twelve-ounce bottle of Pepsi. Services, by contrast, are often customized to satisfy the specific needs of a customer. When you go to the barber or the hairdresser, you ask for a haircut that looks good on you because of the shape of your face and the texture of your hair. When you go to the dentist, you ask him or her to fill or pull the tooth that's bothering you.
- **Customer contact:** You could spend your entire working life assembling cars in Detroit and never meet a customer who bought a car that you helped to make. But if you were a waitress, you'd interact with customers every day. In fact, their satisfaction with your product would be determined in part by the service that you provided. Unlike manufactured goods, many services are bought and consumed at the same time.

1.6 HISTORICAL DEVELOPMENT OF OPERATIONS MANAGEMENT

The idea of operations management began in the eighteenth century as manufacturing management. An economist, Adam Smith, realized that specialization of labour could be very beneficial to any organization's economy. He therefore came up with the idea of breaking up jobs into sub units where only workers specialized in a certain field would

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take up the task not only to ensure efficient delivery of the task but also to further increase their skills (Kumar, and Suresh, 2009, p. 284). Early in the twentieth century, F. Taylor enforced this law which then resulted to the development of scientific management. Since then until in the early nineties, many developments were made based on the traditional of the operation.

In 1776, Adam Smith developed the theory of specialization of labour in the manufacturing industry (Kumar, and Suresh, 2009, p. 284). This was followed by development of cost accounting in 1799 by Eli Whitney among other scientists. Later in 1832, Charles Babbage developed division of labour and assigning of tasks depending on employees' skills as well as the necessity of time management (Kumar, and Suresh, 2009, p. 284). From the scientific management of time, Frederick Taylor developed planning and work performance in the year 1900. Soon after, in 1900, Frank Gilbert came up with the motion of studying jobs (Wilson, 995, p. 87). This was followed by the development of techniques for scheduling of work for employees as well as the development of manufacturing jobs which required the use of machinery.

These two developments were done by Henry Gantt in 1901. In 1915, F.W. Harris developed the use of inventory for economic controls. The human relations department was developed by Elton Mayo in 1927 (Kumar, and Suresh, 2009, p. 284). Following this development was the use of statistical information to check and control the quality of various products by use of quality control charts. This development was by W.A. Shewart in 1931. This contribution was further developed into sampling techniques to control quality of products and for inspection purposes in 1935 by H.F. Dodge and H.F. Roming. In 1946, a group of scientists among which was P.M. Blacker contributed in the application of operations research in the Second World War (Meredith, 2006, p. 189).

A very significant contribution happened in 1946 when John Mauchlly and J.P. Eckert developed digital computers. Following the use of computers, G.B. Dantzig and William developed software for programming business operations in 1947. Linear mathematical programming was later developed in 1950 by two scientists, A. Charnes and W.W. Cooper. Since the initial digital computer was multipurpose, large-scale computers were developed in 1951 by Sperry Univak to help in computation of data. Later in 1966, L. Cummings and L. Porter introduced organizational behaviour whose aim was to continuously study people at workplace (Kumar, and Suresh, 2009, p. 284). In 1970, W. Skinner and J. Orlicky developed the incorporations of all operations in an organization into a unified strategy with common policies. In the same year, G Wright introduced the use of computers in the manufacturing industry alongside control and planning of required materials. In 1980, application of quality productivity was introduced by W.E. Deming from Japan (Kumar, and Suresh, 2009, p. 284).

The term production management therefore was the term for since 1930s up to 2950s. Managers worldwide developed techniques for efficient manufacturing operations. From then, other scientists started studying sociology especially on human behaviour in workplace while mathematical as well as computer scientists developed more advanced techniques for data analysis. With these new advancements, the name operations management came into be which put a lot of emphasis on expansion of the manufacturing sector. Emphasis was

also put on production in the management practices rather than the usual analysing duties (Johnston, 1998, p. 1).

1.7 PRODUCTIVITY, DESIGNING AN OPERATING/ PRODUCTION SYSTEM

Productivity:

Productivity is a relationship between the output (product/service) and input (resources consumed in providing them) of a business system. The ratio of aggregate output to the aggregate input is called productivity.

Productivity = output/Input

For survival of any organization, this productivity ratio must be at least. If it is more than 1, the organization is in a comfortable position. The ratio of output produced to the input resources utilized in the production.

Importance:

Benefits derived from higher productivity are as follows:

- It helps to cut down cost per unit and thereby improve the profits.
- Gains from productivity can be transferred to the consumers in form of lower priced Products or better-quality products.
- These gains can also be shared with workers or employees by paying them at higher rate.
- A more productive entrepreneur can have better chances to exploit expert opportunities.
- It would generate more employment opportunity.
- Overall productivity reflects the efficiency of production system.
- More output is produced with same or less input.
- The same output is produced with lesser input.
- More output is produced with more input.
- The proportional increase in output being more than the proportional increase in input.

Productivity Measurement:

Productivity may be measured either on aggregate basis or on individual basis, which are called total and partial measure.

Total productivity Index/measure = Total output/ Total input

$$= \frac{\text{Total production of goods and services}}{\text{Labour+material+capital+Energy+management}}$$

Partial productivity indices, depending upon factors used, it measures the efficiency of individual factor of production.

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Labour productivity Index/Measure = $\frac{\text{Output in unit}}{\text{Man hours worked}}$

Management productivity Index/Measure = $\frac{\text{Output}}{\text{Total cost of management}}$

Machine productivity Index/Measure = $\frac{\text{Total output}}{\text{Machine hours worked}}$

Land productivity Index/Measure = $\frac{\text{Total output}}{\text{Area of Land used}}$

Partial Measure = $\frac{\text{Output}}{\text{Labour}}$ or $\frac{\text{Output}}{\text{Capital}}$ or $\frac{\text{Output}}{\text{Materials}}$ or $\frac{\text{Output}}{\text{Energy}}$

Steps for Boosting Productivity in Supply Chains

Individual supply chain manager accountability is crucial to improving productivity at a micro level, so that the overall macro result is boosted too. Each individual concerned should:

- **Receive any necessary training**. This includes training in the importance of productivity improvements, the productivity details to be monitored, the scope of the productivity improvements sought (see below), change management techniques to be used, and how incentives will be applied.
- **Collect productivity data.** For different activities, including the levels of inventory kept per individual product, order and customer, together with the revenue and net profit generated by each.
- **Decide where to focus.** Recommend which activities to keep, change, replace, or eliminate.
- **Determine optimal operating methods**. Also, define adequate productivity performance measures for different assets and resources used.
- **Coordinate with counterparts**. These are the people in other departments, whose actions affect supply chain productivity. In particular, agree with the sales department about the accounts to be addressed, and in each case the type of sales process and relationship, the order cycle and product inventory to be held.
- Monitor and ensure good productivity performance.

Each of steps 1 to 4 may require a month or more to be accomplished, meaning several months for putting a productivity improvement program into action. Steps 5 and 6 are continual processes. Step 5 in particular relies on supply chain managers proactively seeking out their counterparts. Sitting and hoping that others see the light will not work, nor will trying to hand off the responsibility for boosting supply chain productivity!

Design for Supply Chain (DfSC)

Design for supply chain or DfSC is a discipline of DFX that provides practical techniques to optimise a product's design to integrate it with the supply chain.

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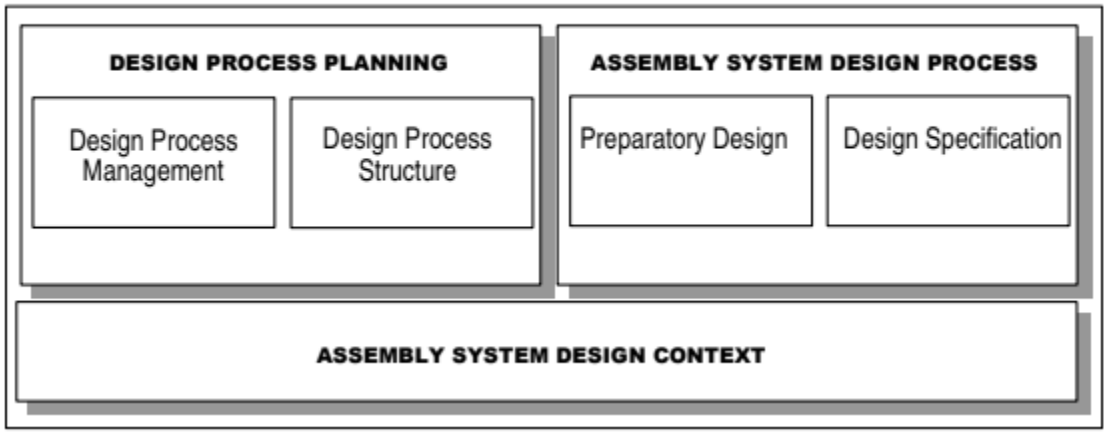
Traditionally, operational logistics have always been an afterthought and their design come much later in the product development process. This is because many companies fail to understand the role of product design in the supply chain.

Why do we need Design for Supply Chain?

Research has shown that decisions taken during the design stage have a considerable effect on agility, customisation strategies, supply chain and product life costs. Smooth collaboration between the product development, manufacturing, marketing, procurement, finance and supply chain management teams can improve the value of a product significantly while reducing overall costs.

A well-thought-out DfSC strategy can improve responsiveness, supply chain visibility and communication, diminishing product costs, time-to-market and supply chain risks. All these benefits give a company an incredible competitive advantage over its competitors in the global market. Design for supply chain proposes making changes in the design to improve the overall logistical efficiency of a product.

Analysis Model for Assembly System Design



The Nine Key DfSC Strategies

1. **Optimize Levels of Product Integration:**
   PDTs should determine the optimal level of integration, or parts, that have been pre-assembled at an upstream supplier. This can be a difficult decision because while integrated components can reduce the number of parts that need to be managed in final assembly and allow for a reduction in assembly time (often by limiting the number of physical interconnections on the manufacturing line), this bundling of P/Ns can create additional supply risk in several ways. First, it can make it more difficult to accurately forecast demand for the part because each integrated component presents another demand variable that must be factored into the forecast for the overall part. Second, aggregate lead times may be increased for an integrated component. Take, for instance, a case where there are two components, each with a lead time of one week. With two distinct suppliers, the components can ship on the same day to arrive at manufacturing for assembly within a week. For integration, the first component must ship to the supplier of

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the second component before facing the standard lead time of one week, resulting in an extended aggregate lead time.

To help with the decision, consider the degrees of commonality, modular design, universal function and postponement that can be imbedded in the integrated part — a common building block used across multiple offerings increases the value of disintegration by allowing postponed features to use a shared supply. While maintaining a competitive part cost is always an important factor, in some cases overall savings be realized even when an individual part's cost is increased.

2. **Leverage Industry Standards:**
Use industry standard parts unless proprietary parts are justified to create a competitive advantage. A standard part uses the vendor part number with no unique marking or other requirements. Industry standard parts allow suppliers to pool demand across the industry, rather than relying solely on their ability to forecast demand for the unique part. In addition, industry standard parts allow for increased flexibility in sourcing from other suppliers and facilitate the cost-effective disposal of excess inventory when needed. Thus, unless the use of a unique part has a specific value add, industry standard parts should be used whenever possible. The perception of greater control by placing unique qualifications on industry standard components needs to be objectively evaluated.

   Similarly, inventories of unique parts for original equipment manufacturer (OEM) customization should also be carefully monitored. PDTs should consider in the design stage what aspects of the product will and will not be available for OEM customization and design so that the product is configured to be line-fit to postpone any OEM personalization as far downstream as possible. Costs are minimized by not having to plan and maintain stocks of unique high-value OEM inventory. Where possible, these OEM-specific inventories should be owned by the OEM.

3. **Minimize Premium Freight:**
Premium freight and resources to expedite supply can often compose a large portion of supply chain costs. In order to minimize these costs, DfSC techniques should be used to reduce lead times on critical components while maximizing the availability of alternate components in the event of a shortage. Long lead times result in volume fluctuations at the back end. It is important to consider flexibility in suppliers and integrated components. For example, when evaluating integration alternatives assess the trade-off between a lowest-cost approach for accurately planned requirements and the real need for low-cost flexibility to address unplanned events. The product should also be designed for compatibility and commonality with predecessor components or for alternate parts usage with other current products.

   Also, the earlier suppliers can be provided with demand forecasts on a P/N level, the greater their capacity to reserve production capabilities to meet demand and avoid the need to expedite. Finally, engineering changes should be evaluated for their overall impact on the supply chain. This is especially important when considering heavier components that will have larger premium costs when expediting.

Engineering changes later in the design process also make it more difficult for suppliers to meet demand forecasts.

4. **Design for Life Cycle:**
   Product should be designed to be supply chain friendly to potential component or infrastructure changes through its lifecycle. These include events such as small improvement to product design, cost improvements or commodity/technology/ infrastructure advances. PDTs should determine which of the product's components are likely to be changed throughout the product's lifecycle and facilitate eventual change with minimum impact in the supply chain. After deciding on the changes that are likely to occur, PDTs should structure the product so that changes can be implemented with minimum disruption to the supply chain.

   It is also important for product design to proactively transition out old technology while introducing new technology. Extended technology transitions add complexity and can be very expensive when the older technologies become hard to supply. The product design must consider forward and backward compatibility — not just from a customer viewpoint, but also for component parts in the supply chain. Design teams should develop risk mitigation plans for low-volume parts to avoid excess inventories or reduced service levels when the technology is going end-of-life.

5. **Configure the selected Supply Chain:**
   The role of a cross-functional product development team should include selecting and configuring the supply chain, but not creating one. Supply chains need to be established based on the company's strategic network plan, not individual products. Market requirements (i.e., volume, complexity and customization) are key factors in the best choice of supply chain.

   There are several important considerations for supply chain selection. First, PDTs should determine if the product best fits the run rate (high volume) or the enterprise (high complexity) model. Second, design should determine what is unique about the product when compared to the attributes of other products using the same supply chain model, and configure the supply chain to address product specific requirements. Third, PDTs should specify the geographic distribution of customers and how cycle time and inventory targets will be achieved. Fourth, design teams should critically decide how many (few) options will be required with the product. The ultimate in postponement is for customers to enable a product to meet their specific needs. Fulfilment of options that go with the product need to be developed to minimize supply chain complexity. The final selection consideration is if and how a product will transition between different supply chains to maximize profitability for the start-of-life, mid-life and end-of-life.

6. **Design for Demand & Supply Planning:**
   Designs that leverage DfSC techniques include commonality, modular design, universal function and postponement "pool demand" requirements. Pooling requirements on a common component reduce variability and improve the ability to accurately forecast demand during lead time. Reducing part count is desirable, but when attach rates are low it may be best to use postponement. Another

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consideration for demand/supply planning is bundling hardware and services/ terms and conditions could be unbundled. Since services and terms and conditions (T&Cs) are not planned, bundling them with hardware creates complexity for planning. Rather than bundling a product with predetermined services, infrastructure systems should enable the addition of the right services to hardware and software to be postponed until the end of the manufacturing process in order to reduce complexity and give customers more flexibility in choosing exactly which services they desire.

7. **Minimize Inventory Costs:**
The two key inventory costs to consider are carrying costs and obsolescence risk. Carrying costs can be reduced when product has quick build-to-ship times and favors a build-to-order (BTO) as opposed to a build-to-stock (BTS) supply chain model. Also, designing to maximize the velocity of parts through the supply chain will reduce inventory value and reduce cost take-downs while inventory is being held. Obsolescence risk can be minimized using short lead times and easily reconfigurable components. Like carrying costs, designing for high velocity movement will also help with obsolescence risk. Configuring for customization at the end of the assembly line will minimize risk by increasing flexibility. Finally, PDTs should configure product components for reuse into the next product transition in the event that obsolescence does occur.

8. **Optimize Order Management:**
Product design should consider the facilitation of order management and customer fulfillment. Product design should be adjusted to provide the maximum level of flexibility to the customer with little or no additional internal cost. This can be accomplished by using the DfSC techniques to facilitate postponement and unbundle P/Ns, thereby reducing complexity and increasing flexibility and order management. PDTs should also consider the ease of special-order entry and manufacturing. The structure of the bill of material needs to leverage the capabilities of the order management systems and facilitate quick and accurate communication of requirements to manufacturing.

9. **Minimize Warranty/Service Costs:**
Warranty costs are minimized by a reliable, high-quality product with easy to diagnose faults and customer replaceable parts that have a high warranty redemption value. Using the DfSC techniques can increase flexibility in terms of alternative parts usage for service. A common part for warranty use may be beneficial even when common parts for base unit manufacture did not make good business sense. Minimizing the portfolio of parts that need to be stocked for service and warranty decreases expense and improves service levels. This is especially important for those parts that have the highest typical defect rates. Additionally, designs that integrate automated internal diagnostic capabilities may increase component costs but vastly decrease overall costs through the facilitation of easy defect assessment. The use of a serviceability assessment tool (SAT) to provide a service cost estimate that can be a key decision point when gauging increased component costs against service expenses.

The profitability of maintenance contracts can be maximized by product testing that identifies both intrinsic and systemic failure modes, and then configuring the product and the supply chain to cost effectively addresses them.

"The ability to design for supply chain is critical for organizations as they strive to achieve the "perfect product launch." The perfect product launch concept involves managing the development and support of complex products and services throughout the entire lifecycle from product design to product build to post-sale service. By deploying product commonality and reuse, our clients achieve supply chain efficiencies from reduced complexity, improved product quality and better manufacturing design. With these design concepts in place, clients can realize the benefits of being first to market and stronger profit margins while reducing end-to-end costs."

1.8 OPERATIONS STRATEGY, PRODUCTION BUDGET AND CURRENT ISSUES IN OPERATIONS MANAGEMENT

Operations strategy is a guiding principle used to plan, analyze, and execute a company's operations. Businesses use operations strategies to identify and implement cost-effective processes for creating and distributing products and services. An operations strategy supports a company's overall business strategy in order to maximize profits.

5 Key Elements of an Operations Strategy

There are a few key elements that go into a company's operations strategy.

- **Production system:** An organization's production system determines the short-term and long-term planning for how resources are turned into marketable products and services. A comprehensive production system includes clear workflows, quality control benchmarks, and supply chain management strategies.
- **Facilities:** A company's operational capabilities are influenced by the size and number of production facilities. To function properly, specific facilities require achievable production goals, clear safety procedures, and inventory management systems.
- **Product or service:** One of the most important elements of any operations strategy is the quality management of a product or service. Businesses analyze the lifecycle of their products and services in order to predict market trends, adjust their product or service, and allocate resources to new service development and product development.
- **Technology:** Operations strategy increasingly depends on new technological developments like machine learning, production line automation, real-time metrics, and market forecasting tools.
- **Resources:** A comprehensive overall strategy for operations takes into account the total operations resource available to an organization, including locational, mechanical, and human resources.

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5 Types of Operations Strategies

Businesses employ different types of operations strategies based on their specific market needs.

- **Core competency strategies:** Core competency operations strategies revolve around the main strengths of a company's business model. By identifying the best core business processes within an organization, core competency operations strategies focus on leveraging existing strengths to maximize profitability.
- **Corporate strategies:** This type of operations strategy adheres to a company's mission statement and aligns itself to a larger corporate strategy. Businesses using this type of operations strategy develop production initiatives, key performance indicators (KPIs), and decision-making processes based on an overall strategic plan determined by company leaders and stakeholders.
- **Competitive strategies:** Companies using this type of strategy develop their operations processes in order to distinguish their product or service from competitors. By identifying competitive priorities within a specific economy, businesses can change their operations strategy to move toward a competitive advantage, whether that's a higher-quality product or a faster lead time during production.
- **Product or service strategies:** This type of operations strategy revolves around the quality control of existing products or services as well as the development of new products and services. Businesses using this model often determine their operations strategies based on the research and ideas from product managers.
- **Customer-driven strategies:** Organizations using customer-driven strategies make operations decisions based on the customer experience. This type of operations strategy aligns with sales and marketing strategies to manage and fulfil customer expectations.

Example of Operations Strategy

An example of an operations strategy is a furniture retailer deciding to change its manufacturing strategy by outsourcing production to an automated facility. By using new technological resources, this hypothetical furniture company can manage its supply chain better and create products faster to improve its competitive position.

Production budget in operations management

The production budget, also called the manufacturing budget, is a budget that determines the quantity of the firm's product that needs to be produced during a budgetary time period. This budget is stated in units of the product or the quantity. Most other budgets are stated in the form of dollars instead of quantity.

The production budget is a quantity budget. It determines the number of units of a firm's product that should be produced to meet the demand of the firm's customers based on the sales forecast and sales budget.

The production budget is also one part of the firm's inventory control. If there is an accurate production budget, the business won't stock out of its product and lose customer goodwill.

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It will also not hold obsolete inventory since the number of units of the product produced is based on the sales forecast.

How to Create a Production Budget

A production budget has four components:

- **Beginning Inventory**
  The beginning inventory is the number of units left over from the previous budgetary period. It is the ending inventory for the previous time period. A budgetary period is a month, quarter, year, or some other time period.
- **Sales Forecast**
  The sales forecast, developed before the sales budget, is the amount of the product the company expects to sell in the same time period. The sales forecast is the anticipated demand for the firm's product.
- **Ending Inventory**
  The ending inventory is the amount of inventory leftover from the previous time period. It becomes the beginning inventory for the next time period. Your firm may want to always hold a few extra units of inventory in stock which is added to ending inventory. This is called safety stock.
- **Production Required**
  The production required equals the amount of the product to be produced during the time period after the beginning inventory, ending inventory, and the sales forecast are taken into account.

After the production budget is determined and the business manager knows how many units of the product to produce in a given time period, you use cost accounting to prepare the cost of what you will produce. You reflect the cost of raw materials in the direct materials purchases budget. Both direct labor and overhead have their own budget.

How to Calculate a Production Budget

You combine the components of the production budget in the following formula to arrive at the units you need to produce:

Expected Unit Sales + Units in Desired Ending Inventory (EI)-
Unit in Beginning Inventory (BI) = Production Required (Units)

Example of a Production Budget

Masks and more, LLC is a small manufacturing business that makes surgical masks, cloth facial coverings, and other personal protective equipment (PPE). Its sales forecast anticipates the sale of 1,000 cloth facial coverings during the next quarter. Masks and More only had 25 units of the product left at the end of the last quarter. The company likes to hold at least 50 units in safety stock.

Here is the production budget for Masks and More for their cloth facial covering masks for the next quarter:

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Production Budget	
	Number of Units
Ending Inventory	50
Plus: Demand based on sales forecast	+ 1000
Minus: Beginning Inventory	- 25
Equals: Production Required in Units	= 1025

As the table shows, Masks and More must produce 1,025 units of its cloth facial coverings during the next quarter to fulfil customer demand.

Current issues in operations management

There are multiple challenges that operations managers face on a daily basis; this blog highlights the following five: globalization, sustainability, ethical conduct, ineffective communication, and system design.

- **Globalization**

  Globalisation is "a process of interaction and integration among the people, companies, and governments of different nations." It is driven by a reduction in trade barriers, advancements in information technology, and transportation technology. Operation managers face competition from the company across the street, as well as, from across the country and across the world. Tishta Bachoo, Accounting Professor at Curtin University in Australia, explains that companies who compete with others abroad will have to improve quality while lowering prices to remain competitive. This falls on the operations manager as he or she is the one who "engages in the four functions of planning, organizing, leading, and controlling to ensure that the product or service remains competitive in the market." Batchoo adds that the operations manager must tap into their creative skills as innovation will be a key factor of success as will knowledge about international business and the myriad cultures of the businesses around the globe.

- **Sustainability**

  In her article, Business Definition of Operational Sustainability, Kay Miranda, journalist for the Houston Chronicle, defines business operational sustainability as a "method of evaluating whether a business can maintain existing practices without putting future resources at risk." When discussing the concept of sustainability, it is often referred to as the Three Pillars of Sustainability which are social, environmental, and economic. Operations managers must concern themselves with the outcomes of each of the pillars including how their work affects safety, welfare, communities, the environment and economic sustainability.

  Effective operations managers must implement best practices with a concern for all three pillars of sustainability. They also need to initiate and verify corrective action when any outcome of one of the three pillars becomes jeopardized.

- **Ethical Conduct**
  Education site ManagementStudyGuide.com takes special note of the role ethics plays in production. Ethics is defined as a subset of business ethics that is "meant to ensure that the production function and/or activities are not damaging to either the consumer or the society." In particular organizations should consider the effects new technologies, defective services, animal testing and business deals have on people, safety, and the environment.

  Unethical behaviour has significantly contributed to the demise of successful corporations like Enron, Tyco, and many varied firms doing business on Wall Street. Being ethical across all business functions such as accounting, human resource management, marketing and sales, and production are clearly within the purview of the operations manager. Unethical behaviour, regardless of its origin, becomes a stain on the company as a whole. The recently noted ethics breach at Wells Fargo is just one poignant example.

- **Effective Communication**
  Being consistent and effective when communicating can be difficult anyone in any position within an organization. The challenge for the operations manager is to be able to communicate effectively with all internal and external stakeholders. Whether they are talking to someone on the factory floor, or in the boardroom, they must be able to effectively communicate their message as well as process the messages being directed to them. Mastering oral, written, and non-verbal communication is integral to making day-to-day operations run smoothly. Effective and efficient communication is also necessary for building employee morale and deepening trust with management. Operations managers who take the time to be self-reflective, the initiative to be authentic, and the effort to work on their communication skills are bound to be both productive and successful. The development of these skills is frequently the most requested of upper-level management of their new and mid-level managers and required to be successful in any company.

- **System Design**
  In Key Issues in Operations, a blog detailing the relationship between system design and operational management, the main theme is that organizations must develop systems capable of "producing quality goods and services in demanded quantities in acceptable time frames." Designing the system, planning the system, and managing the system present a wide variety of challenges to even the savviest operations managers.

  As operations managers work in multidisciplinary environments, they must be aware of and effectively respond to the challenges presented by globalization, sustainability, ethical conduct, effective communication, and system design. Doing these calls for operations managers to excel in the business, technical, and interpersonal aspects of their work as they actively support the mission and vision of their organization.

1.9 CONCEPT OF PRODUCT

Product Concept states that customers or consumers prefer product which is of the highest quality, performance and features. Product concept is a mandatory concept in order to give

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the best possible product to the customer as per the demand and expectation. A product is not complete in itself and requires other factors of business-like marketing, distribution, sales, service etc. to be successful.

Importance of Product Concept

Using Product concept, a company can give identity to the product and can add functional value and usability so that the intended customers can derive this benefit and eventually buy the product in the market.

Product concept is one of the orientation strategies & marketing strategies towards market which a company can follow. Other being Selling Concept, Production Concept, Marketing Concept etc. Marketing Pull is generated because of superior products which helps in success of the brand. Innovation helps to get new products with features which customers would like.

Example of Product Concept

Apple is one company which works highly on product concept to get the best products to their consumers. Apple's products are perceived to be very high quality with innovative features and great performance. Customers go after the products of Apple and that creates a marketing pull.

Advantages & Disadvantages of Product Concept

The merits of Product concept are:

1. Innovation is more using Product Concept as the companies vouch to make better products leading to innovations and inventions which is good for everyone.
2. Quality is the central focus of this concept which fulfils the needs and wants of the customer at the same time.
3. It raises the overall bench mark of the offerings in the market as competitors also try to come to the same level as the innovator which tries to give the best product.

The drawbacks are:

1. Leads to expensive products for basic needs as all manufacturers try to give best possible product to the customer even though the demand can be fulfilled.
2. Customers need supports, service along with a product, so just focusing only on product features can lead to not providing the holistic customer experience.

The product concept has three dimensions:

1. **Managerial Dimension:**

   It covers the core specifications or physical attributes, related service, brand, package, product life-cycle, and product planning and development. As a basis to planning, product is second only to market and marketing research.

   The product offering must balance with consumer-citizen needs and desires. Product planning and development can assure normal rate of return on investment and continuous growth of the enterprise.

2. **Consumer Dimension:**
   To the consumer a product is actually a group of symbols or meanings. People buy things not only for what they can do, but also for what they mean. Each symbol communicates a certain information. A product conveys a message indicating a bundle of expectations to a buyer.

   Consumer's perception of a product is critical to its success or failure. A relevant product is one that is perceived by the consumer as per intentions of the marketer. Once a product is bought by a consumer and his evaluation, i.e., post-purchase experience is favourable, marketers can have repeat orders.

3. **Social Dimension:**
   To the society salutary products and desirable products are always welcome as they fulfil the expectations of social welfare and social interests. Salutary products yield long-run advantages but may not have immediate appeal.

   Desirable products offer both benefits, immediate satisfaction and long-run consumer welfare. Society dislikes the production of merely pleasing products which only give immediate satisfaction but which sacrifice social interests in the long-run.

1.10 IMPORTANCE OF PRODUCT PLANNING AND DEVELOPMENT

What is Product Planning?

Marketing encompasses decisions related to product, price, place, and promotion. Every decision is critical for the effective marketing of the brand. One of these decisions is the product decision which includes all the major aspects related with the product itself. Product planning and development is the most critical aspect of the product decision. Product planning is comprised of both the corporate plan as well as the marketing plan, based on which the product plans are made.

Product planning is followed by product development, which involves finding ways to produce the product based on the blueprint of product derived during product plan. The development process also involves the decision regarding product's feasibility and profitability, i.e., whether developing the product will be profitable for the firm in the long-run or not. Product planning involves various other decisions like designing, packaging and labelling, branding, pricing, and making alterations in the product as per the requirements of the customers. These decisions are to be taken by the marketing managers.

Definition of Product Planning

According to W.J. Stanton:

"Product planning embraces all activities which enable producers and middlemen to determine what should constitute Company's line of products",

According to Johnson:

"Product planning determines the characteristics of product best meeting the consumer's numerous desires, characteristics that add stability to products and incorporates these characteristics into the finished product".

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According to Karl H. Tietjin:

"Product planning is the act of making out and supervising the search, screening, development and commercialization of new products; the modification of existing line and discontinuance of marginal or unprofitable items".

Therefore, we can conclude that the product planning and development is comprised of the product mix decisions related with the product and services which the firm intends to produce and sell. It also includes decisions regarding product policy and strategies, which serve as guidelines for the target market and therefore, help in formulating the target market objectives.

Importance of Product Planning

1. **Initiator of the Marketing Programme:**
   In marketing, product planning is one of the processes undertaken at the very beginning of the marketing programme. It involves planning and deciding about the product at different stages of the product life cycle. The marketing policies, strategies, programmes and procedures are greatly influenced by the decision taken regarding modification, customization, standardization and elimination of a product. Inefficient product planning will put a negative impact on all other decisions, programmes, and policies, since all of them are derived or formulated on the basis of product planning.
2. **Impacts Marketing Actions:**
   Marketing activities rotate around product planning. Hence, inappropriate planning influences the marketing activities and may lead to managerial inefficiencies in the firm. The various elements associated with the marketing programme like advertising policies, distribution channels, pricing policies, personal selling, sales promotion, etc., are all influenced by the product planning decisions.
3. **Results in Customer Satisfaction:**
   As product planning is totally based on the assessment of the needs and requirements of the customers, only reasonable products and services are offered by the firms. This leads to the customer satisfaction. Obsolete or useless products are also eliminated through product planning, which ultimately helps the customers. Thus, customer satisfaction is the end result of an effective product planning.
4. **Ensures Profitability of the Product:**
   Earning profits is the ultimate motive o all the firms. They focus on selling the product as per customers need and in return make profit on such sale. In doing so, product planning serves as the best way to manage fulfilment of customers' needs as well as making profits out of it. For ensuring profitability of the product, the firm undertakes various researches from time to time to Know the change in the taste and preferences, needs, habits, status etc. of the customers. Based on the results of these researches, firm goes for product modification.
5. **Profit Prediction:**
   With the help of product planning, a firm can very easily forecast its profits at different stages of product life cycle, the only thing required by the firm is to know the stage of the PLC. Also, in case of firm's declining phase, the marketers may

decide about which product needs to be developed and which product should be eliminated so as to retain the stability of the firm. Such decision will be helped by appropriate product planning.

1.11 DIFFERENCE BETWEEN GOODS AND SERVICES

BASIS FOR COMPARISON	GOODS	SERVICES
Meaning	Goods are the material items that can be seen, touched or felt and are ready for sale to the customers.	Services are amenities, facilities, benefits or help provided by other people.
Nature	Tangible	Intangible
Transfer of ownership	Yes	No
Evaluation	Very simple and easy	Complicated
Return	Goods can be returned.	Services cannot be returned back once they are provided.
Separable	Yes, goods can be separated from the seller.	No, services cannot be separated from the service provider.
Variability	Identical	Diversified
Storage	Goods can be stored for use in future or multiple use.	Services cannot be stored.
Production and Consumption	There is a time lag between production and consumption of goods.	Production and Consumption of services occurs simultaneously.

1.12 OBJECTIVES OF PRODUCT PLANNING

1. **To meet the customer needs:**
   Just as all roads lead to Rome, all activities in the realm of marketing finally lead to meet the customer requirements. It is because; customer is the king-pin of modern marketing system.

   Product planning is a dependable tool in the kit of a marketing manager to attain this ultimate objective. It is product planning that identifies the customer needs, requirements, aspirations, likes and preferences and guides the firm's resources and efforts towards the accomplishment of this want satisfying.

2. **To spot-light firm's strengths and weaknesses:**
   In this dynamic business world, no company is so strong that it is free from weakness and no company is so weak that it is away from strength. Each firm has its own strengths and weaknesses may be material or human.

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It becomes an internal planning premise. It is product planning that brings these strengths and weaknesses to spot-light because, the future plan the blue-pint of action is founded on this set of given strengths and weaknesses. Thus, pinpointing the strengths and weaknesses becomes another object of product planning so that the products would be so devised as to minimize the weaknesses and maximize the strengths.

3. **To fortify better resource utilization:**
   Each company is committed to resources involving a definite cost structure. This minimum cost level of production is possible only when the company resources are geared to its production plan.

   As product planning is related with development of new products, modification of existing one to changing consumer needs, discontinuance of marginal products, the limited and costly resources are so employed as to get the greatest, better and cheaper production. It is product planning that rests heavily on the nature and extent of internal resources.

4. **To guarantee firm's survival:**
   Product is the hope for the firm's survival. The product that meets the ever-changing needs of customers makes the firm to survive successfully as it becomes adaptive. Product innovation and renovation are the two key words that are to be given due weight-age by a firm that wants to survive for many more years to come. This competitive world can bring the 'best' product because; the very best is subject to improvement.

   In other words, the very best product remains the best for a shorter period of time. It is the product planning that predicts the likely changes in products, technologies, product ideas, inputs so that the latest can be given to make even the greatest a thing of past.

5. **To Increase firm's sales:**
   Sales are like milk capable of giving much warranted cream. Though the amount of cream depends on the quality of milk, this cream can be increased by generating more milk. Every firm rest on sales as the only sources of income to meet the outgoes and retain decent margin to justify its hard work of putting resources and taking risks.

   This is a very significant aspect in these days of keen competition where one unit is cutting the throat of another diplomatically. This survival with success is made possible by product planning that gauges the nature and extent of competition on one hand and counteracts with changed product price promotion and distribution strategies.

1.13 SUCCESSFUL PRODUCT DEVELOPMENT

INTRODUCTION TO PRODUCTION, OPERATIONS MANAGEMENT AND PRODUCT PLANNING DEVELOPMENT

In order to stay successful in the face of maturing products, companies have to obtain new ones by a carefully executed new product development process. But they face a problem: although they must develop new products, the odds weigh heavily against success. Of thousands of products entering the process, only a handful reaches the market. Therefore, it is of crucial importance to understand consumers, markets, and competitors in order

to develop products that deliver superior value to customers. In other words, there is no way around a systematic, customer-driven new product development process for finding and growing new products. We will go into the eight major steps in the new product development process.

1. **Idea generation – The New Product Development Process**
   The new product development process starts with idea generation. Idea generation refers to the systematic search for new-product ideas. Typically, a company generates hundreds of ideas, maybe even thousands, to find a handful of good ones in the end. Two sources of new ideas can be identified:

   a. **Internal idea sources**: the company finds new ideas internally. That means R&D, but also contributions from employees.

   b. **External idea sources**: the company finds new ideas externally. This refers to all kinds of external sources, e.g. distributors and suppliers, but also competitors. The most important external source are customers, because the new product development process should focus on creating customer value.

2. **Idea screening – The New Product Development Process**
   The next step in the new product development process is idea screening. Idea screening means nothing else than filtering the ideas to pick out good ones. In other words, all ideas generated are screened to spot good ones and drop poor ones as soon as possible. While the purpose of idea generation was to create a large number of ideas, the purpose of the succeeding stages is to reduce that number. The reason is that product development costs rise greatly in later stages. Therefore, the company would like to go ahead only with those product ideas that will turn into profitable products. Dropping the poor ideas as soon as possible is, consequently, of crucial importance.

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3. **Concept development and Testing – The New Product Development Process**
To go on in the new product development process, attractive ideas must be developed into a product concept. A product concept is a detailed version of the new-product idea stated in meaningful consumer terms. You should distinguish

   a. A product idea à an idea for a possible product

   b. A product concept à a detailed version of the idea stated in meaningful consumer terms

   c. A product image à the way consumers perceive an actual or potential product.

4. **Marketing strategy development – The New Product Development Process**
The next step in the new product development process is the marketing strategy development. When a promising concept has been developed and tested, it is time to design an initial marketing strategy for the new product based on the product concept for introducing this new product to the market.

   The marketing strategy statement consists of three parts and should be formulated carefully:

   a. A description of the target market, the planned value proposition, and the sales, market share and profit goals for the first few years

   b. An outline of the product's planned price, distribution and marketing budget for the first year

   c. The planned long-term sales, profit goals and the marketing mix strategy.

5. **Business analysis – The New Product Development Process**
Once decided upon a product concept and marketing strategy, management can evaluate the business attractiveness of the proposed new product. The fifth step in the new product development process involves a review of the sales, costs and profit projections for the new product to find out whether these factors satisfy the company's objectives. If they do, the product can be moved on to the product development stage.

   In order to estimate sales, the company could look at the sales history of similar products and conduct market surveys. Then, it should be able to estimate minimum and maximum sales to assess the range of risk. When the sales forecast is prepared, the firm can estimate the expected costs and profits for a product, including marketing, R&D, operations etc. All the sales and costs figures together can eventually be used to analyze the new product's financial attractiveness.

6. **Product development – The New Product Development Process**
The new product development process goes on with the actual product development. Up to this point, for many new product concepts, there may exist only a word description, a drawing or perhaps a rough prototype. But if the product concept passes the business test, it must be developed into a physical product to ensure that the product idea can be turned into a workable market offering. The problem is, though, that at this stage, R&D and engineering costs cause a huge jump in investment.

The R&D department will develop and test one or more physical versions of the product concept. Developing a successful prototype, however, can take days, weeks, months or even years, depending on the product and prototype methods.

Also, products often undergo tests to make sure they perform safely and effectively. This can be done by the firm itself or outsourced.

In many cases, marketers involve actual customers in product testing. Consumers can evaluate prototypes and work with pre-release products. Their experiences may be very useful in the product development stage.

7. **Test marketing – The New Product Development Process**
   The last stage before commercialization in the new product development process is test marketing. In this stage of the new product development process, the product and its proposed marketing program are tested in realistic market settings. Therefore, test marketing gives the marketer experience with marketing the product before going to the great expense of full introduction. In fact, it allows the company to test the product and its entire marketing program, including targeting and positioning strategy, advertising, distributions, packaging etc. before the full investment is made.

   The amount of test marketing necessary varies with each new product. Especially when introducing a new product requiring a large investment, when the risks are high, or when the firm is not sure of the product or its marketing program, a lot of test marketing may be carried out.

8. **Commercialization**
   Test marketing has given management the information needed to make the final decision: launch or do not launch the new product. The final stage in the new product development process is commercialization. Commercialization means nothing else than introducing a new product into the market. At this point, the highest costs are incurred: the company may need to build or rent a manufacturing facility. Large amounts may be spent on advertising, sales promotion and other marketing efforts in the first year.

1.14 CHALLENGES OF PRODUCT DEVELOPMENT

Developing a new product is a challenging task. Few companies will only succeed. There are some odds present which makes life challenging for the development teams. Following are the challenges of Product development.

1. **Trade-Offs**
   Trade-off means that a balance achieved between two desirable features. This is the most difficult part of product development. Recognizing and understanding these trade-offs will maximise the success of the product. For example, an aeroplane can be made lighter but this will result in an increase in the manufacturing costs. So here we need to balance between the manufacturing cost while making the plane even lighter.

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2. **Dynamics**
   Being successful in the market is not only the end but sustaining the competition in the market is also even more challenging. As the technologies improve, customer preferences changes/evolve and the introduction of the new products in the markets. The decision making in this kind of environment is a challenging task.
3. **Time Pressure**
   The product development decisions should be made under time pressure even though there is incomplete information.
4. **Economics**
   With the firm investment in product development, the firm will expect a reasonable return on investment with this product. The product should be a reasonable price so that the customers are willing to pay and inexpensive to produce. These are the challenges that can make product development more challenging for a firm and the enterprise level. There are a few other challenges at the individual people and the development teams.
5. **Creation**
   As the idea takes shape and comes to reality as a physical component or equipment, each and every creative action that performed by the individual in the development team will contribute to the success of the product.
6. **Team Diversity & Team Spirit**
   Successful product development requires the skills and talents. As a result, the product development teams involve the people with a wide range of experiences, personalities and perspective put together for the success. For this, they need to be motivated and cooperative together as a team to bring up the energy in every one in creating the product.

1.15 NEW PRODUCT DEVELOPMENT STRATEGY

To achieve market success with its product, an organization must first map out a methodology. It should be a step-by-step plan that will allow the team to move the product forward at each stage along its journey from concept to market launch. We call this predefined process and sequence of events the product development strategy. A product development strategy is crucial for several reasons. Here are just a few.

1. **It helps align the cross-functional team around the big-picture goals and priorities from the start.**
   This will help the team make better-informed tactical decisions throughout the development process when challenges and questions arise—which they always do during product development.
2. **It provides the team with feedback and guidance for every step of the product's development journey.**
   Imagine that during the market-validation stage of its new concept, the product team finds lower-than-expected levels of interest from its user personas. If the team is operating from a predefined product development strategy, they will be in a

better position to know whether to proceed with their original plan or to pivot and prioritize other functionality first.

3. **It enables more efficient development.**
   When a company has a clearly defined product development strategy, there will be a better sense of how to allocate resources and estimate timeframes throughout the development cycle. In an agile development organization, this will also help clarify which task-level initiatives take priority at any given time, and which ones to include in an upcoming sprint.

Build a Product Development Strategy Around Design Thinking

Product development strategies differ by company, industry, and other factors. There is no one-size-fits-all approach that works under all circumstances. There are common elements to many successful product development strategies.

The Design Thinking Approach:

- Empathize with users
- Define the problem
- Brainstorm potential solutions
- Build a prototype
- Test your solution

Applying a Product Development Strategy to The Design Thinking Approach:

Step 1: Empathize with users.

Home appliance manufacturers devised a simple strategy decades ago to see the world through the eyes of their users. The product managers for these companies would visit the homes of customers and ask to watch as they used their products—dishwashers, vacuum cleaners, blenders, etc.

The PMs would take note of which features customers used, how they activated those features (which often wasn't the way the company intended), what problems they encountered while using the products, and what if any workarounds they came up with.

For example, let's say a customer is dealing with a vacuum cleaner with a long cord that tangled easily. The customer might simply throw the cord over her shoulder while vacuuming. It signaled to the product team that they needed a better solution to help users keep the cord out of the way while they vacuumed.

You might not be able to visit your customers' homes, but what strategies can you devise to gain a sense of how your user persona views the world. And, how can your products solve their real-world challenges?

Step 2: Define the problem

Now that you've been able to view how your users view the world, you can think through some of the challenges they face. Where have you noticed them throwing a vacuum-cleaner cord over their shoulders? For every step in your product development strategy, you will want to create a structure, a plan.

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You might organize your work into the following 3 steps:

1. Write down every user pain point you've identified.
2. Distill these into a shortlist, just a handful of pain points. You can narrow the list to only the most severe pain points you've found, or according to pain points that you believe your team could most quickly and easily develop a solution. Or a combination of both.
3. Run the list by your product team for additional input, and to arrive at a list the team agrees is worth pursuing.

Step 3: Brainstorm potential solutions

Again, in a product development strategy, you'll need structure at every step. Brainstorming does not mean simply sitting in a room alone, thinking of ideas. Build a process around it. For example:

1. Pull together your cross-functional team for an open brainstorming session. Before this meeting, you'll also want to share with the team your findings from whatever research you did to gain more empathy from your users' point of view. It will help the team better understand the types of solutions you're hoping to build, and why.
2. Establish go/no-go criteria for each suggestion at the beginning of your session. You might decide, for example, that each person who presents a product idea has 5 minutes to persuade the group that it's viable. Then, if a majority of the team agrees, the idea advances to the next level.
3. After you've narrowed your list of product concepts down to a manageable number, conduct a rough calculation of time, budget, and resources needed to develop a minimum viable product or even a minimum viable feature. Now you have another set of criteria to help you narrow your choice of which product concepts to pursue.

Step 4: Build a prototype

Here you will coordinate with your designers and your development team to build an MVP or a working version of your concept that you can put in real users' hands to gauge their level of interest.

At this stage, you will have a broad idea of the market problem you're addressing and your product's big-picture strategy for solving it. Share this idea with your designers and developers. Let them apply that strategic understanding of their work.

Step 5: Test your solution

In the design thinking approach, this final stage refers not to internal QA testing but to allowing your user personas to try your product and tell you what they like and don't like about it.

And because this is part of your step-by-step product development strategy, you will want to apply structure to this stage of your product's journey. You might, for example, want to establish your go/no-go metrics upfront. Will you consider this concept viable if 30% of users say they were impressed with your MVP? If 10% say they'd buy it? Would these numbers need to be higher?

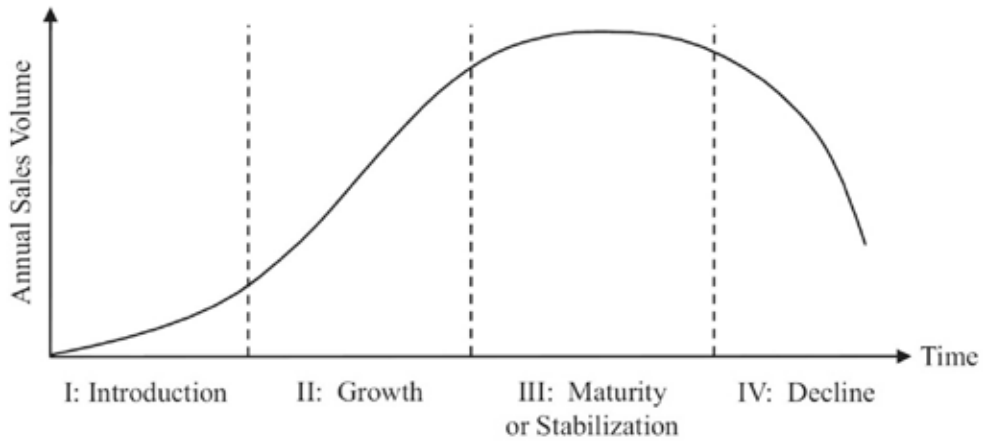
How to Create a Product Development Strategy

The product management team plays a crucial role in product development—acting as the strategic directors of the process. But although we use the two terms often interchangeably, product development is not synonymous with product management. Product development is a much broader process that involves the coordinated effort of many teams across a company, including:

- Product management
- Design (UX/UI)
- Development (or manufacturing)
- Marketing
- Testing and QA
- Sales
- Shipping or distribution
- Support

1.16 PRODUCT LIFE CYCLE

The term product life cycle refers to the length of time a product is introduced to consumers into the market until it's removed from the shelves. The life cycle of a product is broken into four stages—introduction, growth, maturity, and decline. This concept is used by management and by marketing professionals as a factor in deciding when it is appropriate to increase advertising, reduce prices, expand to new markets, or redesign packaging. The process of strategizing ways to continuously support and maintain a product is called product life cycle management.



How Product Life Cycles Work

Products, like people, have life cycles. A product begins with an idea, and within the confines of modern business, it isn't likely to go further until it undergoes research and development (R&D) and is found to be feasible and potentially profitable. At that point, the product is produced, marketed, and rolled out.

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As mentioned above, there are four generally accepted stages in the life cycle of a product—introduction, growth, maturity, and decline.

1. **Introduction:** This phase generally includes a substantial investment in advertising and a marketing campaign focused on making consumers aware of the product and its benefits.
2. **Growth:** If the product is successful, it then moves to the growth stage. This is characterized by growing demand, an increase in production, and expansion in its availability.
3. **Maturity:** This is the most profitable stage, while the costs of producing and marketing decline.
4. **Decline:** A product takes on increased competition as other companies emulate its success—sometimes with enhancements or lower prices. The product may lose market share and begin its decline.

When a product is successfully introduced into the market, demand increases, therefore increasing its popularity. These newer products end up pushing older ones out of the market, effectively replacing them. Companies tend to curb their marketing efforts as a new product grows. That's because the cost to produce and market the product drop. When demand for the product wanes, it may be taken off the market completely.

The stage of a product's life cycle impacts the way in which it is marketed to consumers. A new product needs to be explained, while a mature product needs to be differentiated from its competitors.

Companies that are seeking new ways to grow and move out of market decline may try:

- Extending the product line like soda brands Coca-Cola or Pepsi adding cherry, vanilla, and other flavours.
- Repackaging the product as in the example of Listerine, which was formerly a surgical antiseptic. Listerine was then repackaged and rebranded to become a mouthwash that cures bad breath.
- Trying new pricing strategies as Dollar Shave Club did. The company uses subscription pricing as well as pricing based on the number of blades in each razor.
- Launching new versions of the product like Apple, which maintains the hype with every new iPhone release.
- Moving into new product categories would mean moving back to the beginning of the product life cycle—and sometimes that's what it takes to survive. Nintendo is a great example of this. They went from making video arcade games to video game systems for personal use.

INTRODUCTION TO PRODUCTION, OPERATIONS MANAGEMENT AND PRODUCT PLANNING DEVELOPMENT

Product life cycle examples

While all products go through the life cycle, some have already gone the entire cycle and fallen by the wayside. Here are a few examples of products that are either currently in their product life cycle or have been discontinued.

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Typewriters

- Christopher Latham Sholes of Milwaukee, WI, patented the first typewriter in 1868. It had been in development for nearly 300 years as inventors tried to perfect a design.
- By the late 1800s, the introduction stage of the life cycle began when commercial typewriters were made available to the public.
- Shortly thereafter, in the growth stage, typewriters were used in businesses, homes, and offices.
- Typewriters lingered in the maturity phase until the 1980s when emerging technologies pushed them to decline.
- The typewriter market declined. Typewriters were, for the most part, discontinued in favour of computers, tablets, and smartphones. Most typewriters available today are novelty items and vintage collectibles.

VCRs

- Believe it or not, VCRs were being developed in the 1950s as a method of watching VHS tapes from recorded TV. The first actual prototype was as big as a desk and cost nearly Rs. 50k in 1950, which translates to over Rs. 500,000 today. All that to record television shows to watch at a more convenient time.
- In 1977, the first (small and affordable) VCR was introduced to the public for recording and playing back video on television screens.
- From the late 70s to early 2000s, most homes had a VCR in them, along with a plethora of tapes. This was definitely a period of extreme growth.
- As the VCR entered maturity, companies were searching for ways to reduce the cost and add features.
- Technology led to the decline of the VCR, eventually giving way to the DVD and now streaming services.

Electric vehicles

- Electric vehicles were first developed in the early 1800s. They fell out of favour because charging was an issue for the average consumer. Fast forward to today. Automakers, most notably Tesla, are shifting their focus to all-electric or hybrid technology.
- They have been introduced to the market with a focus on innovation and eco-friendliness as their marketing messages.
- Electric vehicles are currently in their growth stage as companies continue to improve the design and features of their offerings. The growth stage is extended because ongoing market innovation leads to improvements, and that, in turn, increases sales potential. For now, they are seeing continued growth and the maturity stage is nowhere in sight.

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1.17 FACTORS TO BE CONSIDERED IN NEW PRODUCT PLANNING

Marketing a new product is challenging. You have to target the right customers with the right product and message at the right time. Much of the success in new product launches lies in the planning that occurs months in advance. This includes the use of market research to understand consumer needs and the preparation of effective promotional strategies.

- **Marketplace Need**
  The first step in marketing is to research the marketplace to discover needs and preferences. This contributes to the development of a marketable product or service solution that has a high potential for success. Customer surveys, test product sample marketing and polling are techniques used to identify what customers want. This knowledge is useful in designing products that provide clear advantages to customers relative to competitors.
- **Product Benefits**
  Just knowing what customers want doesn't guarantee success. A gap in the ability of the marketing function to control outcomes exists in product development. Marketing may know what customers want and how to market the benefits, but they typically don't design and develop products. Still, a quality product or service that offers benefits desired by customers is necessary. Even when early adopters buy a bad product, word will spread quickly that it doesn't satisfy their needs and expectations.
- **Clear Differentiation**
  On the contrary, a quality product alone doesn't necessarily do the trick. You need a clear market position derived from competitor analysis and differentiation. If 10 competing brands offer the exact same benefits, customer decisions become very arbitrary. In developing and promoting products, you want to focus on one or two key advantages or distinctions that separate your brand and that customer will appreciate. Organic food marketers, for instance, try to appeal to customers especially concerned with more natural and healthy food options.
- **Effective Promotion**
  Promotion is a major factor to product marketing success that's controlled by the marketing function. This includes paid advertising, public relations or free media exposure and sales efforts. Choosing the right media to connect with target customers and creating impacting messages that appeal to customers in the right way are critical steps to promotion success. Even with a great product, poor promotion can lead to marketing failure. Advertising research is useful in the development of impacting messages that promote desired benefits and reach the market.

1.18 CHAPTER SUMMARY

INTRODUCTION TO PRODUCTION, OPERATIONS MANAGEMENT AND PRODUCT PLANNING DEVELOPMENT

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

of a range of inputs into the required (products/services) having the requisite quality level. The set of interrelated management activities, which are involved in manufacturing certain products, is called as production management. If the same concept is extended to services management, then the corresponding set of management activities is called as operations management. This management concept involves planning, scheduling, supervising and control of the activities that concern the production of goods to meet the needs of consumers and also generate profit for the business. Production Management involves using resources judiciously, to create acceptable products. In this case, raw materials are being transformed into value-added products efficiently.

The idea of operations management began in the eighteenth century as manufacturing management. An economist, Adam Smith, realized that specialization of labour could be very beneficial to any organization's economy. He therefore came up with the idea of breaking up jobs into sub units where only workers specialized in a certain field would take up the task not only to ensure efficient delivery of the task but also to further increase their skills (Kumar, and Suresh, 2009, p. 284). Early in the twentieth century, F. Taylor enforced this law which then resulted to the development of scientific management. Since then until in the early nineties, many developments were made based on the traditional of the operation. PDTs should determine the optimal level of integration, or parts, that have been pre-assembled at an upstream supplier. This can be a difficult decision because while integrated components can reduce the number of parts that need to be managed in final assembly and allow for a reduction in assembly time (often by limiting the number of physical interconnections on the manufacturing line), this bundling of P/Ns can create additional supply risk in several ways. The product life cycle is the progression of a product through 5 distinct stages—development, introduction, growth, maturity, and decline. The concept was developed by German economist Theodore Levitt, who published his Product Life Cycle model in the Harvard Business Review in 1965. We still use this model today. Marketing a new product is challenging. You have to target the right customers with the right product and message at the right time. Much of the success in new product launches lies in the planning that occurs months in advance. This includes the use of market research to understand consumer needs and the preparation of effective promotional strategies.

1.19 REVIEW QUESTIONS

SHORT ANSWER TYPE QUESTIONS

1. **What is production operations management?**
2. **Explain Challenges of Product Development.**
3. **Define product planning.**
4. **How to Create a Product Development Strategy?**
5. **Explain Product life cycle. Give one example also.**

LONG ANSWER TYPE QUESTIONS

1. **Factors to be considered in new product planning explain in brief.**
2. **Explain the 5 stages of the product life cycle.**

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3. **Explain New product development process in brief.**
4. **Write a brief note on product planning and also explain its importance.**
5. **Write a brief note on operations strategy and production budget.**

1.20 MULTIPLE CHOICE QUESTIONS

1. **There are _____ stages of the product life cycle.**
   a. 2
   b. 3
   c. 4
   d. 5
2. **The application of that principle to production function is the term _____.**
   a. Production management
   b. Quality management
   c. Production and quality management
   d. None of the above
3. **The production budget, also called the _____.**
   a. Assurance budget
   b. Manufacturing budget
   c. Product budget
   d. All of the above
4. **The first stage in the product life cycle is _____.**
   a. Production
   b. Manufacture
   c. Development
   d. All of the above
5. **The term _____ is being increasingly replaced by simply Operations management.**
   a. Production management
   b. Operations management
   c. Both A and B
   d. None of the above
6. **There are _____ Types of Operations Strategies.**
   a. 5
   b. 4
   c. 3
   d. 2
7. **Production management attempts to utilize _____.**
   a. 5M's
   b. 6M's
   c. 7M's
   d. 8M's

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8. Product is the _____ for the firm's survival.

a. Hope
b. Production
c. None of the above
d. All of the above

9. The product life cycle is the progression of a product through _____ distinct stages.

a. 2
b. 3
c. 4
d. 5

10. Adam Smith is an _____.

a. Mathematician
b. Scientist
c. Economist
d. None of the above

♦♦♦♦♦

UNIT II

FACILITY AND PRODUCT PLANNING AND CONTROL (PPC)

STRUCTURE

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2.1 LEARNING OBJECTIVE

After completion of this unit, student will be able to:

- Explain others about production planning and control.
- Understand about merits and demerits of different locations.
- Know about the concept of production planning.
- Know about the benefits and limitations of PPC.

2.2 INTRODUCTION

For efficient, effective and economical operation in a manufacturing unit of an organization, it is essential to integrate the production planning and control system. Production planning and subsequent production control follow adaption of product design and finalization of a production process. Production planning and control address a fundamental problem of low productivity, inventory management and resource utilization. Production planning is required for scheduling, dispatch, inspection, quality management, inventory management, supply management and equipment management. Production control ensures that production team can achieve required production target, optimum utilization of resources, quality management and cost savings.

Planning and control are an essential ingredient for success of an operation unit. The benefits of production planning and control are as follows:

- It ensures that optimum utilization of production capacity is achieved, by proper scheduling of the machine items which reduces the idle time as well as over use.
- It ensures that inventory level is maintained at optimum levels at all time, i.e., there is no over-stocking or under-stocking.
- It also ensures that production time is kept at optimum level and thereby increasing the turnover time.
- Since it overlooks all aspects of production, quality of final product is always maintained.

2.3 IMPORTANCE OF FACILITY PLANNING

Facilities management is a vital part of successfully operating a business. Therefore, when you incorporate a facilities manager into the day-to-day running of your business, they will be essential to:

Strategic Planning

Strategic planning provides a clear direction for your business and will help you to evaluate your progress as time goes on. A facilities manager will help to define long-term and short-term objectives, such as cutting costs and boosting productivity, as well as help you meet these goals. Strategic planning will get you from where you are now to where you want to be. Therefore, strategic planning is essential to the successful and manageable growth of your business.

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Managing Your Day-to-Day Operations

As well as being a part of strategically planning for the future, facilities managers are also likely to be involved in the day-to-day running of your business.

Their duties might include:

- Ordering stock.
- Ensuring that all facilities comply with UK and EU legislation and guidance.
- Planning, directing and coordinating central services such as reception, mail, cleaning, waste disposal and recycling.
- Keeping staff safe.

Additionally, facilities managers will organise, coordinate and manage office space, as well as supervise contractors and plan any disruptions to minimise the impact on office activities. A good facilities manager will improve the overall operational efficiency of your company. They will provide your employees with the tools they need to work well and help the day-to-day operations of your business run seamlessly.

Office facilities manager

Implementing and Enforcing Health and Safety Procedures Your business must have procedures in place to protect all employees, visitors and members of the public from harm. Usually, your facilities manager will manage this process. They will carry out risk assessments and implement and enforce health and safety procedures to reduce the risks of your workplace hazards.

Additionally, they will handle any on-site emergencies and will monitor your procedures to ensure they are always up to date. By doing so, they will help your business comply with health and safety legislation.

Organising Maintenance, Repairs and Security of the Building and Premises

Facilities managers are usually in charge of organising the security, maintenance and repairs of your building. This protects employees and their property, prevents unauthorised access and ensures your building meets legal requirements. Facilities managers are required to take care of the entire site, or a certain area of it, assess the condition, determine if repairs are needed and ensure these repairs are carried out. They are also responsible for organising waste disposal and management. Many employees take the cleanliness of their workspace for granted but, without a facilities manager organising the process, the hygiene standards could slip.

2.4 FACTORS AFFECTING LOCATION DECISIONS

Facility Location is the right location for the manufacturing facility, it will have sufficient access to the customers, workers, transportation, etc. For commercial success, and competitive advantage following are the critical factors:

Overall objective of an organization is to satisfy and delight customers with its product and services. Therefore, for an organization it becomes important to have strategy formulated around its manufacturing unit. A manufacturing unit is the place where all inputs such as

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raw material, equipment, skilled labors, etc. come together and manufacture products for customers. One of the most critical factors determining the success of the manufacturing unit is the location.

Facility location determination is a business-critical strategic decision. There are several factors, which determine the location of facility among them competition, cost and corresponding associated effects. Facility location is a scientific process utilizing various techniques.

Numerous factors might affect the location decision. The suitable location is determined by analyzing various factors, parameters and issues. Some of the factors are listed below:

- **Product and Industry**
  The nature of the product impacts the facility's location. For instance, poultry farms are established on the outskirts of the city.
- **Availability of Resources**
  The plant must be located close to the suppliers of the raw materials. Because it minimizes the transportation cost, time and overall cost of production.
- **Proximity to Consumers**
  The organizations offering services may choose to locate facilities near their target customers. Thus, providing them with an advantage over similar service providers.
- **Climate Conditions**
  Manufacturing of some products demands specific climatic conditions. For this reason, industries are set up in the areas where such climatic condition exists.
- **Proximity to Market**
  The companies producing customized or assembled products are located near their target market. Consequently, it reduces the time required for products assembling and delivery.
- **Taxes**
  The tax rates vary within and across the regions. This factor directly impacts the organizations.

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- **Regulatory and Policy Issues**
  The political policies differ in different geographical boundaries. So, the organizations prefer locations inside open economies having favourable policies.
- **Labour Supply**
  Before installing the plant, companies assess the availability of skilled labour. Also, they ensure the availability of basic necessities for the employee's survival.
- **Free Trade Zones**
  Free Trade Zones are areas in which one can conduct business free from customs duties. Thus, it is an essential factor when selecting a site location.
- **Infrastructure**
  Before the installation, Industries must assess the availability of infrastructure in that region. It may include connectivity via Rail, Roads, Air and Sea.

Location Decision Process

Step 1: Investigation

Firstly, the organizations investigate their requirements regarding their location. They conduct an internal SWOT analysis and decide whether to move, expand or install a new setup.

Step 2: Identification

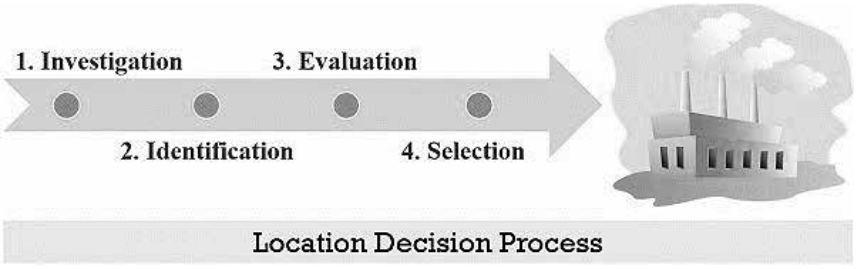
Post investigation, they try to identify the potential locations for locating the facility. For example, installing the facility in the Domestic or Foreign regions.

Step 3: Evaluation

The next step in the location decision process is evaluating the potential locations. The evaluation process may include a detailed comparison of all the alternatives available.

Step 4: Selection

Companies conduct a thorough analysis of the location and government policies in the selected region. Also, an in-depth evaluation of the merits and demerits of the chosen area. Therefore, choosing the most appropriate location of the facility for installation.



2.5 MERITS AND DEMERITS OF DIFFERENT LOCATIONS

Merits of Supply Chain Management

- **Cost Efficiency**
  Supply chain management assist in attaining cost efficiency within the organization. It aims at optimizing all process of business which bring down the production cost,

packaging cost, warehousing and transportation cost and avoids any wastage of goods by facilitating timely delivery. It minimizes the overall operating expenses and enhances the overall profitability.

- **Enhance Output**
  The concept of supply chain management aims at maximizing the overall productivity of business. Supply managers monitor all production processes and ensure that all resources are efficiently utilized. Any wastage of resources is avoided which lead to maximize the overall output.
- **Avoids Delay in Process**
  Preventing any delays of business process is one of the major advantages of supply change management. Supply chain manager ensure that all materials are timely acquired for facilitating uninterrupted production of products. Also, they regulate all delivery and logistics services of business which promote delivery at right time at right location thereby avoiding any delays.
- **Easily Identify Problem Areas**
  Supply chain management enable business in recognizing its issue that are adversely affecting its reputation and profitability. Managers can easily track the performance of every department and identify which one is lacking in delivering its duties. In absence of this concept, it will be difficult to detect the issue and every department will blame each other for any problem that erupts.
- **Better Collaboration**
  Process of supply chain management bring better collaboration among distinct parties of business. It focuses on developing a proper communication channel within the business for avoiding any confusion or disputes. Smooth flow of information among all stakeholders like employees, customers, suppliers and distribution enhance understanding which leads to create a better collaboration.

Demerits of Supply Chain Management

- **Expensive To Implement**
  Major limitation of process of supply chain management is that it is quite expensive to implement. It requires large investment in terms of time, money and other resources that become unaffordable for small businesses.
- **Complicated**
  Process of supply chain management involves numerous complexities as it involves several departments within the organization. It may lead to create confusion and hamper the normal functioning of business. Employees may feel hesitant and demotivated to accept this concept as it is new to them thereby giving rise to several other difficulties.
- **Lack of Co-Ordination Among Departments**
  The concept of supply chain management functions properly only if there is better coordination among departments of departments. Establishing a coordination among several departments within big corporate is a quite difficult task where this concept may eventually fail to perform.

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- **Requires Trained and Personalized Staff**
  Supply chain management requires qualified and trained human resources for its effective executive within the company. Company needs to incurs heavy expenses for acquiring such taskforce that is professional and highly skilled. Small companies may find it unfavourable for their implementation.
- **Lack Of Reliability**
  Supply chain management lacks of reliability as it is completely dependent upon the mode of information exchange among several departments. If there is any instance of inaccurate information sharing by any of the department, then it will have adverse effects on performance of whole supply chain.

2.6 FACILITY LAYOUT

For an organization to have an effective and efficient manufacturing unit, it is important that special attention is given to facility layout. Facility layout is an arrangement of different aspects of manufacturing in an appropriate manner as to achieve desired production results. Facility layout considers available space, final product, safety of users and facility and convenience of operations.

An effective facility layout ensures that there is a smooth and steady flow of production material, equipment and manpower at minimum cost. Facility layout looks at physical allocation of space for economic activity in the plant. Therefore, main objective of the facility layout planning is to design effective workflow as to make equipment and workers more productive.

A model facility layout should be able to provide an ideal relationship between raw material, equipment, manpower and final product at minimal cost under safe and comfortable environment. An efficient and effective facility layout can cover following objectives:

- To provide optimum space to organize equipment and facilitate movement of goods and to create safe and comfortable work environment.
- To promote order in production towards a single objective.
- To reduce movement of workers, raw material and equipment.
- To promote safety of plant as well as its workers.
- To facilitate extension or change in the layout to accommodate new product line or technology upgradation.
- To increase production capacity of the organization.

An organization can achieve the above-mentioned objective by ensuring the following:

- Better training of the workers and supervisors.
- Creating awareness about of health hazard and safety standards.
- Optimum utilization of workforce and equipment.
- Encouraging empowerment and reducing administrative and other indirect work.

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Factors affecting Facility Layout

Facility layout designing and implementation is influenced by various factors. These factors vary from industry to industry but influence facility layout. These factors are as follows:

- The design of the facility layout should consider overall objectives set by the organization.
- Optimum space needs to be allocated for process and technology.
- A proper safety measure as to avoid mishaps.
- Overall management policies and future direction of the organization.

Design of Facility Layout

Principles which drive design of the facility layout need to take into the consideration objective of facility layout, factors influencing facility layout and constraints of facility layout. These principles are as follows:

- Flexibility: Facility layout should provide flexibility for expansion or modification.
- Space Utilization: Optimum space utilization reduces the time in material and people movement and promotes safety.
- Capital: Capital investment should be minimal when finalizing different models of facility layout.

Design Layout Techniques

There are three techniques of design layout, and they are as follows:

- Two- or Three-Dimensional Templates: This technique utilizes development of a scaled-down model based on approved drawings.
- Sequence Analysis: This technique utilizes computer technology in designing the facility layout by sequencing out all activities and then arranging them in circular or in a straight line.
- Line Balancing: This kind of technique is used for assembly line.

2.7 OBJECTIVES AND PRINCIPLES OF GOOD PLANT LAYOUT

Plant layout is a plan for effective utilization of facilities for the manufacture of products; involving a most efficient and economical arrangement of machines, materials, personnel, storage space and all supporting services, within available floor space. A good rather an ideal layout is one which provides maximum satisfaction to all concerned i.e., shareholders, management employees and consumers.

Objectives of a Good Plant Layout

Only through an efficient layout, the organization can attain the following objectives:

- Economy in handling of materials, work-in-process and finished goods.
- Minimization of product delays.
- Lesser work-in-progress and minimum manufacturing cycle time.
- Efficient utilization of available space.

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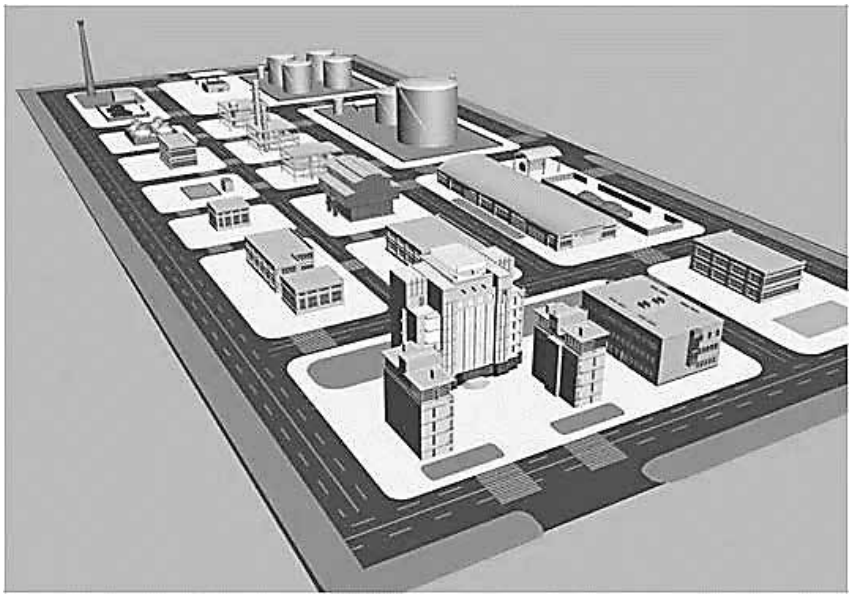
- Easy supervision and better production control.
- Greater flexibility for changes in product design and for future expansion.
- Better working conditions by eliminating causes of excessive noise, objectionable odour smoke etc.



Principles of a Good Plant Layout

Overall integration of factors: A good layout is one that integrates men, materials, machines and supporting activities and others in a way that the best compromise is obtained. No layout can satisfy each and every principle of a good layout. Some criterion may conflict with some other criterion and as a result no layout can be ideal it has to integrate all factors into the best possible compromise.

Minimum movement: A good layout is one that permits the minimum movement between the operations. The plant and machinery in case of product layout and departments in case of process layout should be arranged as per sequence of operations of most of the products.

- Since straight line is the shortest distance between any two points, men and materials as far as possible should be made to move along the straight path
- A door may be made in a wall or a hole may be drilled in a ceiling if that eliminates or reduces material handling in place of stairs or a distant door.

Uni-direction flow: A good layout is one that makes the materials move only in the forward direction, towards stage of completion, with any backtracking.

- Since straight line is the shortest distance between any two, points, materials as far as possible should be made to move on the principle of straight-line flow. And when straight line flow is not possible, other flows like U-shaped flow, circular flow or zig zag flow may be adopted, but the layout may ensure that materials move in the forward direction.
- To ensure forward flow, equipment, if necessary, may be duplicated.

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Effective use of available space: A good layout is one that makes effective use of available space both horizontal and vertical.

- Backtracking and duplicated movements consume more time, involve un-necessary materials handling, add to cost and lead to inefficiency.
- Raw materials, work-in-progress and finished goods should be piled vertically one above another rather than being strewn on the floor.
- Pallets or equivalents should be made use of to pile up several layers one above another.
- Area below the work tables or in the cupboards built into the wall are welcome since they reduce requirement of space.

Maximum visibility: A good layout is one that makes men, machines and materials ready observable at all times.

- All departments should be smoothly integrated, convenient to service and easy to supervise.
- Every piece of positioning or screening or partitioning should be scrutinized and carefully planned.
- Special cupboards, enclosures, offices, partitions etc. should be avoided except when their utility is established beyond doubt.

Maximum accessibility: A good layout is one that makes all servicing and maintenance point readily accessible.

- Machines should be kept sufficiently apart and with reasonable clearance from the wall so that lubrication, adjustment and replacement of belts, removal of parts at the time of repairs etc can be done conveniently by the maintenance staff.
- Area in front of electrical panels and fire extinguishers should be kept free from obstructions.

2.8 TYPES OF LAYOUTS

There are mainly four types of plant layout:

a. Product or line layout

b. Process or functional layout

c. Fixed position or location layout

d. Combined or group layout

a. Product or Line layout

In an industrial set up, sometime, the machines and equipment's are arranged in one line depending upon the sequence of operations required for the product. The raw materials and semi-finished materials move from one workstation to another sequentially without any backtracking or deviation. Under this, machines are grouped in one sequence. Therefore, materials are fed into the first machine and finished goods travel automatically from machine to machine, the output of one

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machine becoming input of the next, e.g., in a paper mill, bamboos are fed into the machine at one end and paper comes out at the other end. The raw material moves very fast from one workstation to other stations with a minimum work in progress storage and material handling. The grouping of machines is done on following general principles.

1. All the machine tools or other items of equipment's must be placed at the point demanded by the sequence of operations.
2. There should no points where one line crossed another line.
3. Materials may be fed where they are required for assembly but not necessarily at one point.
4. All the operations including assembly, testing packing must be included in the line.

Advantages of Product layout

1. Low cost of material handling, due to straight and short route and absence of backtracking.
2. Smooth and continuous operations.
3. Continuous flow of work.
4. Lesser inventory and work in progress.
5. Optimum use of floor space.
6. Simple and effective inspection of work and simplified production control.
7. Lower manufacturing cost per unit.

Disadvantages of Product layout

1. Higher initial capital investment in special purpose machine (SPM).
2. High overhead charges.
3. Breakdown of one machine will disturb the production process.
4. Lesser flexibility of physical resources.

Thus, these types of layouts are able to make better utilization of the equipment that is available, with greater flexibility in allocation of work to the equipment and also to the workers one should be very cautious about any imbalance caused in one section is not allowed to affect the working of the other sections.

b. Process or functional layout

In this type of layout machines of a similar type are arranged together at one place. For example, machines performing drilling operations are arranged in the drilling department, machines performing casting operations be grouped in the casting department. Therefore, the machines are installed in the plants, according to various processes in the factory layout.

Hence, such layouts typically have drilling department, milling department, welding department, heating department and painting department etc. The process or functional layout is followed from historical period. It evolved from the

handicraft method of production. The work has to be allocated to each department in such a way that no machines are chosen to do as many different jobs as possible i.e., the emphasis is on general purpose machine. The work, which has to be done, is allocated to the machines according to loading schedules with the object of ensuring that each machine is fully loaded.

Advantages of Process layout

1. Lower initial capital investment is required.
2. There is high degree of machine utilization, as a machine is not blocked for a single product.
3. The overhead costs are relatively low.
4. Breakdown of one machine does not disturb the production process.
5. Supervision can be more effective and specialized.
6. Greater flexibility of resources.

Disadvantages of Process layout

1. Material handling costs are high due to backtracking.
2. More skilled labour is required resulting in higher cost.
3. Work in progress inventory is high needing greater storage space.
4. More frequent inspection is needed which results in costly supervision.

Thus, the process layout or functional layout is suitable for factories / businesses which have job order production; that is involving non-repetitive processes and customer specifications and non-standardized products, e.g., tailoring, light and heavy engineering products, made to order furniture industries, jewellery etc.

c. Fixed position or location layout

Fixed position layout involves the movement of manpower and machines to the product which remains stationary. The movement of men and machines is advisable as the cost of moving them would be lesser. This type of layout is preferred where the size of the job is bulky and heavy. Example of such type of layout is locomotives, ships, boilers, generators, wagon building, aircraft manufacturing, etc.

Advantages of Fixed position layout

1. The investment on layout is very small.
2. The layout is flexible as change in job design and operation sequence can be easily incorporated.
3. Adjustments can be made to meet shortage of materials or absence of workers by changing the sequence of operations.

Disadvantages of Fixed position layout

1. As the production period being very long so the capital investment is very high.
2. Very large space is required for storage of material and equipment near the product.

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3. As several operations are often carried out simultaneously so there is possibility of confusion and conflicts among different workgroups.

d. Combined or group layout

Certain manufacturing units may require all three processes namely intermittent process (job shops), the continuous process (mass production shops) and the representative process combined process [i.e., miscellaneous shops]. In most of industries, only a product layout or a process layout or a fixed location layout does not exist. Thus, in manufacturing concerns where several products are produced in repeated numbers with no likelihood of continuous production, combined layout is followed.

Generally, a combination of the product and process layout or other combination are found, in practice, e.g., for industries involving the fabrication of parts and assembly, fabrication tends to employ the process layout, while the assembly areas often employ the product layout.

In soap, manufacturing plant, the machinery manufacturing soap is arranged on the product line principle, but ancillary services such as heating, the manufacturing of glycerine, the power house, the water treatment plant etc. are arranged on a functional basis.

2.9 CONCEPT OF PRODUCT PLANNING AND CONTROL (PPC)

Production Planning

Production planning is one part of production planning and control dealing with basic concepts of what to produce, when to produce, how much to produce, etc. It involves taking a long-term view at overall production planning.

Therefore, objectives of production planning are as follows:

- To ensure right quantity and quality of raw material, equipment, etc. are available during times of production.
- To ensure capacity utilization is in tune with forecast demand at all the time.

A well thought production planning ensures that overall production process is streamlined providing following benefits:

- Organization can deliver a product in a timely and regular manner.
- Supplier are informed will in advance for the requirement of raw materials.
- It reduces investment in inventory.
- It reduces overall production cost by driving in efficiency.

Production planning takes care of two basic strategies' product planning and process planning. Production planning is done at three different time dependent levels i.e., long-range planning dealing with facility planning, capital investment, location planning, etc.; medium-range planning deals with demand forecast and capacity planning and lastly short-term planning dealing with day-to-day operations.

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Production Control

Production control looks to utilize different type of control techniques to achieve optimum performance out of the production system as to achieve overall production planning targets.

Therefore, objectives of production control are as follows:

- Regulate inventory management
- Organize the production schedules
- Optimum utilization of resources and production process

The advantages of robust production control are as follows:

- Ensure a smooth flow of all production processes
- Ensure production cost savings thereby improving the bottom line
- Control wastage of resources
- It maintains standard of quality through the production life cycle.

Production control cannot be same across all the organization. Production control is dependent upon the following factors:

- Nature of production (job oriented, service oriented, etc.)
- Nature of operation
- Size of operation

Production planning and control are essential for customer delight and overall success of an organization.

2.10 IMPORTANCE OF PRODUCT PLANNING AND CONTROL (PPC)

Throughout the years, manufacturers have been on a quest to improve their operations by increasing productivity, managing their inventory, and optimizing their resource utilization. These are some of the main challenges faced by manufacturers. Many strategies have emerged as solutions to allow manufacturing operations to improve their overall production efficiency. One such strategy is Production Planning and Control (PPC), which is a term used to describe two essential components of manufacturing: production planning and production control. The production planning portion handles the activities necessary before production actually begins, such as materials planning, capacity planning, and operations scheduling. The production control portion oversees the actual production process by ensuring that the production team is able to meet its production targets and is operating according to schedule. Overall, production planning and control can play a substantial role in production through schedule optimization, waste reduction, and cost minimization.

Production Planning & Control Importance

For many manufacturers, the techniques and strategies used in production planning and control have been extremely beneficial in improving their operations. Some of the most beneficial features of production planning and control include the following:

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- **Customer Service Enhancement** - The production planning component of PPC ensures that the organization can deliver a finished product on time. Customers can benefit from having high-quality products being delivered promptly due to improved scheduling and optimized production. These improvements ultimately win customers over and can persuade them to establish a profitable and ongoing relationship with the manufacturing organization.
- **Inventory Control** - Proper inventory management can be a challenging thing to achieve as planners must balance holding enough inventory to satisfy customer demand while minimizing the risks and costs of holding too much inventory. With a promising production planning and control system, inventory planning becomes much easier. These types of systems allow planners to only purchase enough materials to fulfil orders which reduces the need for holding a lot of raw materials. In addition, they can provide the tools for utilizing a Just-In-Time scheduling strategy, which further reduces the need for holding finished goods or large quantities of work-in-process items. Importance of Production Planning and Control
- **Equipment Improvement** - Production planning and control will ultimately unveil areas and machines that are not able to meet their production targets. These could signal a lack of productivity due to faulty equipment which can be remedied by scheduling regular maintenance and cleaning for the underperforming resources. This will enable you to have equipment that is able to meet the targeted production outputs and ensure that the resources are being used efficiently. In addition, the capacity planning aspect of production planning and scheduling will ensure that all resources are being utilized to their full potential.
- **Plant Morale Improvement** - Stress can be a tremendous hindrance in manufacturing as it increases the likelihood of errors and defects on the shop floor. A production planning and control system that ensures a systematic workflow through the production flow allows planners to better quote lead times. The overall outcome is that activities are properly coordinated and there is no need to rush orders to meet deadlines. The shop floor personnel are then able to know what needs to be done and are able to meet their production goals without the stress of rushing orders due to a disorganized plan.
- **Idle Time Reduction** - In manufacturing production, idle time refers to the paid time where an employee or machine is unproductive. Idle time is usually due to workers waiting for materials to begin production or on various machine repairs. These periods of low productivity can be costly for manufacturers. However, production planning and control is a viable solution to minimize downtime as it can effectively coordinate the purchasing and release of materials to ensure that every production step can start when scheduled.
- **Quality Improvement** - High-quality products must be able to meet industry standards at various checkpoints in the manufacturing process. As production planning and control overlook all aspects of production from materials planning

to resource optimization, this ensures that the quality of the finished goods is maintained. Having quality products is critical nowadays to ensure the satisfaction of customers. Your customers will be more likely to choose and endorse your brand if they know that your products are consistently reliable and durable.

- The many benefits of production planning and control show that it can increase a business's revenues by maximizing the utilization of its resources. Overall, if the individual components within the organization are not working well together, there will only be a limited amount of success for the entire manufacturing operation. A software that is becoming extremely common to handle production planning and control strategies is Planet Together's advanced planning and scheduling (APS) software. This type of software provides insight into the current operations and allows the planning and scheduling to occur concurrently to increase the efficiency of the operations.

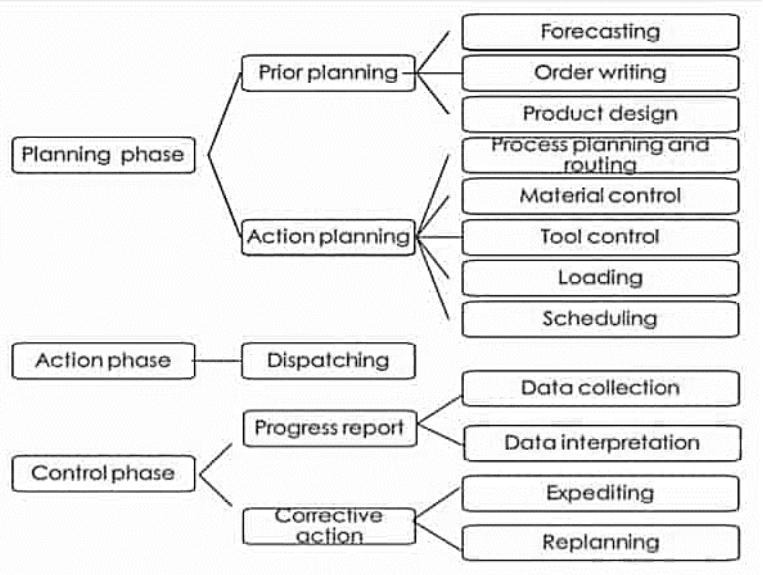
2.11 FUNCTIONS OF PPC DEPARTMENT

Three main phases of PPC:

1. Planning phase
2. Action phase
3. Follow up or control phase

- These three phases as mentioned above make up the main body of functions of PPC. There are other secondary functions that are essential contributors to the efficient performance of production, planning, and control.
- Also, there are other functions that are supported by these three phases which are not generally considered to be direct functions of production planning and control.
- These include quality control- cost control and so on.

Function of PPC



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Prior Planning:

Prior planning implies that a course of action is established in advance. The whole activity must be planned and exists on paper before the very first action takes place.

1. **Fore-canting (Estimation of future work):** Fore-casting is defined as the estimation of future activities i.e., the estimation of type, quantity, and quality of future work. These estimates provide the basis for establishing the future requirement for men, materials, machines, time, and money.
2. **Order writing (Preparation of work authorization):** If the work is to be controlled, it must begin with a specified documents authorising it. So, it means giving the authority to one or more persons to do a particular job.
3. **Product design (Preparation of specifications):** After the work authorization has been prepared the next step is to collect the information necessary to describe the work in detail. This includes blueprints or drawings, a list of specifications, a bill of material, and so on.

Action Planning:

In any type of work activity, the following steps are necessary for planning details of the work to be done:

1. **Process planning:** The determination of the most economical method of performing an activity, all factors being considered. Routing. The arrangement of work stations is determined by the route.
2. **Material control:** Determination of material requirements and control of material (inventory control).
3. **Tool control:** Tool control may be subdivided into two categories:
4. Design and procurement of new tools.
5. Control storage and maintenance of tools after procurement.
6. **Loading:** Determination and control of equipment and manpower requirements. Loading may be defined as the assignment of work to the facility. The facility may be equipment, manpower, or both.
7. **Scheduling:** Determination when the work is to be done. Scheduling consists of time phasing of loading (workload) i.e., setting both, starting and ending time for the work to be done.

The common practice dictates that routing, loading, and scheduling be performed simultaneously.

Action Phase:

- The work is started in the action phase. There is only one production planning activity in the action phase i.e., dispatching. Dispatching is the transition from the planning phase to the action phase.
- It consists of the actual release of detailed work authorization to the work centers. Follow up or Control Phase:

- Once the work is started in an activity it is necessary to evaluate continuously the progress in terms of plan so that deviations can be detected and corrected as quickly as possible. The control phase accordingly consists of two parts:

Progress report:

1. **Progress reporting:** (Data collection). The first step in progress reporting is to collect data for what is actually happening in the activity (Progress of work).
2. **Data interpretation.** After the data has been collected, then it is necessary to interpret it by comparing the actual performance against the plan.

Corrective Action:

1. **Expediting.** If the data collected from the production unit indicates that there is a significant deviation from the plan and the plan cannot be changed, then some action must be taken to get back on plan.
2. **Replanning.** It should be emphasized that the plan is not to be changed but to be followed, however, if after expediting to correct deviation it is found that, it is impossible to perform according to plan. It would be necessary to replan the whole affair. It may also be found that there were errors made while developing the original plan. In all such cases replanning is necessary.

2.12 PHASES IN PRODUCTION PLANNING AND CONTROL

1. **Planning**

   The first important step in production planning and control is concerned with the careful preparation of production plans. Production plans determine what will be produced and where, at what type, by whom, and how. For detailed planning of operations, the relevant information may be obtained from several sources in the enterprise. Information about quantity and quality of products to be manufactured may be obtained from customers' orders and the sales budget, and information about production facilities may be obtained from the management and the engineering department. Thus, the planning function formulates production plans, and translates them into requirements for men, machinery and materials.

   Whatever be the planning period, production planning helps in avoiding randomness in production, providing regular and steady flow of production

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activities, utilizing production facilities to its maximum for minimizing operating costs and meeting delivery schedules; coordinating various departments of the enterprise for maintaining proper balance of activities, and above all, providing the basis for control in the enterprise.

2. **Routing**

The next important function of production planning and control is routing which involves the determination of the path (i.e. route) of movement of raw materials through various machines and operations in the factory. "Routing includes the planning of where and by whom work shall be done, the determination of the path that work shall follow, and the necessary sequence of operations". To find this path, emphasis is placed on determining operating data, which usually includes planning of 'where' and 'by whom' work should be done, the determinations of the path that work shall follow, and the necessary sequence of operations. These operating data are contained in the standard process sheet which helps in making out a routing in the standard process sheet which helps in making out a routing chart showing the sequence of operations and the machines to be used. If the machine loan chart indicates the non-availability of certain machines, alternate routing may also be included on the routing chart. The most efficient routing may have to be compromised with the availability of the machines at a particular time. In other words, "routing establishes the operations, their path and sequence, and the proper class of machines and personnel required for these operations."

From the above, it can be inferred that routing is one of the highly essential elements and prime considerations of production control because many production control functions are closely related processes and are dependent on routing functions. Thus, it is essential to solve the different problems concerning: appropriate personnel; full utilization of machines; and determining with precise degree the time required in the production process.

3. **Scheduling**

Scheduling is planning the time element of production — i.e. prior determination of "when work is to be done". It consists of the starting and completion times for the various operations to be performed. In other words, scheduling function determines when an operation is to be performed, or when work is to be completed, the difference lies in the details of the scheduling procedure. To work out effectively, the scheduling, as a part of production control function, determines the time when each operation called for on the route sheet is to be done on the specified machine in order to meet the desired delivery dates. Good control function directs not only the time that each particular operation should start but also indicates the progress of each manufacturing part, the amount of work ahead of each machine, and the availability of each machine for the assignment of new work.

Schedules are of two types: Master schedule and Detailed schedule. Activities, if recorded on plant-wise basis, would be preparing master schedule, while mere detailed schedules are employed to plan the manufacturing and assembly operations required for each product.

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4. Dispatching

Dispatching is the part of production control that translates the paper — work into actual production. It is the group that coordinates and translates planning into actual production. Dispatching function proceeds in accordance with the details worked out under routing and scheduling functions. As such, dispatching sees to it that the material is moved to the correct work place, that tools are ready at the correct place for the particular operations, that the work is moving according to routing instructions. Dispatching carries out the physical work as suggested by scheduling. Thus, dispatching implies the issuance or work orders. These work orders represent authority to produce. These orders contain the following information:

- The name of the product;
- The name of the part to be produced, sub-assembly or final assembly;
- The order number;
- The quantity to be produced;
- Descriptions and numbers of the operations required and their sequence,
- The departments involved in each operation
- The tools required for particular operation; and
- Machines involved in each operation and starting dates for the operations.

5. Expediting

Expedition or follow-up is the last stage in the process of production control. This function is designed to keep track of the work effort. The aim is to ensure that what is intended and planned is being implemented. "Expediting consists in reporting production data and investigating variances from predetermined time schedules. The main idea behind expedition is to see that promise is backed up by performance". It includes the following functions:

- Check-up to ensure that all materials, tools, component parts, and accessories are available at all work centres in specified quantities for starting and carrying out manufacturing operations.
- Check-up on the status of work-in-progress and completed work at various work stations. This includes collecting information relating to the starting and completion time and date of work completed, status of work-in-progress relative to scheduled completion dates, position of movements of materials, component parts, and sub-assemblies within the plant, and inspection results.
- Preparation of progress records and keeping the control boards up-to-date.
- Reporting to manufacturing management on all significant deviations so that corrective action may be taken. It also includes reporting to production planning department so that future plans may be adjusted.

Thus, production planning and control by completing the above discussed phases ensures the manufacturing of goods of right quality, quantity and at competitive

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market rates. One thing must be borne in mind that production planning and control is a never-ending process, and its various functions are inter-dependent.

2.13 PRODUCTION PLANNING

Production planning incorporates a multiplicity of production elements, ranging from the everyday activities of staff to the ability to realize accurate delivery times for the customer. With an effective production planning operation at its nucleus, any form of manufacturing process has the capability to exploit its full potential. Let us see what famous management gurus have to say about the function of planning and production planning in particular:

Planning is deciding the best alternative among others to perform different managerial operations in order to achieve the predetermined goals…. **Henri Fayol**

Planning is an intellectual process, the conscious determination of the course of action, the basing the decisions on purpose, facts and considered estimates…. **Koontz and O'Donnell**

Planning is the continuous process of making present entrepreneurial decisions systematically and with best possible knowledge of their futurity by organizing systematically the efforts needed to carry out these decisions and measuring the results of these decisions against the expectation through organized and systematic feed-back….. **Peter Drucker**

Planning is the process of selecting and relating of facts in the visualization and formation of proposed activities believed to be necessary to achieve the desired results…. **George Terry**

2.14 FACTORS DETERMINING PRODUCTION PLANNING

1. **Nature of Production:** In job-oriented manufacturing products and operations designed for some particular order which may or may not be repeated in future. Here production usually requires more time whereas in a continuous manufacturing system inventory problems are more complex but control operations are rather simple due of fixed process. In mixed stock and custom manufacturing system inventory troubles are more complex but control operations are rather simple because of fixed process. in mixed stock and custom manufacturing systems the problem control is further complicated due to simultaneous scheduling of combined process.
2. **Nature of Operations/Activities:** In intermittent manufacturing system the operations markedly varied in terms of their nature sequence and duration. Because of this the control procedures requires continuous modifications and adjustments to suit the requirement of each other. Generally, the complexity of production planning and control function increases with the increases in the variety of operations. Factors affecting the complexity of production control procedures are:
   - Number of ultimate parts in the end product.
   - Number of different operations on each part.
   - Extent to which processes are dependent on the completion of previous operations.
   - Variations in production rates of machines used in the process.

- Number of discrete parts and sub-assemblies.
- Degree to which customer ™s orders with specific delivery dates occur.
- Receipt of many small lot orders.

3. **Magnitude of Operations:** Centralized control secures the most effective coordination but as an organization grows in size, decentralization of some production control function becomes essential. The degree to which the performance of an activity should be decentralized depends upon the scope of operations and convenience of their locations.

2.15 PRODUCTION PLANNING SYSTEM

In industry, the requirements for digital planning tools have been growing for years. This is because constantly increasing product ranges and new manufacturing processes are leading to more and more complexity. Competitive and price pressures continue to pick up speed, and the demand for individual products is increasing. As a result, companies feel compelled to improve their production and planning processes. This is the only way to ensure ongoing competitiveness. This is why more and more companies are turning to intelligent software solutions in production planning and control.

The production planning system (PPS) is a software tool that supports companies in planning, operational control, and monitoring production. The system is designed to support the user in the production planning & production control process and manage the data. The software system thus helps those responsible for production, purchasing, and sales to make better decisions by analysing the processes. In doing so, the software delivers objective results.

PPS system is undoubtedly helpful for all companies – from SMEs to large corporations. The software gives planners more control over all planning steps. This leads to better response and delivery times. In addition, the software reduces lead times in production. A long lead time is one of the biggest problems companies faces. The PPS helps to reduce the lead time significantly. In addition, a PPS offers other benefits as well. It is an effective tool to ensure that planning and production are working correctly and efficiently.

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2.16 PRODUCTION CONTROL

All organizations irrespective of size, use production control to some degree. In small organizations, the production control may be performed by one person; but in large complex industries the production control department is normally well-organised and highly specialized. Production control presupposes the existence of production plans, and it involves the use of various control techniques to ensure production performance as per plans. Co-ordinating men and materials and machines are the task of production control.

Production control may be defined as "the process of planning production in advance of operations; establishing the exact route of each individual item, part of assembly; setting and finishing dates for each important item, assembly and the finished products, and releasing the necessary orders as well as initiating the required follow-up to effectivate the smooth functioning of the enterprises." According to Henry Fayol, production control is the art and science of ensuring that all which occurs is in accordance with the rules established and the instructions issued". Thus, production control regulates the orderly flow of materials in the manufacturing process from the raw material stage to the finished product.

Production control aims at achieving production targets, optimum use of available resources, increased profits through productivity, better and more economic goods and services etc. An effective production control system requires reliable information, sound organization structure, a high degree of standardization and trained personnel for its successful operation.

A sound production control system contributes to the efficient operation of plant. In terms of manufacturing customer's orders, production control assures a more positive and accurate completion and delivery date. Delivering an order on time is obviously important to the customer and to the development of customer goodwill. Production control also brings plan and order to chaotic and haphazard manufacturing procedures. This not only increases the plant efficiency but also makes it a more pleasant place in which to work. Most people recognize that employees prefer to work and do better work under conditions of obvious control and plan. Morale may be considerably improved. Effective production control also maintains working inventories at a minimum, making possible a real saving in both labour and material investment. Thus, good production control helps a company operate and produce more efficiently and achieve lowest possible costs.

Objectives of Production Control

The success of an enterprise greatly depends on the performance of its production control department. The production control department generally has to perform the following functions:

- Provision of raw material, equipment, machines and labour.
- To organize production schedule in conformity with the demand forecasts.
- The resources are used in the best possible manner in such a way that the cost of production is minimized and delivery date is maintained.

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- Determination of economic production runs with a view to reduce setup costs.
- Proper co-ordination of the operations of various sections/departments responsible for production.
- To ensure regular and timely supply of raw material at the desired place and of prescribed quality and quantity to avoid delays in production.
- To perform inspection of semi-finished and finished goods and use quality control techniques to ascertain that the produced items are of required specifications.
- It is also responsible for product design and development.

Thus, the fundamental objective of production control is to regulate and control the various operations of production process such a way that orderly flow of material is ensured at different stages of the production and the items are produced of right quality, in right quantity, at the right time with minimum efforts and cost.

2.17 PRODUCTION CONTROL SYSTEM

The production control is the function of management which plans, directs and controls the material supply and processing activities of an enterprise so that specified products are produced by specified methods to meet an approved sales programme. It ensures that activities are carried out in such a way that the available labour and capital are used in the best possible way.

Production Control

The British Standards Institute defines the term production control to include the following:

1. The production plan or planning
2. Scheduling
3. Machine or labour utilization or dispatching
4. Stock control
5. Manufacturing control or routing and
6. Progress

Objectives of Production Control

1. Issuing the necessary orders to the proper personnel through the prescribed channels for effecting the plan.
2. To ensure availability of the means of carrying out the orders — the materials, machines, tools, equipment and manpower — in the required quality at the required time.
3. To ensure carrying out of the orders by the personnel so that goods are produced in the required quantities of the specified quality at the pre-determined time. Thus, the underlying principle of production control is that the highest efficiency in production is obtained by producing the required in time and in the best and cheapest method possible.

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Functions involved in Production Control

Following factors are involved in the practice of production control:

1. **Control Activities**
   This is done by releasing manufacturing orders through dispatching. Thus, plans are set in motion at the assigned time.
2. **Control of Material Movement**
   The time at which material is received from the supplier, and issued to the plant is observed and a close watch is kept on its movement from one plant to another to ensure that this movement is in accordance with the production cost.
3. **Availability of Tools is Controlled**
   Steps are to be taken to ensure that tools specified in the production plan are available as and when required.
4. **Quantity Produced is Controlled**
   Work-in-process at pre-determined stages of production is observed to determine that right quantity of specified quality work is processed.
5. **Control of Replacement**
   Quantity of raw material and work-in-process which fails to pass each stage of inspection is observed. Provision is made to issue replacement orders for each material for work.
6. **Labour Efficiency and Control**
   Time taken on each unit of work-in-process is observed and recorded. Comparison of time taken is made with the time allowed in scheduling.

2.18 BENEFITS OF PPC

Below are five benefits your small business can take advantage and benefit from having a PPC advertising to help you reach a new audience.

1. **Small Upfront Investment**
   Most forms of advertising require a rather large upfront investment. Pay per click marketing doesn't take much money to get started because most search engines don't charge companies to begin a PPC campaign, which means you don't have to pay a fee to set up an account. With pay per click marketing, you pay when someone clicks on your ad. You can begin your PPC account with a balance of Rs. 300 to get started and increase your budget from there. You are not required to use the entire budget within 30 days and can carry over into the following month.

2. **You Are in Control of The Campaign**
   You can change your PPC ads when you want and they are easy to adjust. This puts you in complete control of your marketing campaign, and it's an easy way to advertise your services and products.

   You can also adjust the keywords that people have to search for to bring up your ads. When dealing with pay per click advertising it's important to change your ads to meet developments in your industry or to match the latest trends.

3. **Results Are Easy to Measure**
   As we talked about above, there are plenty of digital marketing options when it comes to promoting your business, including SEO. However, measuring the results from some marketing campaigns can be difficult. That's not the case with PPC marketing.

   Services such as Google Ads allow you to easily track:

   - Keywords
   - Ads that are seen by potential buyers
   - Which ads perform the best
   - Click Through Rate (CTR)
   - Conversions (Leads)

   There's no reason to pay for ads that don't work, and with PPC advertising, you don't have to.

4. **Quick Results**
   In the business world, time is money. This means that you want to start generating results from your advertisements as quickly as possible. With a pay per click campaign, you can start seeing an increase in visitors to your website as soon as a few days. This is because your ads are being placed on top of search results and are being clicked on by users who are searching for solutions to their problems or a product related to your website. It's a simple, yet very effective, set up.

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5. **Set Your Own Budget**
   No matter how big or small your business is, everyone has a marketing budget. Most forms of advertisement require you to pay a large, upfront fee. With pay per click marketing, you can set your own budget because you're only paying when someone clicks on your ads. You can put a set amount of money into your marketing campaign, and once your budget runs out, the ads are stopped. You're never charged extra or hit with hidden fees, which allows you to determine just how aggressive you want your campaign to be

2.19 LIMITATIONS OF PPC

Certain trends in user activity have indicated that there are weaknesses in pay per click advertising that may have never been quite so apparent as now.

1. **Steep Learning Curve**
   It goes without saying that managing a PPC campaign is anything but a pick up and play affair. In order to conduct an effective PPC strategy, there needs to be a certain level of literacy with its metrics that can be quite overwhelming for newcomers. Compared to the other methods of web marketing, PPC generally has one of the steepest learning curves of all and will require significant commitment for even a marginal level of proficiency to the gained.
2. **Can Be Expensive**
   PPC is not only one of the most complex methods to become skilled in, but it is also be one of the costliest as well. Mistakes that are made on a high-volume PPC strategy can be expensive enough to discourage marketers from making any additional attempts. Though it isn't impossible to profit from PPC, attempting to do so requires a mindset that is at peace with losing any invested capital at the early start of the campaign. Once the campaign starts to perform you should start seeing a better ROI.
3. **Shrinking ROI Potential**
   Even after taking the time to invest in becoming PPC proficient, the observable trends in potential customers have shown far less interactions with ads of any sort.

Just as traditional advertising agencies have struggled with the drop in printed ad revenue, PPC marketers have had to cope with the fact that a greater proportion of users have begun to use ad blocking software. While SEO services can be used to organically funnel traffic to web pages via page rank representation, the prevalence of ad blocking software essentially locks out conversions that can't be obtained by any tweaking of the PPC method. As it stands, the risk of losing capital on paid ads may not evenly match with what one stands to gain if successful.

4. **Contextual Semantic Targeting Backfires**
   What is often cited as one of the characteristic advantages of PPC advertising can also be one of its most frustrating as well. The contextual delivery of certain PPC ads can be useful for activating ads upon the detection of a certain designated keyword in search queries, but at the same time, this also includes other search queries that might contain the word in an unrelated context. If the ad doesn't shed enough light on exactly what the context is, money can be wasted from clicks by users who searched for a term that was similar but not the same as what the marketer had in mind.

5. **Saturation and Inflation**
   The rate of advertiser spending on search engine optimization has steadily increased. The higher influx of advertisers has led to an inflation of the price of Google Ads bidding and cost per click, which means that the competition will only grow steeper as the window for profit grow smaller. Finding yourself in a situation where you could be overspending and costing your business money each month is somewhere you do not want to be especially if the budget is not there. You want to avoid dipping into your own personal funds to maintain a pay per click campaign for your business. When it comes to running a PPC strategy you have to take into account your business and industry you are in. This will help you make the right decision when it comes to having a budget and whether it's worth running a Google Ads campaign.

2.20 CHAPTER SUMMARY

For efficient, effective and economical operation in a manufacturing unit of an organization, it is essential to integrate the production planning and control system. Production planning and subsequent production control follow adaption of product design and finalization of a production process. Production planning and control address a fundamental problem of low productivity, inventory management and resource utilization. Production planning is required for scheduling, dispatch, inspection, quality management, inventory management, supply management and equipment management. Production control ensures that production team can achieve required production target, optimum utilization of resources, quality management and cost savings. Strategic planning provides a clear direction for your business and will help you to evaluate your progress as time goes on. A facilities manager will help to define long-term and short-term objectives, such as cutting costs and boosting productivity, as well as help you meet these goals.

Production planning incorporates a multiplicity of production elements, ranging from the everyday activities of staff to the ability to realize accurate delivery times for the customer.

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With an effective production planning operation at its nucleus, any form of manufacturing process has the capability to exploit its full potential. In industry, the requirements for digital planning tools have been growing for years. This is because constantly increasing product ranges and new manufacturing processes are leading to more and more complexity. Competitive and price pressures continue to pick up speed, and the demand for individual products is increasing. As a result, companies feel compelled to improve their production and planning processes.

2.21 REVIEW QUESTIONS

SHORT ANSWER TYPE QUESTIONS

1. **What is Strategic Planning?**
2. **Define production planning.**
3. **Discuss Objectives of Production Control.**
4. **Define the terms of production control.**
5. **Explain action planning.**

LONG ANSWER TYPE QUESTIONS

1. **Discuss limitations of PPC.**
2. **Discuss benefits of PPC on a brief note.**
3. **Write a brief note on production planning.**
4. **Explain Principles of a Good Plant Layout in brief.**
5. **Explain the importance of facility planning. Also discuss the Demerits of Supply Chain Management.**

2.22 MULTIPLE CHOICE QUESTIONS

1. **Facilities management is a _____ of successfully operating a business.**
   a. Vital part
   b. Not an important part
   c. Secondary part
   d. None of the above

2. **Cost Efficiency, Enhance Output, Avoids Delay in Process, Easily Identify Problem Areas, Better Collaboration these are _____ of supply chain management.**
   a. Demerits
   b. Merits
   c. Functions
   d. All of the above

3. **"Planning is deciding the best alternative among others to perform different managerial operations in order to achieve the predetermined goals…." This line is said by _____.**
   a. Hart
   b. Koontz and O'Donnell

c. Urwick
d. Henri Fayol

4. **_____ can satisfy each and every principle of a good layout.**
   a. Some layout
   b. Every layout
   c. No layout
   d. None of the above

5. **The production planning system (PPS) is a software tool that supports companies in _____.**
   a. Planning
   b. Operational control
   c. Monitoring production
   d. All of the above

6. **You can change your PPC ads when you want and they are _____.**
   a. Difficult to adjust
   b. Easy to adjust
   c. Can't change
   d. All of the above

7. **There are _____ factors of production planning.**
   a. 1
   b. 2
   c. 3
   d. 4

8. **In the business world, time is _____.**
   a. Money
   b. Valuable
   c. Nothing
   d. All of the above

9. **Schedules are of two types:**
   a. Master schedule
   b. Subjective schedule
   c. Detailed schedule
   d. Both A and C

10. **A _____ is one that makes the materials move only in the forward direction, towards stage of completion, with any backtracking.**
    a. Good layout
    b. Bad layout
    c. Not working layout
    d. None of the above

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UNIT III

VENDOR RELATIONS AND PURCHASE MANAGEMENT, MANAGEMENT OF INVENTORY

STRUCTURE

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3.1 LEARNING OBJECTIVE

After completing this unit, students will be able to:

- Understand the Importance of Vendor relations and Purchase management.
- Learn about the Functions of Purchase Department.
- Know the Preparation of Purchase Budget.
- Learn about Vendor Relation Management.
- Understand the Inventory Turnover Analysis
- Learn about ABC analysis.

3.2 INTRODUCTION

As the growing popularity of just in time and supply chain management, the supplier seems to be more significant role for manufacturing to achieve their customer satisfaction in terms of quality, delivery and business point of view. The smooth running of production line could be interrupted by the poor quality of material. The schedule to delivery will be affected by both poor qualities of material and poor delivery performance. Also, the manufacturing will get less profit if they select the non-reasonable price of material, as of the material is the cost of manufacturers. In order to achieve the Quality Manufacturing Excellence (QME), the Vendor Management System (VMS) is the one most important factor of success. The vendor/ supplier is the partnership that concerned to manufacturer not only the quality but also other business issues.

As Vendor Partnership Relation (VPR), it is necessary to work closely between manufacturer and supplier as a team working such as training a supplier's staff about quality techniques, including a design review meeting to gain ideas on how supplier parts can best be used, providing sale projections/ forecasts with supplier to support their production scheduling, sharing information of accept/ reject criteria for manufacturer and supplier, etc. Such this VPR, it leads to establish the Vendor Management Team (VMT) at Manufacturer to assess, work, and coordinate with the vendor partnership at a first stage of production. The supplier performance has a significant effect on the competitiveness in implementation Just-In-Time and entire supply chain. In this paper, proposed the strategies in managing vendor called Vendor Management System (VMS), its benefits and how do you source a best vendor.

Vendor management has a number of definitions. Some companies believe that it is the management of vendors in order to achieve better prices and terms. Others believe that vendor management is building a relationship with your vendors in order to obtain mutually beneficial interactions. There is also an increasing prevalence for purchasers to allow vendors to manage the procurement process as in Vendor Managed Inventory (VMI) systems, also known as Vendor Management Inventory. In this procurement process, used by many large retailers, the vendor interfaces with the purchaser's sales and inventory accounts and delivers new products on a just in need (JIT) basis. Vendor management includes care in selecting a vendor and then undertaking regular and frequent reviews using detailed evaluation methods. During this vendor selection process, a period of

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vendor analysis is undertaken to find the vendors who will provide quality products at keen pricing and advantageous terms. Each vendor is matched to a set of vendor selection criteria to find the most appropriate vendor for the purchasing company.

Large vendors often have vendor ratings assigned to them from reputable consultancies that greatly aid the process. The entire purchasing process and management of several vendors is assisted by a set of tools, technologies and services, collectively known as Vendor Relationship Management (VRM). Vendors align themselves with their customer's Vendor Management System that builds an efficient and profitable procurement relationship for both companies. Vendor performance management is usually measured by service level agreements (SLA) and alignment to their contractual obligations. Some companies use a balanced score board methodology. Measurements of the relationship, account management, quality, delivery and costs are the most common. Those companies who hire multiple staff, particularly temporary staff are able to use a Vendor Management System (VMS) to minimize costs and prices and maximize efficiency. A VMS is an internet-based application that connects to one or more service providers. Features include a procurement process, consolidated billing and time sheets. It appears that however, you want to undertake your vendor management or your vendor supply, there is a software package or consultancy out there to assist you in your performance reviews.

Moreover, a business can run smoothly its operating activities only when appropriate amount of inventory is maintained. Inventory affects all operating activities like manufacturing, warehousing, sales etc. The amount of opening inventory and closing inventory should be sufficient enough so that the other business activities are not adversely affected. Thus, inventory also plays an important role in operations management.

3.3 IMPORTANCE AND FUNCTIONS OF VENDOR RELATIONS AND PURCHASE MANAGEMENT

Maintaining a healthy relationship with your vendors can promote an environment of collaboration and mutual respect that makes working together more enjoyable. While every business relationship is unique and comes with its challenges, having a strong vendor strategy can help you create long-lasting partnerships that promote mutual success. Building successful relationships takes patience and trust, and if you are responsible for vendor relations, it's important to learn how to handle it effectively. In this article, we define vendor relations, explain why it's important and explore strategies that you can use to establish and support successful vendor relationships.

What are vendor relations?

Vendor relations are supplier-buyer relationships supported by contracts and buyer-implemented management strategies. Companies use vendors to supply products or services that they need to function. If a business establishes an ongoing exchange with a single vendor, they may choose to begin a business relationship that allows for the buyer and supplier's success. In these relationships, companies may implement various methods to ensure the agreement with their vendor remains consistent, prosperous and mutually beneficial.

Why are vendor relations important?

Vendor relations are important because they can influence the longevity of your agreement, make it easier to accomplish goals and increase the potential for successful collaborations. In general, having good relationships with your vendors can improve your customer service, enhance the quality of your products and make your processes more cost-efficient.

For example, the better your relationship with a vendor, the more likely they will be to understand your business and provide you with ways to be competitive in the market, such as by giving you access to exclusive products. They may also ensure that the goods they give you are high quality and delivered on time.

Strategies for a successful vendor relationship

The success of your relationship with your vendors can depend on the strategies you choose to implement. While there are many ways to manage your relationship with a supplier, developing useful methods early on can help you engage with them effectively throughout the life of your agreement. Here are some helpful best practices you can use to build and maintain long-lasting, mutually beneficial partnerships with your vendors:

- **Choose the right vendor**
  The key to a successful partnership often depends on the steps you take before the relationship even begins. Before going out to bid, consider doing research on potential vendors you think might be a good fit for your business. Try to weigh factors like how your customers might receive the vendor, if they fit your company's long-term goals, their pricing flexibility and if they're a good culture fit. Choosing a vendor that matches well with your goals and vision can promote a healthy relationship.
- **Set clear expectations**
  When you first enter a relationship with a vendor, it can be helpful to define your expectations. Try to foresee any potential challenges and address them early on. Having a document or contract that clearly establishes your expectations can help you if you encounter obstacles in the future. If you have already entered into an agreement with a vendor but find that they are not meeting your needs, you can still introduce a document with actionable requirements. This can help both parties manage their expectations and ensure mutual success within your relationship. When drafting your expectations, consider the opinions of key stakeholders and interested parties as well.
- **Communicate frequently**
  Consider taking the time to maintain an active relationship with your vendor. Frequent one-on-one meetings can facilitate timely reactions to potential issues, promote trust and establish an open environment for sharing ideas. Communicating often can also help you build and develop your relationship. Ultimately, moving away from a more formal approach to vendor relationship management and focusing instead on building a connection can improve your ability to work together and generate new ideas. By being receptive to your vendor's opinions and providing quality customer service, your relationship can develop into a valuable, enduring partnership with mutual care and respect.

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- **Be upfront about any problems**
  One key component of a successful vendor relationship is trust. Addressing potential obstacles early on may give you and your vendor time to work on solutions together. It can also establish a precedent for healthy communication. If the vendor approaches you with bad news, try to be receptive and understanding and create an environment of teamwork, transparency and timely updates.
- **Practice continued performance management**
  Performance management is a tool business use to ensure the vendor is adequately reaching milestones, producing consistent deliverables and meeting goals. Consider checking in with your vendor regularly to make sure the relationship is adequately progressing. Try to provide clear and actionable feedback and address any concerns about service, transparency and products to ensure they understand your needs and can meet them effectively.
- **Take a collaborative approach**
  Vendor relations usually exist because they represent a mutual opportunity for both the supplier and the businesses they supply. Most vendors aim to secure larger contracts because they represent predictable sales, increased brand exposure and consistent business. Likewise, businesses benefit from vendor relationships because they often provide reliable products, pricing flexibility and tailored customer service.

  Developing your relationship with this in mind can help you craft goals and strategies that benefit both your company's goals and your vendor's goals. Coming up with approaches that allow for mutual success may help your relationship with your vendor as well as your own progress. By keeping your vendor's success in mind, you can curate an environment of teamwork, positivity and collaboration.
- **Plan for the long term**
  Planning for the long term can help you devise strategies that uncover the root of potential problems rather than developing quick fixes that don't allow for relationship growth. Choosing a vendor that can scale up with you if you grow or work with you if your business model changes allow you to feel confident in the long-term viability of your partnership. In your meetings with your vendor, consider taking the time to discuss future strategies and goals rather than just your present ones.
- **Use technology to stay organized**
  While the human element of your vendor relationship is critical, you can also aid in your relationship's success by investing in software designed to onboard new vendors, track the receipt of deliverables, manage invoices and communicate with your vendors. The technology you choose to use may depend on your specific vendor agreement. However, regardless of how you track your progress, keeping up-to-date records can help you stay organized and effectively communicate your needs.

What is purchase management?

Purchase management is a business discipline that enables companies to manage the

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activities and relationships that make up the purchasing functions necessary to do business. At its core purchase management is all about saving money, increasing profits and it is an important function for any wholesale, distribution or manufacturing business. Efficient purchase management provides a prime opportunity for wholesalers to clear bigger profits by controlling costs of the inventory stock needed to run their business. To deliver the greatest profitability for an organization it is crucial that products and services are purchased at the best price and quality available. To ensure the most cost-effective outcomes, purchasing strategies are necessary and should be developed in line with a basic purchasing cycle to best manage all the necessary functions from one centralized location.

Importance of Purchase Management

Purchasing decisions have a direct impact on a business's inventory control and the management of accurate inventory stock levels. Good purchase management practices streamline purchasing and inventory control processes to reduce holding costs and to ensure inventory levels are replenished in a timely manner. Many businesses invest significant resources into inventory stock yet fail to monitor purchasing. Purchasing activity comprises of more than simply buying stock, it also involves researching products for the business, vetting suppliers and sources of inventory stock, then following up to ensure deliveries are received on time, in good condition and in the right quantity.

Purchasing cycles

A purchasing cycle shows the steps that a business will go through before making any product purchase. It starts from the knowledge there is a product need, to specifying the quantities required and when they are needed by. Once a purchase need is identified, the prices and quality of different products and inventory stock from different suppliers needs to be compared before a decision is reached on where to source the goods. A purchase order is then approved, in larger organizations this many require approval from more than one person.

The business and the supplier then negotiate the terms of the purchase contract. At this stage of the purchasing cycle, it may also be determined if this is a one-off sale or whether it will be an ongoing relationship with the chosen supplier. When the stock is receipted into the business, the goods are counted and inspected for quality and then recorded in the company's inventory management system.

Functions of purchase department

A purchasing department is the division of a company that's responsible for acquiring the goods and services the business requires to operate. Some companies refer to purchasing departments as procurement departments or buying departments. These units are often an important part of helping companies meet their daily needs and their long-term strategic goals. How much responsibility a department has can vary on the size of the company, but they often help monitor the supply chain and help manage vendor contracts to keep the company's operations efficient. Purchasing departments are often an important part of large corporations and small businesses. They establish policies and procedures that try to ensure the financial health of a company. Understanding the functions and roles of purchasing departments may help you develop supply strategies and procurement goals to

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benefit your company. In this article, we explore what a purchasing department is, describe its main strategic and operational functions and list its additional roles.

What is the main function of a purchasing department?

A company's purchasing department may have a large influence on its ability to reach its strategic and daily operational goals. Its ability to acquire enough materials while lowering costs can allow a company to raise its profits, lower its expenditures and achieve growth. Purchasing departments can use their contacts with suppliers to improve the overall quality of a business' product and lower risks in a company's operations by effectively managing these relationships. On the operational level, purchasing departments ensure businesses receive everything they need for projects. This can include raw materials for manufacturing, supplies for employees, office spaces or technology. When purchasing departments provide these goods efficiently, it can ensure production remains high and products and services reach customers on time.

Additional purchasing department functions and roles

Purchasing departments manage a variety of roles in a company, depending on its type or size. Some of their additional functions and roles include:

- Assessing the needs of their company
- Comparing and negotiating prices
- Coordinating deliveries
- Managing supplier relationships
- Managing competition
- Monitoring performance
- Obtaining subsidies and benefits
- Maintaining compliance
- Improving quality
- Managing budgets
- Developing strategies
- Maintaining records

3.4 DETERMINING PURCHASING NEEDS

There is a new awareness of the purchasing function and it is an emerging function in many companies. In an increasingly competitive environment, preserving margins is a priority. Achieving gains in terms of productivity, as well as in purchasing, is becoming more and more a key strategic focus. In order to remain competitive in sales, companies have a strong interest in taking advantage of this competitive universe in purchasing.

VENDOR RELATIONS AND PURCHASE MANAGEMENT, MANAGEMENT OF INVENTORY

An update on the 6 steps of the purchasing process, to identify areas for improvement.

Step 1: Identification of the need

When faced with an issue, the company identifies a need, which results in the purchase of a product or service. Internally, the company may, for example, need new equipment in

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order to launch a new product. It may also want to replace a machine that has just broken down or simply seek a better quality/price ratio. The need may also arise externally: the buyer may have the idea for an acquisition at a trade fair, by seeing an advertisement or by listening to a representative present a new product.

To improve an existing product or to innovate, to reduce purchasing costs by seeking the best value for money: the identification of the need is dictated by a policy of performance gains. At this stage of the purchasing process, it is a question of **making the need emerge so as to be able to source suppliers capable of solving the problem.**

Step 2: The description of the product characteristics

Specifying the need allows the company to establish exhaustive and rigorous specifications. This document serves as the basis for the rest of the purchasing process. At this stage, it is a question of **detailing the characteristics and technical specifications sought in order** to address the problem in the best conditions. This process involves a number of questions:

- **Does the research relate to a standard or complex product?** In the case of a complex product, the opinion of third party experts may be necessary to determine precisely the expected characteristics, and to prioritize the selection criteria – price, lead time, longevity, etc. – in order to determine the best solution.
- **What are the core components of the product and which components can be standardized?** The goal is to detail the technical specifications required, using the value analysis method. The company examines the product in its technical specifications and evaluates the order of importance of the individual components. At stake: cost reduction. Some components can be modified, standardized or manufactured more cheaply without affecting the overall quality of the product. In order to visibly reduce costs, it is important to look at the most expensive components and at those with a life expectancy that exceeds that of the finished product.

Step 3: Drafting the specifications

Is it necessary to issue a tender?

Conducting a call for tenders is a cumbersome and costly procedure that should be used sparingly. If the purchase is for a strategic product, a major purchase offering substantial profit potential, it is advisable to launch a call for tenders. This will challenge the usual suppliers, who will have to question their offers and business practices. The call for tenders is also relevant in the context of a new purchase, or to look for new technical solutions. The call for tenders should contain the terms and conditions, according to your needs, and a questionnaire in order to obtain additional information about the company. The preparation of an invitation to tender leads to the drafting of the specifications. **The more precise and informative the specifications are, the easier the next steps in the purchasing process will be.** A good specifications document (Statement of Work = SOW) should allow suppliers to offer several solutions. In all cases, the SOW should clearly specify the expectations that the product or service must meet, an estimate of the annual volume and

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a description of the context (problems encountered, services involved, budget allocated). Depending on your needs, the specifications can take different forms:

- A **technical specification** that describes a request in terms of solutions and means of implementation. This document can detail precisely everything that is expected from the product or service, through general and individual specifications.
- A **functional specification** that describes the demand in terms of needs and expected services. This document describes the function expected by the product or service, leaving the door opens to various technical solutions.

In both cases, you can rely on the 5W1H method: who, what, where, when, how, how much, why, to describe your requirement from every angle.

Step 4: Supplier sourcing

Sourcing must allow the selection of the best suppliers. In this context, it is important to gather all the information necessary to have a good knowledge of the market.

- **Draw up an exhaustive list of referenced suppliers**, extending to potential suppliers not identified. Internet, professional directories, supplier catalogue… All means are good to identify potential suppliers by country. To assist you in this market prospecting, it may be useful to have a subscription to sites providing access to professional directories, or a subscription to professional journals.
- **Submit RFIs**, requests for information, to the potential suppliers previously identified, in order to collect more information about them.
- **Monitor supplier approvals**. This step involves sending additional RFIs and conducting supplier audits to minimize financial risks and ensure technical reliability and logistical capabilities.

Step 5: In-depth analysis of applications

With or without a call for tenders, you now have several candidates to meet your needs. These must now be screened against the elimination criteria, before the remaining offers are analysed in more detail.

Perform a pre-screening

Start by **defining elimination criteria**. These can be a particular technical skill, geographical location or the search for a specific industrial equipment. This initial selection can then be followed by a multi-criteria analysis to evaluate the remaining candidates.

Carry out a detailed analysis of each proposal

The buyer establishes a list of criteria, ranked in order of importance, and evaluates the performance of each company on each criterion. Of course, depending on the situation encountered, the importance of the criteria fluctuates. For routine purchasing products, for example, timeliness and price are key attributes, followed by the supplier's reputation. Conversely, for products that require a change in internal operating methods, the priority criteria are technical assistance, the supplier's adaptability and the reliability of the product.

It is then advisable to find out the overall cost of acquisition and commercial conditions by asking suppliers for detailed costing. The terms of payment requested should be acceptable

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and the proposed Inco terms advantageous, depending on the geographical location. Finally, it is important to ensure that the timeframe is appropriate and under control. At this stage, you should also take into account the adaptability, financial security and sustainability of the company!

The list of objective and subjective criteria to be taken into account

Objective criteria

- The price
- Geographic location
- Terms and conditions of payment
- Respect of delivery times
- Ease of operation or use
- Ease of maintenance
- Relevance of the product/service to the user's needs
- Reliability and product quality
- The technological maturity of the solution
- Technical specifications
- The existence or not of technical services offered
- The existence or not of training offered by the supplier
- Duration of training required
- The after-sales service

Subjective criteria

- Pre-existing relationships
- The supplier's prestige and reputation
- Perceived competence
- The personality of the interlocutors, the professional "feeling".

How many suppliers for the same product?

Today, companies tend to drastically reduce their number of suppliers. The strategy of increasing the number of interchangeable suppliers is thus being abandoned in favour of other strategies such as using two suppliers in parallel. In this way, the buyer avoids over-dependence. Rather than using a single supplier, it is possible to **choose a preferred supplier, which will be used in 80% of the cases**, relying on a second supplier for the rest.

Step 6: Preparing for the negotiation

With the information gathered in the previous phase, you should be able to **develop a negotiation strategy**. If the buyer has a lot of information about a registered supplier, a new supplier may be more difficult to approach. The focus should then be on its economic situation, its business forecasts, its production resources and its competitive positioning.

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Technical preparation of the dossier

This stage consists in determining the administrative and technical clauses to be negotiated, as well as the objectives to be achieved. The buyer needs to prioritize: to know on which clauses he can agree to make concessions to the seller. He must set realistic and ambitious objectives.

In addition to enquiring about the characteristics, performance and final positioning of the product, it is necessary **to find out about the supplier's dependency rate**. Knowing the share of company purchases in the supplier's turnover will make it possible to assess the balance of power and use it as leverage during negotiations.

Opting for sequential negotiation

Rather than negotiating en bloc, addressing all clauses at the same time, it is recommended to negotiate sequentially. With this approach, the buyer does not move on to the next clause until it has achieved its objective on the first clause. It is then better to start with the easiest points, before finishing on the most sensitive ones. Negotiation helps to reinforce the stakes and to identify the risks. It is also an opportunity to lower the cost and **to lay the foundations of a relationship of trust with the supplier**, in order to move towards a partnership.

In this sense, it is preferable to carry out an individual interview with each supplier consulted. This approach will enable the proposal to be revalidated, whether in terms of quantity, price or lead time, but also to assess the risks: stock shortages, production planning, substitute products, etc. Finally, it is an important step in renegotiating pricing conditions, by acting on the purchase volume, payment terms or transport. At the end of this process, a contract is signed. This must include the following elements: quantity, price, deadlines, price revision, compensation clause, as well as mentioning the competent jurisdiction in case of dispute.

Conclusion: A successful purchasing process requires careful work. This is a crucial exercise, as selecting the wrong supplier can jeopardize your entire business. To help you with all or part of this process, you can rely on the sourcing expertise of ISP Group. As an organization entirely dedicated to reducing and optimizing purchasing costs, we have been helping companies with their purchasing issues for more than 15 years. As an international expert with in-depth knowledge of the market, we are able to identify and interview the best suppliers for you, in accordance with your requirements in terms of quality, price and deadlines, – of course – but also in terms of risk management. In addition to saving you time and tedious work, ISP Group enables you to **increase your performance while establishing a long-term relationship with your new business partner.**

3.5 PREPARATION OF PURCHASE BUDGET

A purchases budget report allows business owners to determine how much money and goods are needed to reach desired goals. This particular budget is used for companies that have products in stock or inventory, as the value of inventory plays a large role in a complete purchases budget.

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Calculating Purchase Budget

A purchases budget provides a representation of what the business plans to buy for the inventory and how much inventory it plans to grow or hold over a given period of time. The budget is created using a simple formula: the desired ending inventory, plus the cost of goods sold, minus the value of the beginning inventory. This equation gives you the total purchases budget. For example, if you want Rs. 10,000 in ending inventory and your cost of goods sold is around Rs. 3,000, add these two values and subtract the value of your beginning inventory from the Rs. 13,000 total. If the value of the beginning inventory is Rs. 2,000, for example, the amount if your total budget is Rs. 11,000.

Cost of Goods Sold

The cost of goods sold is a collected sum of all products or services offered by the company in terms of the production value. The sum is a total of products costs plus the means to get it ready for sale. Some companies even break it down and explain how the cost is divided in terms of planning, production and testing, for example.

Purchases Budget Purpose

A purchases budget is created to keep track of the company's inventory value and the amount of goods sold. It also is used to help you keep track of your desired ending inventory value each month. The purchases budget is often just a partial budget for a business and is often found in a business master budget.

Planning

The specificity of the purchases budget allows business owners to use the information to plan the inventory. The purchases budget is often a single component of a larger inventory and purchase budget for a business, as this particular budget focuses on the value and growth of inventory. It also helps plan for future purchases of goods.

3.6 VENDOR RELATION MANAGEMENT

Vendor Relationship Management (VRM) is a class of business movement made conceivable by software programming solutions that expect to give clients both freedom from merchants and better means for drawing relationships with vendors. This equivalent solution can likewise apply to vendor relations with different establishments and associations.

Understanding Vendor Relationship Management

Vendor relationship management (VRM) strengthens the buyer-supplier relationships to establish trust and achieve a mutually beneficial goal. If you have an efficient vendor relationship management process in place, you can seamlessly deliver a number of key benefits like optimized costs and much smoother data flows.

Vendor relationship strategies

Successful vendor partnerships need a great deal of forethought and effort. Here are tried and tested three vendor relationship management strategies that you can apply to maximize the inherent value of supplier relationships:

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- **Build relationships and partnerships**
  The first step of the process is to build relationships with your vendors and treat them as valuable partners. Turn your relationships into a strategic vendor-buyer relationship model. Establish KPIs by involving them and monitor them on a timely basis. Their involvement in strategic decisions helps set clear objectives and expectations. This will allow you to tap into their expertise as well as offer other benefits like increased trust, and preferential treatment.
- **Communicate often**
  Poor communication is at the heart of most business failures. The inability to convey or receive important information from your suppliers can end up shaking the very foundations of your vendor management process. Corporate buyers need to communicate with their vendors frequently in order to transmit their requirements effectively and get a better understanding of their suppliers' capabilities.
- **Create a win-win situation**
  Running after short-term cost savings will cost your organization more in the long run and make a substantial impact on the quality. So, rather than squeezing your suppliers to cut down the cost, take some time to study and understand your vendor's business.

Negotiation should be based on good faith and value rather than resorting to strong-arm tactics. Objectives of the partnership should be structured in a way that offers equal opportunity for profitability and strengthens both businesses.

The benefits of vendor relationship management

Here are just some of the things you can expect after implementing a strategic vendor relationship management process:

- An increase in win-win partnerships
- Improved forecasting and budgeting to support your procurement teams
- Cost avoidance and cost savings
- Improved stakeholder and vendor satisfaction
- Vendor performance management
- Improved compliance and certification renewals
- A reduction in waste, like shelf ware
- Improved metrics to support better project management
- Improved contract management and clearer deliverables
- More knowledge on updates and innovations

Vendor ratings, also commonly known as supplier ratings, are based on a formal system for evaluating organizations that provide products or services to a company. It is a process in which suppliers are assigned status or a title depending on several parameters. For example, various factors like price, quality of goods delivered, credibility, delivery time, and other mixed variables affect the ratings. The Supplier ratings are based on the vendor's

performance and can be categorized into multiple levels: good, average, and best, or whatever the company decides.

Benefits of Vendor Ratings and Assessment

Below mentioned are the significant benefits of rating your vendor.

- It assists the buyer in identifying areas of weakness in the vendor's performance and allows the buyer to take corrective steps.
- It assures a consistent level of vendor performance through regular reviews of their performance.
- It assists consumers in establishing the appropriate level of communication.
- Vendor rating aids the customer in comprehending the vendor in all critical aspects and determining whether or not the vendor is appropriate to deal with or not. Elimination of Prejudices and word-of-mouth is essential to make more data-driven decisions.

Different Types of Vendor Ratings

- **Evaluation with the help of available data:** In this type of evaluation, you can collect information about the supplier by using papers such as financial reports, logbooks, and notebooks. You can select a suitable supplier for your business based on the evaluation results.
- **Post-event evaluation:** Here, you must answer questions such as «What happened?» and «How did it happen?» What went wrong? This information aids in your evaluation of the vendor.
- **Pre-event evaluation:** In this instance, gather the vendor›s past data to determine his skills.

There are supply chain management solutions (SCM) out there with an inventory module that includes vendor rating and evaluation mechanisms. Furthermore, the assessment should be based solely on measurable results rather than relying on opinions. We've presented you with some useful ways to guide your evaluation process so you may adequately rate a new supplier or analyze one of your existing suppliers as needed.

Introduction to Vendor Evaluation (comparison)

As a consumer, when you want to purchase an item, whether it is a new car or a flat screen television, you will most likely do some research on the prices of your local stores or from vendors on the internet. When you have narrowed your search you then look at other criteria that may be important to you, like warranty or availability. Lastly, you will look at other less tangible criteria such as your previous experiences with the vendor and how their customer service was.

This behavior is exactly the same for companies when they want to evaluate the vendors in their supply chain. Unless your company only uses one vendor for each item they purchase, there will invariably be an occasion when a decision has to be made as to which vendor gets your business. There are a number of different scenarios when this will occur, for example when the item is purchased for the first time and when an item is no longer single sourced.

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Purchasing an Item for the First Time

When a decision has to be made between vendors, the purchasing or supply chain department will use some vendor evaluation method to be their tool in the decision. If the item is to be bought for the first time, the purchasing or supply chain department may have contacted a number of vendors and sent them a Request for Quotation (RFQ). Each vendor would then complete the RFQ with the information that was required, normally the price and terms.

The purchasing or supply chain department would then use these completed quotations, in conjunction with other information they have collected on the vendors, to make a short list for further evaluation or make a final selection. The purchasing or supply chain department would evaluate the vendors based on a number of criteria they had decided upon which may include objective criteria such as price and warranty and subjective data which would include past experience with the vendor. Based on the weighting given to these criteria the purchasing or supply chain department would be able to fairly evaluate each vendor.

Choosing Between Vendors

If the sourcing of an item has been from a single vendor but another vendor has been approved to supply the same item, a decision would need to be made on vendor selection when a requisition has been received by the purchasing or supply chain department. Many companies use a vendor evaluation tool that allows transaction data to be analyzed to give a comparison between vendors. The vendor evaluation uses criteria that have been determined by the purchasing or department to compare vendors such as:

- Price
- Delivery reliability
- Delivery date adherence
- And the quality of the item

There are any numbers of criteria that can be used in a comparison and these are usually weighted so that important criteria are given more credence. For example, a company may decide that the quality of the items it receives from vendors is more important than price, which in turn is more important than delivery reliability. The company would then weight these criteria so that the overall score reflects that requirement.

Vendor evaluation is important as it can reduce supply chain costs and improve the quality and timeliness of the delivery of items to your company. The skill in evaluating vendors is to determine which criteria are important and the weighting that these criteria are given. It is important to remember that these criteria may be different for each item you are sourcing and possibly different between regions or countries. Objective data is useful to compare the information that you can obtain from each purchase order and goods receipt, but sometimes the subjective data that your purchasing agents can provide such as customer service and the willingness of the vendor to accommodate your requirements is as or more important in a vendor evaluation.

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Optimizing your supply chain means that you and your company are delivering your customers what your customers want when your customers want it— and doing that by spending as little money as possible. A robust vendor evaluation practice will help start that process off by guaranteeing lowest costs, highest quality and on-time delivery.

3.7 NEGOTIATIONS WITH A SUPPLIERS

Negotiating the right deal with your suppliers doesn't necessarily mean getting what you want at the cheapest possible price. You may want to negotiate other factors such as delivery times, payment terms or the quality of the goods. Most business owners would view a good deal as one that meets all their requirements. But there are many other factors to consider, such as whether you want to do business with a particular supplier again. Both sides should conclude a negotiation feeling comfortable and happy with the agreement. Negotiations can be unsuccessful if either side feels forced into a corner. Following are the ways to negotiate a deal:

1. **Setting objectives when negotiating with suppliers**
   There's a range of key considerations you need to bear in mind when setting objectives for purchase negotiations. These might include:

   - Price
   - Value for money
   - Delivery
   - Payment terms
   - After-sales service and maintenance arrangements
   - Quality
   - Lifetime costs of a product or service
   - Whether or not the product or service is essential to your business

   Before you start to negotiate, draw up a list of the factors that are most important to you. Decide what you are - and aren't - prepared to compromise on. For example, if you're ordering supplies in bulk you might want to find a supplier that will offer you a discount. Or if you're investing in a complicated piece of computer software, you might want to make sure that training is provided as part of the deal. The key is to establish your preferred outcome. But remain realistic - if you're not prepared to compromise, the negotiations won't get far. You should also consider what offer the supplier is likely to make and how you'll respond. Remember that if you want to do more business with the supplier in the future, you should aim to strike a deal that both parties are happy with. Although getting the best possible deal in the short-term is important, a good relationship in the future may help you get even cheaper prices or other perks, such as priority delivery. Don't underestimate the importance of good will.

2. **Understand your supplier**
   By conducting some basic research into a potential supplier you can work out how valuable your business is to them. Your bargaining power increases in direct proportion to your potential supplier's need for your business.

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If the supplier runs a near monopoly it is likely to have the upper hand because:

- It has enough business already
- You only have a few other sources to select from

However, if the supplier has a number of competitors - or is a new entrant to a particular market - you'll be in a much stronger position. Also, the supplier may already be offering good deals in a bid to increase its market share. Alternatively, a supplier may need your business to get rid of old stock or to fill spare production capacity. Try to find out as much as you can about the state of its order book. If you're a small supplier's main customer, your leverage in negotiations may be considerable.

3. **Developing a negotiating strategy**
   It's essential to plan your strategy in writing before beginning negotiations. This will help you set clear goals and work out where you will draw the line and walk away from the deal. Start by defining what your priorities are, such as low price, high specification goods or a specific delivery schedule. Think about different offers the supplier could make and what you are willing to concede or compromise on. For example, you may decide that you'll only pay the full price in exchange for fast turnaround. Write down your negotiating strengths and how you might use them to get the concessions you require. Consider ways of defending the weaker parts of your argument and negating the supplier's main strengths.

4. **Negotiating team**
   Once you've set out your strategy, it is also essential to get your negotiating team right. Make sure it has skills in all the necessary areas. You'll need to ensure you match the seniority of the supplier's representatives. For example, you shouldn't send a junior account manager to bargain with their managing director. Make sure each member of the team is familiar with your negotiating strategy. The more confident they sound about what they want, the more likely they are to get it.

5. **Conduct negotiations**
   Before you start negotiating, state the aspects of the deal you're happy with and the points you want to discuss. Ask the supplier to do the same. Make sure both sides are satisfied with what is being negotiated. Get the supplier to restate any discounts offered and payment terms. Keep these key bits of information to hand. If you have enough bargaining power, insist on using your own terms and conditions of purchase. Do not indicate that there are things you're prepared to concede or compromise on too early in the negotiations. Try to give the impression you're approaching the negotiations positively without revealing your position. For important or large purchases suggest setting out the key points of the deal in writing. For example, for the purchase of company cars, these might state your requirements, such as the make, year, model, the interior specification and delivery times. You also need to be aware of common negotiating **tactics**. If the other party keeps referring to urgent deadlines or a person they need to confer with, remember they may be using pressure tactics. Use such tactics yourself with caution. Don't allow pressure to force you into agreeing to a point you're not happy with. Ask

for a break if you need one. Each time you agree to a point, clarify that you've understood it correctly and write it down. In some trades, suppliers set artificially high prices that are then permanently discounted. If this scenario applies to your business then ensure that any concessions the supplier gives are real -negotiate discounts that go beyond the standard level.

6. **Negotiating on price**

   Some price negotiating techniques will be familiar if you've ever bartered at a market. Never accept the first offer - make a low **counter-offer** in return. The other party is likely to come back with a revised figure. Always ask what else they can include at the given price. If the price is suspiciously low, ask yourself why. Are the goods of sufficiently high quality? Do they really offer value for money? What will after-sales service be like? You can also try to make the asking price look high by exposing any ongoing costs. Ask about repair costs, consumables and other expenses. If the current state of the supplier's market means prices is falling, point this out. If the price includes features you don't need, try to lower it by asking to remove those features from the deal. Use your bargaining power to get a good deal. For example, if you're a big customer of the supplier, you could ask for **bulk discounts**.

   But remember that if you squeeze the price too low - perhaps by threatening to walk away from the negotiations - you may end up getting a poor deal. The supplier may have to cut costs elsewhere - in an area such as customer service, which could prove costly to you in the long run. Even if you are a supplier's main customer and enjoy most of the bargaining power, forcing it to meet prices at which it could go out of business won't protect your reputation as a highly valued customer. The supplier will soon look for other customers and is likely to feel resentful.

7. **Running checks on your supplier**

   Before signing a contract with any supplier it's essential to carry out **due diligence** to check it can fulfill the agreement. You should **credit check** potential suppliers to ensure they have the cash flow to deliver what you want, when you need it. This is especially important if you're entering into a long-term contract. For example, if your supplier is the only available supplier of Customer Relationship Management (CRM) software you are installing, you need to be sure it isn't at risk of going out of business. The supplier will probably also run checks on you to ensure you have the means to pay for its goods or services. It's also a good idea to get **references** for the supplier from other customers. The supplier should be happy to put you in touch with some of its previous clients. If not, ask yourself what he is trying to hide. However, remember that he›s unlikely to put you in touch with a dissatisfied customer. Sometimes a manager in a business bids for contracts and then passes the account to someone else. If this is likely to be the case, make sure you›re happy with whoever is being assigned to do the work - and that you›ll be able to deal with the manager if any problems arise.

8. **Drawing up a contract for your purchase**

   Once all the points have been negotiated and a deal has been agreed to its best to get a **written contract** drawn up and signed by both parties. Although verbal

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contracts are acceptable and legally binding, they›re very hard to rely on in court. Both parties should agree on what the contract will cover. Typically, it will include:

- Details of price, payment terms and delivery schedule
- A clause stating the supplier's right to ownership of the goods until they're fully paid for
- A clause limiting the seller's contractual liability - taking into account the purchaser's statutory rights

Depending on who holds the bargaining power in the negotiations, the terms and conditions used may be your own, the supplier's or a mixture of the two. You should consider getting legal advice when drawing up your standard terms and conditions. Aim to get a contract that protects your interests and that shifts **legal responsibility** for any problems to the supplier. Notify the supplier in writing how you intend to use its supplies and ask for written confirmation that what it is selling you is suitable.

It's a good idea to explicitly ask about any hidden problems and to keep a written record of all assurances given. Make sure that your contract covers the level of **after-sales service** you require.

Build into the contract what will happen if there are any problems with the goods or services. For example, will the supplier replace individual faulty goods or the whole batch and within what time period? Agree on penalties for failure to meet delivery times or quality standards, such as a future discount. You should also consider including any dispute resolution or **exit procedures** that must be followed if either party is dissatisfied with the relationship or wants to end the contract.

3.8 ISSUE OF PURCHASE ORDERS

Purchase orders (POs) are documents sent from a buyer to a supplier with a request for an order. Each PO will outline the specifics of a purchase request, including an order description, quantity of items, and the agreed-upon price and payment terms. They also identify the purchase order (PO) number.

When a seller – like a supplier or a vendor – accepts a purchase order, a legally-binding contract is formed between the two parties. Although purchase orders add a few extra steps to the purchasing process, they help to ensure a smooth transaction between the buyer and the seller. They also help reduce the risk of fulfilling an incomplete or incorrect order. In short, these documents are an opportunity for the buyer to clearly and explicitly communicate their request to the seller. On top of this, if the buyer refuses payment upon delivery of a good or service, the seller is protected because the purchase order acts as a binding contract between both parties. Lastly, some commercial lenders will use purchase orders as a reference to provide financial assistance to an organization.

VENDOR RELATIONS AND PURCHASE MANAGEMENT, MANAGEMENT OF INVENTORY

How do purchase orders work?

In order to streamline the purchase of goods and services that an organization requires to operate successfully, a purchase order must follow a strict step-by-step procedure known as the purchase order process.

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Who issues a purchase order?

The buyer is responsible for creating and issuing a purchase order. In larger companies, a procurement or purchasing department will typically issue the purchase order. In smaller companies, the business owner, operations manager, or financial manager may issue the purchase order. It's also important to note that the role of creating and issuing a purchase order can be designated to a central purchaser for a specific team. For example, in a software company, an office manager can create purchase orders. Ultimately, who issues the purchase order comes down to how a company decides to set up its purchasing process.

Who approves a PO?

One or several people can approve purchase orders depending on the purchasing process that's in place. In larger companies that have defined purchasing processes, purchase order approvals are typically structured around locations and departments, with specific dollar thresholds attached.

For example, if a digital marketing manager in a software company is requesting a new ad budget, the purchase order approval routing could include a marketing director and a CFO (or another role in charge of the company budget). In smaller companies, CFO or CEO could be the final approval for any kind of spend, which can result in approval bottlenecks.

What does a purchase order contain?

Generally speaking, here's what a purchase order contains:

- Product(s) or service(s) being purchased
- Quantity purchased
- Specific brand names, SKUs, or model numbers
- Price per unit
- Delivery date
- Delivery location
- Company billing address
- Agreed payment terms (e.g. on delivery, in 30 days, etc.)

These items can be a strict requirement or an option, depending on an organization's procurement and purchasing workflows. In addition, purchase orders can be customized to suit the needs of a business, so this list is not exhaustive. With e-procurement software like Procure, you can add account codes in the requisition phase. Adding this information will streamline the reconciliation process and make it easier to transfer information to your accounting system.

Understanding the steps in the purchase order process

The purchase order process is the journey a PO takes from creation through to closure and everything in between. Depending on the nature of a company (size, industry, human resources, organizational structure, the goods and services it is acquiring, etc), the purchase order process can also be modified to include additional necessary steps like quality checks,

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budget approval, contractual approval, and more. **Here are the steps in the purchase order process:**

1. **PO creation**
   When a company (i.e. the buyer) decides to buy a product or service, it creates a purchase order that details what is being requested from the seller, along with pricing and payment terms.
2. **PO approval**
   Before a PO can be sent, it needs to be approved. A company's approval process will dictate who, within the company, is required to approve a PO before it is sent to the supplier. Modern companies tend to facilitate this step by requiring (and approving) purchase requisition first. This process eliminates the need for PO approval, and streamlines the process for the purchasing team.
3. **PO sent to a vendor**
   Once approved, the PO is sent to the seller. For software companies that buy online, this step might seem redundant. However, POs also serve as an internal document that streamlines reconciliation for the accounting team once the invoice is received. So while it isn't mandatory to send the PO to the vendor, it's still good practice to keep it for internal purposes.
4. **PO received [binding contract]**
   The vendor/seller receives the order. Once the vendor tells the company that it can fill the order, the purchase order becomes a binding contract. E-procurement tools like Procure offer to send POs through an online procurement system, which makes it easier to track those emails with POs were both sent by the company and received by the vendor.
5. **Receipt of goods or services**
   The seller ships the order, attaching the PO number to the packing list. This helps the buyer know which order has arrived.
6. **Invoicing**
   The seller also invoices for the order, making sure to include the PO number to the invoice.
7. **Three-way matching**
   The company uses 3-way matching to confirm that the PO number and order details (quantities and prices of the goods and services ordered) match up on the Purchase Order, Invoice, and Packing Slip.
8. **Authorize and arrange payment**
   Provided everything checks out and the company is happy with the order, the company approves the invoice and arranges payment to the seller (as per the agreed-upon payment terms).
9. **Purchase order closure**
   When the above steps are completed, mark the PO as closed.

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Purchase order vs invoice: what's the difference?

If you're new to using POs, you might be wondering: how are they different from an invoice? Well, to start, different team members create these documents. Buyers create the PO and send them to vendors. In turn, this prompts the vendor to accept the PO and send an invoice back to the buyer. It's common for the PO and the invoice to contain similar details. The invoice generally references the PO number, along with an invoice number, to confirm that both documents contain the same information and correspond to each other.

Here's a handy table that explains the key differences between purchase orders and invoices:

	Purchase Order	Invoice
Who creates it?	Buyers are responsible for creating Pos.	Vendors are responsible for creating invoices.
When to send?	Must approve and send to the vendor prior to purchase, or kept for internal record.	Create and send an invoice once the payment has been received.
What Information does it contain?	-Details of what's being purchased (products/services and the requested quantities) - SKUs, model numbers, and brand names of each item. - Pricing - Delivery date - Delivery location - Billing address - Payment terms	- PO number - Invoice number - Itemized breakdown of the order with the cost.

Here's an example to help you understand how to use a PO and an invoice in the purchasing process:

- David is an IT Manager at a software company. He needs to purchase some laptops for new hires. He creates a PO that outlines everything that's needed, including the quantity and any specific requirements (like the number of laptops, laptop models, etc).
- The company responsible for selling the laptops receives the PO. After they confirm they can supply the laptops with the required specifications, they fulfill the order. They ship the laptops with a delivery date and attach an invoice.
- When David receives the laptops, he has to verify the delivery.

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- Sarah, the company's accounting manager, will then perform a 3-way match once the invoice is received. Provided everything matches up, Sarah can submit the invoice for approval and then pays the seller.
- Once complete, it's important to mark the PO as closed and the invoice as paid.

The Pros and cons of using POs. POs are important because they can help companies:

- Avoid duplicate orders
- Avoid surprise invoices
- Track incoming orders
- Catch unexpected pricing increases
- Improve financial and inventory accuracy
- Comply with auditing requirements
- Smarter budget: procurement teams can only purchase with available funds, which require approval
- Improve (and even speed up) delivery times, as POs help to schedule delivery for whenever the buyer needs it
- Ensure clear communication with vendors
- Act as legally binding documentation

However, it's important to assess your company's specific needs before introducing a purchase order system as there's an administrative downside to using POs.

The drawbacks of using POs include:

- POs create additional paperwork, which can be annoying for smaller purchases and time-consuming for smaller teams
- Although they don't act as a legal contract between the vendor and the supplier, credit cards can replace POs to help with record keeping and documenting purchases. (Keep in mind, if a company does use credit cards for purchasing, POs can facilitate the credit card reconciliation process for the accounting team.)

3.9 RECEIVING GOODS AND INSPECTION

'Goods receiving' is the function of checking items delivered to the business, either coming in as new stock or as supplies. This includes inspecting the quality, condition, and quantity of any incoming goods, and allocating them to a space in the warehouse.

Why is it important?

All items purchased by the business serve a specific function, whether they are supplies to be used internally, or stock to be on sold to customers. Keeping track of all items coming into the warehouse ensures that that the right products are received and promptly stored in an appropriate place. Following a goods receiving process can help to maintain an efficient warehouse and identify any issues with suppliers.

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1. **Match the delivery to a purchase order**
   First, ensure the delivery has come to the right place by matching the details on the Consignment Note to the Purchase Order raised by your business. The Purchase Order should also be used to check that each item matches the description and quantities ordered. Generally, the boxes or cartons will have a description of the item and quantities of its contents. Ensure you record the following for each new delivery:

   The date and time goods arrived

   - The name of the delivery partner and driver
   - Check off quantities and description of goods against purchase order
   - Note any discrepancies
   - Names of the personnel who performed these checks

   Maintaining accurate reports is essential for accurate bookkeeping as well as resolving any disputes that may arise in the future regarding the items or supplier. If there is no purchase order or record of the order, check with your supervisor or purchasing department before rejecting the goods.

2. **Check products are not damaged**
   Before accepting the delivery, it's important to conduct a quality check to ensure the items are not damaged or malfunctioning. It's not always feasible to open each carton and check every single item, particularly for large shipments. So in these cases you may wish to complete a spot check rather than open each and every carton. Check for signs of breakage or faults, and ensure all items are as described on the purchase order. If any damaged items are found in the delivery, record the extent of the damage on the consignment note and immediately notify the supplier with details of the issue to discuss the next steps.

3. **Log received items into your inventory**
   Enter the items you have received into your warehouse management system as soon as possible, including the date and quantities received. This will allow the stock to be allocated to new orders right away.

4. **Allocate storage space for goods**
   It's important to pack away a new delivery promptly to ensure no items become lost or damaged. Supplies should be distributed to the appropriate person in the business, or packed away in the usual space to be accessed when required. For goods received in as stock, these items will need to be allocated a space in the warehouse for storage until ready to be picked for an order.

5. **Notify your accounts payable department**
   Send a copy of the signed and dated consignment note to your accounts payable team. This information can then be matched with the invoice from the supplier to ensure payments are only made for items that were actually received.

3.10 PAYMENT TO SUPPLIER AS PER TERMS

Vendor payments, also called supplier payments, forms an integral part of accounts payable

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management. It is one of the most common money transactions for any business and, therefore, must be well-managed. Making vendor payments is the final action in the procure-to-pay or purchase-to-pay cycle of an organization. Vendor payments are defined as paying external suppliers or vendors of a business to purchase goods, services, or both, by establishing a feasible process and system that suits the organization. It begins with a business concern placing an order to purchase goods or services from an external vendor, supplier, or provider. It creates a purchase order for the vendor. Once it receives the goods or services ordered, the business will get an invoice from the vendor.

In the final step, the business makes a payment towards this invoice, termed a vendor payment. Prompt and systematic management of vendor payments will ensure a stable relationship with the suppliers or vendors. It also ensures that the business can clear all its liabilities before the invoice due dates approach, without facing the risk of interest or late payment penalties. It essentially fosters a strategic partnership with a pool of vendors, promoting business growth in the long run. Vendor payment management becomes crucial where the organization operates in the following conditions, to mention a few.

- Vendor payments in different currencies
- A vast number of vendors to handle
- Varying credit period lengths to track
- Multiple branches and units from which payments are made, needing cash flow management,
- Sale and purchase transactions with the same vendor, needing offsetting of liabilities,
- Need for timely payments to ensure compliance with the MSME Act and GST laws.

Process of vendor payments explained

Vendor payments may be processed by the accounts payable team in a large entity. Likewise, it may be carried out by a small number of people in a medium-sized business or by the accountant or the owner in a small business or professional concern. The following are the steps involved in the vendor payment process-

Step 1: Collect the invoice from the vendor or supplier if the vendor is yet to send it.

Step 2: Verify the completeness and accuracy of the purchase invoice received. Check for the approval of the vendor's authorized signatory.

Step 3: Account for the invoice on the ERP or accounting system by making the necessary journal entry. Also, understand, calculate and account for any taxes such as TDS under the income tax law and any input tax credit (ITC) under GST, where it applies.

Step 4: Deposit TDS with the government within the due dates defined by the Income Tax Rules in the required form, where it applies. Also, conduct reconciliation of GSTR-2A and GSTR-2B with the purchase register at regular intervals. Follow up with vendors if they have not uploaded the invoices on which you can claim ITC and nudge them to report them in their GSTR-1. Report such ITC in the GSTR-3B return filed, either monthly or quarterly, as applicable.

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Step 5: On or before the invoice due date, take the approval of the authorized signatory of your business concern to initiate or make the invoice payment.

Step 6: Make the vendor payment, net of the TDS deducted and record it in the books of accounts using a payment voucher. Pay using the mode agreed upon beforehand between the vendor and your business concern. It can be UPI, bank transfers, e-wallets, e-commerce payment gateways, mobile payments, cash, etc. Also, collect the receipt from the vendor and record it in the books of accounts upon successful payment.

Note that you can automate several steps mentioned above using a cloud-based vendor payment system, sometimes built into your ERP as well.

Solutions to effectively manage vendor payments

Most businesses use spreadsheets for calculating TDS at the time of vendor payment. But now, with companies undergoing a digital transformation, there is more dependency on innovative, tech-based solutions to simplify business operations. The benefits of tech-based solutions for vendor payment management are as follows-

- Allows automation of approvals within the timelines
- Ensures audit-ready data by keeping a digital trail
- Simplifies bill payments with less manual intervention
- Provides a smooth tracking of cash flows for your organization

3.11FOLLOW UP AND EVALUATION

Performance evaluations are but one component of an employer's overall performance management system. They're designed to measure employee job performance using regular appraisals, constructive feedback, improvement plans and informal meetings between supervisors and employees about job goals and as-needed guidance concerning duties and responsibilities. Follow-up evaluations serve an equally important purpose in the employment relationship because they don't permit employers to drop the ball in assuring their employees that the company is willing to invest in their success.

- Schedule a follow-up meeting with new employees approximately 30 to 60 days after they begin working. By this time, they have completed new-hire orientation, become acquainted with the co-workers with whom they have the most interaction, and understand the supervisor's work style and expectations. This needn't be a meeting to strictly discuss job performance -- it's important because it's a continuation of the welcome message they received during the orientation and on boarding process and demonstrates your interest in strengthening the employer-employee relationship.
- Ask questions during this early follow-up evaluation to ensure the job meets the expectations the employee had upon accepting the job offer. Test her knowledge about workplace guidelines, policies and company processes. This is a proactive measure for learning whether she understands the organization's performance standards and if you made a wise hiring decision because you'll get an idea of

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whether she's becoming comfortable in her new role and adjusting to the workplace culture.

- Instruct supervisors and managers who conduct annual performance appraisals to follow up with employees whose appraisals may have fallen short of the company's performance standards. For example, if an employee's skills using software applications necessary to perform her job duties aren't up to par, the supervisor should have noted that in the performance appraisal and recommended corrective measures, such as job skills or computer training. The follow-up evaluation -- 30 to 60 days later -- is essential to determining whether the employee is benefiting from the guidance and training she received during her annual appraisal.
- Follow up with employees about their performance-based salary raises or wage increases. If your organization had to delay raises for performance- or budget-related reasons, ensure that the raises due employees have become effective and that the amount promised matches what they were promised during the performance appraisal meeting. This conveys that the organization lives up to its employees' expectations concerning tangible rewards, which in turn, often satisfies employees' expectations for effective leadership that cares about their well-being.

3.12 MAKE OR BUY DECISIONS

A Make or Buy Decision is a decision made to either manufacture a product/ service in house or buy it from outside suppliers (outsourcing) based on cost-benefit analysis. A complete or accept decision can be made using quantitative or qualitative research and most of the time, the results of quantitative analysis (cost-benefit analysis) are enough to decide on whether to make the product in-house or buy (outsource) from outside suppliers.

How Does Make or Buy Decision Work?

The decision applies to both goods and services. Businesses compare the cost and benefits of producing the goods or services within the company and the cost and benefits of getting an outside supplier to supply the goods and services into consideration. The value here must include all the fees associated with manufacturing (including material, labor, cost of machinery and space), storing, moving, taxes, etc. and the corresponding benefits must include benefits in terms of increased margins (for in-house production) or low capital requirement (for outsourcing).

Analysis for Make or Buy Decision

Cost Head

- Under quantitative analysis, businesses consider all the costs associated with producing the product or service in-house. These costs include buying and maintaining equipment, cost of the premises (lease, etc.), raw material cost, conversion cost, cost of fuel and electricity, labor cost, warehousing or storage cost, shipping cost, and the cost of capital. The benefits include higher margins from in-house production.
- The cost associated with outsourced production includes the product and service, transportation, warehousing, and storage and labor costs for managing the logistics.

- The decision becomes a little straightforward if the company does not have an idle capacity to produce the product or service. In this case, the management can opt to hire an outside supplier considering that it is not of critical importance, and the firm's intellectual property is not endangered.
- Considering the company has the idle capacity, and it is already incurring a large part of fixed expenses, it can choose to manufacture in the house if the marginal cost of manufacturing is less than what it will cost to buy from outside suppliers.

Examples of Make or Buy Decision

Example 1: As stated earlier, there may be some factors at play that may influence a company's decision to make an item in the house or outsourcing it.

Under such circumstances, two factors are to be considered:

- Whether surplus capacity is available and
- The marginal cost of per unit manufacturing

Assume a company is deciding between manufacturing a part in-house that costs Rs. 26 per unit, including direct cost, fixed overheads, and variable overheads, as given in the table below.

Cost Head	Cost per Unit (Rs.)
Direct Cost	15
Fixed Overhead	4
Variable Overhead	7
Total Cost	**26**

The same part is available in the market at Rs. 23 per unit, including the cost of buying, shipping, and warehousing, as shown in the table below.

Cost Head	Cost Per Unit (Rs.)
Cost of Part	20
Shipping and Warehousing Cost	3
Total Cost	**23**

Should the Firm Make or Buy the part?

Analysis

If surplus capacity available will remain idle if the component is bought, out of pocket expenses will be Rs. 23 per unit, Rs 1 more than the variable and direct cost of making component which is Rs 22 (Rs 15 + Rs 7). Hence it is economical to make it. However, if the Firm is utilizing or can utilize the capacity in making some other part which contributes to say Rs. 4 per unit in profits, the effective cost of buying the component will be Rs. 19 (Rs. 23 less Rs. 4 contribution from other products). In that case, it would be economical to buy the Component at Rs. 23 per unit from outside. The relevant calculation for making decision may be as follows:

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Particulars	Make (Rs.)	Per Unit Cost Buy & Leave Capacity Idle (Rs.)	Buy and Use Capacity for Other Product (Rs.)
Cost of Making/Buying	22	23	23
Contribution from other Product	-	-	4
Net Relevant Cost	22	23	19

Factors Considered for Make or Buy Decision

The following are the major factors considered while deciding to make the good or service in-house.

- Cost concerns (when it is expensive to outsource)
- Desire to enhance the manufacturing focus
- Intellectual property concerns
- Quality concerns
- Unreliable suppliers
- The need for direct quality control over the product
- Emotional reasons (for example, pride)
- Absence/shortage of competent suppliers
- Insignificant volume for a prospective supplier
- Reduction of shipping and transportation costs
- For maintaining a backup source
- Environmental reasons
- Political reasons

The following are the major factors considered while deciding to buy the good or service from the outside supplier.

- Lack of expertise
- Research and specialized know-how of the supplier better than the buyer
- Cost considerations (cheaper to buy the item)
- Insufficient or no manufacturing capacity at the buyer's end
- De-Risking the sourcing
- Low-volume requirements
- The supplier is more equipped than the buyer
- Procurement and inventory considerations
- Product or service not essential to the firm's strategy
- Preference of Brand

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Advantages of Make or Buy Decision

Some of the advantages of making or buy decisions are as follows:

- The finding helps choose the most efficient option to go about in-house production of outsourcing.
- The decision helps in the strategic maneuver of the business.
- The decision helps save the cost for many businesses.
- Businesses benefit from the lower cost of mistakes if they think strategically about this decision.

Finally, the make or buy decision should be taken with utmost care keeping the long-term and short-term benefits into consideration. There are pros and cons to both make and purchase; however, generally, businesses tend to outsource function where they do not have a core competency or when the cost of procuring the components or services from outside suppliers is significantly cheaper.

3.13 MEANING AND IMPORTANCE OF PROCUREMENT

Procurement management is responsible for overseeing all the processes involved in acquiring the products, materials, goods and services needed for efficient business operations. Depending on the business and industry, the terms "sourcing," "purchasing" and "procurement" may be used interchangeably to describe the function of procuring supplies and managing the process, with sourcing considered more strategic, and purchasing and procurement used to refer to the actual operational function.

Organizations across all industries depend on the expertise of procurement management in seeking out and managing external supplier relationships to ensure these needed items are acquired at the best possible cost. For these reasons, procurement management has a direct impact on an organization's bottom line and strategic business operations.

Traditionally, some businesses have used the term procurement synonymously with purchasing. But now, purchasing is often seen as just one stage in a larger, more strategic procurement process. So, what exactly is procurement? Procurement involves every activity involved in obtaining the goods and services a company needs to support its daily operations, including sourcing, negotiating terms, purchasing items, receiving and inspecting goods as necessary and keeping records of all the steps in the process.

What is the Importance of Procurement?

Without procurement, it would be impossible for most business operations to function. Procurement management ensures that all items and services are properly acquired so that projects and processes can proceed efficiently and successfully. More than a business necessity, procurement can be leveraged as a competitive advantage when optimized to save money, time and resources. But driving down costs by avoiding delays and errors and maximizing resources is just part of the reason procurement management plays an important role in a company's bottom line.

Procurement is an important step in understanding supply chains, because it helps a company find reliable suppliers that can provide competitively priced goods and services

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that match the company's needs. That's the case whether the company is seeking raw materials for manufacturing, a marketing services provider or new office supplies.

For example, if a company needs a new supplier to provide an ongoing service for an indefinite period of time — such as an email security solution — the procurement process helps the company choose the supplier that best meets all of the business's requirements at a reasonable price. It enables the business to avoid wasting time, money and valuable resources dealing with an inadequate supplier.

Minimizing cost is one important aspect of improving your procurement processes. But it's also vital to identify suppliers that provide the quality of goods and services that the company needs and have the capacity to deliver reliably and a track record of doing so.

Types of Procurement

Procurement can be categorized in several ways. It can be classified as direct or indirect procurement, depending on how the company will use the items being procured. It can also be categorized as goods or services procurement depending on the items that are being procured.

- **Direct procurement** refers to obtaining anything that's required to produce an end-product. For a manufacturing company, this includes raw materials and components. For a retailer, it includes any items purchased from a wholesaler for resale to customers.
- **Indirect procurement** typically involves purchases of items that are essential for day-to-day operations but don't directly contribute to the company's bottom line. This can include anything from office supplies and furniture to advertising campaigns, consulting services and equipment maintenance.
- **Goods procurement** largely refers to the procurement of physical items, but it can also include items like software subscriptions. Effective goods procurement generally relies on good supply chain management practices. It may include both direct and indirect procurement.
- **Services procurement** focuses on procuring people-based services. Depending on the company, this may include hiring individual contractors, contingent labor, law firms or on-site security services. It may include both direct and indirect procurement.

Types of Procurement				
	Direct Procurement	**Indirect Procurement**	**Goods Procurement**	**Services Procurement**
What is it?	Any good or service required to produce an end product.	All non-production-related goods or services.	Physical items typically held as inventory, whether for direct or indirect procurement purposes.	All people based services procured, whether for direct or indirect procurement purposes.

Examples	Raw materials, components and parts, machinery, items purchased for resale.	Office supplies, marketing services, utilities.	Raw materials, wholesale items, office supplies.	Law firms, contractors, contingent labor, on-site security services.

How Procurement Works?

The procurement process generally involves a number of steps. The business identifies particular goods and/or services that it needs, sources the suppliers that will help the company reach its business objectives, negotiates terms and costs and then purchases and receives the relevant items. A small company may have just one person handling procurement of all goods and services. Larger companies may have a team of people specialized in dealing with different suppliers or supporting specific internal business groups. For some items, the team may need to gather input from several different business groups in order to determine the company's overall requirements. It's important to remember that procurement doesn't consist of a series of isolated acts — it's an ongoing process. For example, businesses generally aim to establish relationships with key suppliers to help obtain the best service and lowest possible costs, which ultimately translate into higher profit margins. Companies may also need to conduct regular quality assurance checks and performance analysis to make sure suppliers consistently meet expectations.

9 Steps in the Procurement Process

Procurement processes vary greatly depending on each company's structure and needs, but generally include the following nine core steps:

1. **Identify which goods and services the company needs.** First, a business must identify its requirements for a specific item or a service. This may be a new item that the company hasn't previously purchased, a restock of existing goods or a subscription renewal. This step typically involves delving into the nitty-gritty details of what the business needs, such as the precise technical specifications, materials, part numbers or service characteristics. At this stage, it's a good idea to consult all business departments affected by the purchasing decision to ensure the procured items accurately reflect the needs of each department.
2. **Submit purchase request.** When an employee or business group needs to procure a significant quantity of new supplies or services, they make a formal purchase request (also known as a purchase requisition). A purchase request notifies the company that a need exists, usually via department managers, purchasing staff or the financial team, as well as specifications such as price, time frame needed, quantity and other important things for the purchasing team to keep in mind. The department overseeing the purchase can then approve or deny the purchase request. If approved, the procurement team can proceed with selecting a vendor and making the purchase.

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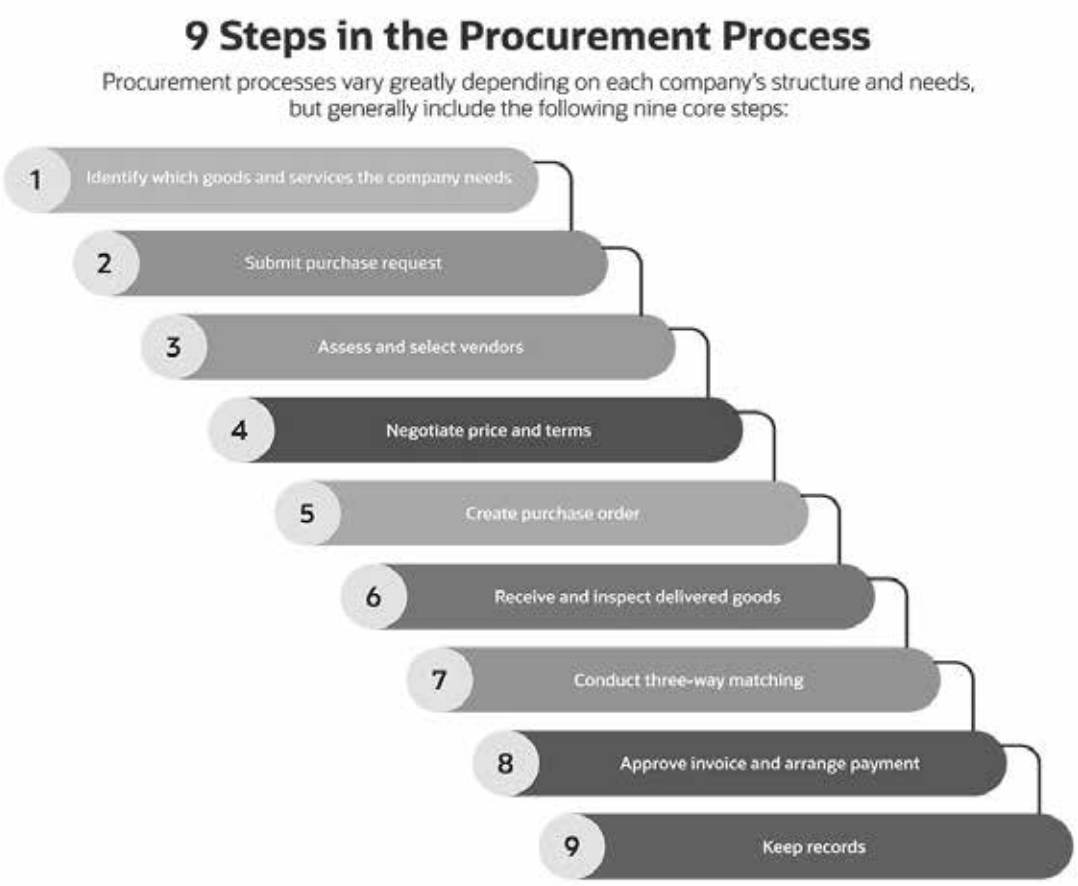
3. **Assess and select vendors.** With a clear list of requirements and an approved purchase request, now is the time to find the best vendor and submit a request for quote (RFQ) – this is what the purchasing team sends to potential suppliers in order to receive a quote – it is important to be as detailed as possible so you can compare apples to apples. Vendor assessment should focus not only on cost but also on reputation, speed, quality and reliability. Many companies consider ethics and social responsibility as well, since procurement is often intertwined with corporate identity. A retailer that prides itself on sustainability would stand to benefit from partnering with environmentally responsible suppliers, for instance.
4. **Negotiate price and terms.** A common best practice is to get at least three quotes from suppliers before making a decision. Examine each quote carefully and negotiate where possible. If you need to walk away from a deal, be sure that you have concrete alternative options. Once you've agreed on final terms, be sure to get them in writing.
5. **Create a purchase order.** Fill out a purchase order (PO) and send it to the supplier. The PO should be sufficiently detailed to identify the exact services or goods needed and to enable the supplier to fill the order.
6. **Receive and inspect the delivered goods.** Carefully examine deliveries for any errors or damage. Make sure everything is delivered as specified in the PO and that the quality meets or exceeds expectations.
7. **Conduct three-way matching.** Accounts payable should conduct three-way matching by comparing the purchase order, order receipt or packing list and invoice. The goal is to ensure the goods or services received match the purchase order and to prevent payment for unauthorized or inaccurate invoices. Highlight any discrepancies between the three documents and resolve issues before arranging payment.
8. **Approve the invoice and arrange payment.** If the three-way match is accurate, approve and pay the invoice. Businesses should strive to have a consistent invoice payment process through accounts payable that checks that payments match the invoice amount and due date. A standardized process can help make sure invoices are always paid on time, which can prevent late fees and build good relationships with suppliers.
9. **Recordkeeping.** It's important to maintain records for the entire procurement process, from purchase requests to price negotiations, invoices, receipts and everything in between. These records may be useful for multiple reasons. They help the company reorder goods at the right price in the future, as well as assist with auditing processes and calculating taxes. Clear, accurate records can also help resolve any potential disputes.



Stages of Procurement

The nine major steps of the procurement process can also be thought of in three distinct stages: the sourcing stage, the purchasing stage and the receiving stage.

- **Sourcing stage:** This covers the initial steps in which the business identifies its needs, creates a purchase request and assesses vendors. Even after the initial sourcing steps are complete, it's a good practice to build a strong relationship with suppliers. They can establish grounds for suppliers to learn from partners, improve products and processes and develop trust.
- **Purchasing stage:** This stage includes negotiating terms, creating orders and receiving and inspecting goods and services.
- **Payment stage:** Accounts payable conducts three-way matching to ensure order and invoice accuracy. The invoice can then be approved and the payment is arranged. Records of all invoices, orders and payments should be kept and carefully maintained.

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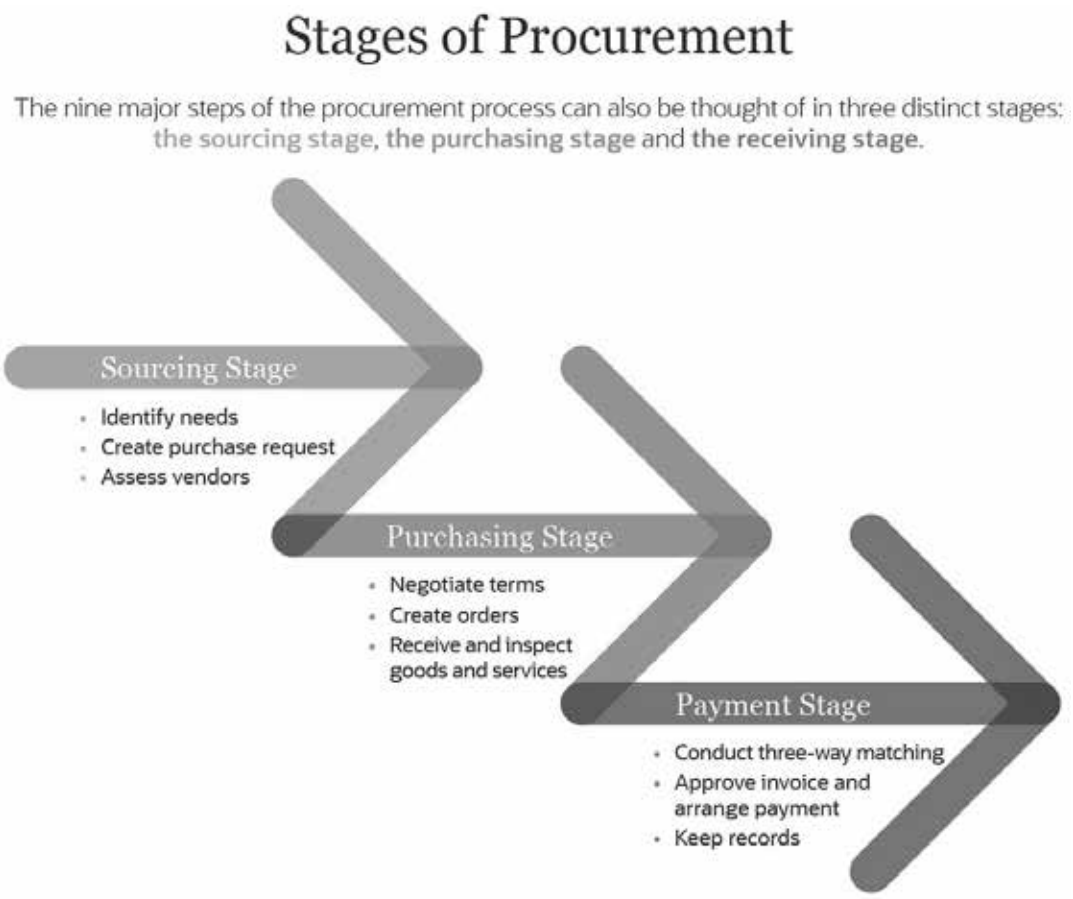

Procurement Life Cycle

Organizations commonly think of steps in the procurement process as a life cycle. This perspective provides a reminder that all the tasks and stages in the procurement process overlap and rely on each other and that the process is continuous. A carefully thought-out procurement life cycle also recognizes the integration between the process and the business as a whole, including the need to align with existing company rules and procedures covering areas such as budgeting. The process is not always linear, and sometimes adjustments need to be made to account for a dynamic digital supply chain with shifting suppliers, availabilities and costs.

Three Components of Procurement

Three key components work together to make the procurement process happen: people, process and paperwork.

- **People:** People generally are responsible for initiating or authorizing every step of the procurement process. In addition to procurement specialists, the people involved include other stakeholders, such as accounts payable and the business groups that request the goods and services. The number of people involved often depends on the value of the goods and services; more stakeholders may be involved in specifying and approving high-value purchases.

- **Process:** An effective procurement process can help a company succeed by keeping costs down and ensuring supplies arrive when the business needs them. A well-designed and methodical process helps to promote accuracy and timeliness because every person involved knows exactly what they need to accomplish and how long they have to complete the tasks. In contrast, a disorganized procurement process results in inefficiencies and potentially costly errors. Overpayments, for example, can impact the bottom line, while late payments negatively affect relationships with suppliers.
- **Paperwork:** It's important to maintain records for every stage of the procurement process and ensure they are easily accessible. These records act as a store of organizational knowledge about payment terms and supplier performance, helping the business maintain an efficient procurement process — even if the procurement staff changes over time. In the case of an audit or a dispute, a business must be easily able to follow the paper or electronic trail through each stage of the procurement process.

Principles of Procurement

In public-sector organizations, the procurement process is generally similar to the process in private-sector organizations — but with a few important differences. Because the people involved handle public funds, they generally must follow rigorous principles during the procurement process. These principles can be regarded as an ethical code of conduct that holds public servants accountable for their purchases. Some of the principles may also be beneficial to private-sector organizations. The principles vary somewhat depending on the organization. Here are seven of the most common procurement principles:

1. **Value for money:** The organization must manage funds efficiently and economically when procuring goods and services. This may include conducting cost-benefit analyses and risk assessments. It's worth noting that low cost does not necessarily equate to greater value; characteristics such as quality and durability also factor into determining whether the purchase represents value for money.
2. **Fairness:** Procurement should not provide preferential treatment to individuals or suppliers. All bids should be assessed objectively, based on how well they meet the organization's needs.
3. **Competition:** Organizations should seek competitive bids from multiple suppliers, unless there are specific reasons not to do so, such as a sole-source provider where the good or service is only available from a single vendor.
4. **Efficiency:** Procurement processes must be carried out efficiently to help maximize value and avoid delays.
5. **Transparency:** Organizations should make relevant procurement information available to everyone, including the public as well as suppliers. Information should be kept confidential only when there are legal or other valid reasons to do so.
6. **Integrity:** Those who practice public procurement should always strive to be perceived as trustworthy, reliable, honest and responsible. Funds must be used for their intended purpose and in the public interest.

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7. **Accountability:** People involved in the procurement process are accountable for their actions and decisions. They are required to report procurement activities accurately, including any errors.

Procurement & Finance

In many companies, procurement and finance teams operate as separate departments. Historically, they have sometimes been at odds for one major reason: Procurement spends money, while finance focuses on profitability, which sometimes means finding ways to spend less. However, a strategic partnership between the two groups can benefit the business as a whole, partly because each group can provide unique insights into the business's operations. For example, a well-run procurement team may have a deep understanding of how carefully sourced goods and services can help business groups maximize profitability.

This helps the finance group get a better overall picture of company spending and how it affects the bottom line. Integrated supply chain management software that can connect information from across the business, including finance, is an important tool to bridge the traditional divide and help teams work together to advance business objectives. Supply chain management software can also help you track progress toward goals by providing the information you need for key performance indicators (KPIs) in a simple-to-understand format for your procurement team.

Do's and don'ts in procurement strategy decisions

When implementing or refining a procurement strategy, the decisions you make early on determine whether that strategy will succeed or fail.

- DON'T think you know everything. DO seek to learn what you don't know. Every organization has not-so-obvious opportunities for Procurement to add value. Search for these opportunities with an open mind and they will present themselves for further evaluation.
- DON'T randomly try to save money. DO strategically select areas for cost reduction. "The key way to do this is really partnering with your finance staff, partnering with your CFO," says Ravi Thakur, vice president of Services & Support for Coupa, a provider of cloud spend management solutions. "It's working with them to understand what metrics drive their business such that you can go ahead and work with them to cut cost where it matters."
- DON'T "wing" a procurement strategy. DO base a procurement strategy on a business case with a clear return on investment (ROI). When administrators review budget requests, they will ask "Are you going to create a business plan for me that's going to create revenue or cut costs?" according to Thakur. ROI is "the only reason people will invest in a strategy, a process, or software, [so] make the business case for hard dollar savings."
- DON'T assume that Procurement is prepared for a new strategy. DO prepare procurement employees for new roles. Communication and training are mandatory if different results are expected.

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- DON'T believe that your leadership is enough to drive change. DO get buy-in for your procurement transformation from senior administration. "Make sure that the executive team is engaged" in procurement change management, advises Thakur. "Unless you get the buy-in from [your administrators] in order to go out and proactively talk about that change and make it a key initiative for the organization, it's very difficult to get [internal customers] to go and follow a transformation."

How Do You Get Procurement Strategies To Succeed?

- DON'T think that policies are all you need for compliance. DO make compliance the easiest option for your internal customers. "If you go and look at what an employee does when they go home at night, they're on Facebook, they're on Google… they expect to use the same thing within their day-to-day job," observes Thakur. "If they're working on tools or systems that don't offer the same types of flexibility or usability, they're going to start avoiding using those tools" and may resort to easier processes that violate policies.
- DON'T wait for savings opportunities to be revealed to you. DO leverage data to partner with other departments. Some procurement departments don't start searching for ways to achieve cost savings until a requisition arrives. That's too late for strategic procurement departments. "Look, you're in procurement... you're the quarterback of saving money and managing everything going through your supply chain," explains Thakur. He goes on to suggest that you, as a procurement leader, should take the lead in working with all major business units because "you're the only one within the [institution] that has visibility across all spend, across what everyone's doing. So, leverage that!"
- DON'T assume that lower prices alone will increase profits. DO work to ensure that savings are kept. Once you've negotiated deals and put low-cost contracts in place, "are you working to make sure that you're not just reallocating that money to a different group, but really cutting it from the bottom line?" asks Thakur. "Once you do those negotiations, and once you see the value that procurement's offering, make sure the value is kept [and] simply not lost by reallocating funds" to different budgets.

3.14 COLLABORATIVE PROCUREMENT

Collaborative procurement is a means to deliver greater efficiencies through combined purchasing power, and with public bodies under pressure to deliver more for less, collaborative procurement has become embedded in the procurement process. Collaboration provides an integrated approach to delivering procurement solutions, and helps organisations to drive efficiencies, reduce risk and save money by buying together. By working with other procurement organisations, collaborative procurement can result in fewer tendering exercises, which leads to lower administrative costs and allows public organisations to spend more time focusing on the specialised purchases that are unique to them.

What are the benefits of collaborative procurement?

The key benefit of collaborative procurement is that it helps organisations leverage their

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combined purchasing power to deliver savings that would not be possible if they were purchasing alone. Traditionally, procurement has been done on a one-to-one basis, with a buyer dealing with a supplier individually and trying to get the most bang for their buck. However, collaborative procurement means that organisations can work with other bodies and expand their purchasing scale, which will bring down the average cost per unit.

For example, if an organisation needs to tender for an everyday item such as printer paper, then it makes sense to join with other organisations who are in a similar position and approach the market with their aggregated requirements, rather than have a separate deal for each organisation resulting in a higher cost per unit. Collaborative procurement can also drive the standardisation of best practices in procurement, which can help your organisation become more efficient, improve process management and save money in the long run by sharing procurement knowledge, expertise and experiences.

Similarly, collaborative procurement means that organisations can work together with others in the same sector, forming groups and sharing information about markets and suppliers within that sector. This is particularly helpful for smaller organisations who can use groups and networks to develop procurement-related expertise which would otherwise be difficult for them to develop by themselves.

Additionally, having a dialogue with organisations operating in the same sector and interested in procuring the same solutions is a good way to benchmark your own performance and find out how you shape up against your peers. Being involved in these groups also gives your organisation the chance to form purchasing consortia to drive efficiencies. This is when organisations, such as local authorities or higher education institutions, come together to aggregate their procurement budgets with the goal of delivering major cost and quality benefits.

Efficiency East Midlands (EEM) is a perfect example of collaborative procurement in the housing sector, and consortia like EEM are a growing breed. Developed by Delta e-Sourcing, EEM allows its 97 member organisations to come together and buy in bulk the goods and services they jointly require, enabling them to make massive cost savings compared to individual orders. Their goal is to develop collaborative thinking and a working approach that delivers the fullest possible range of benefits – organisationally, financially and socially.

3.15 SUPPLY RISK AND PROCUREMENT REPORTS

Supply chain risk management (SCRM) is the process of identifying, assessing, and mitigating the risks of an organization's supply chain. Implementing global supply chain risk management strategies can help an enterprise operate more efficiently, reduce costs, and enhance customer service. Supply chain management refers to how organizations manage the flow of their goods, including all the processes involved in transforming raw materials the organization consumes into finished products or services the organization offers. It includes planning and managing sourcing, procurement, conversion, and logistics management functions.

One of the main reasons companies implement global supply chain management strategies is to boost their competitive advantage. That said, the globalization of supply chains can

also increase potential risks to quality, safety, business continuity, and reputation. Those issues need attention too. Every company, regardless of industry, is exposed to both internal and external risk factors from supply chain disruption.

Internal supply chain risks include risk events caused by:

- Disruptions of internal operations.
- Changes in management, key personnel, and business processes.
- Not putting contingencies in place in case something goes wrong.
- Not implementing proper cybersecurity policies and controls to protect against cyber-attacks and data breaches.
- Not complying with environmental regulations or labour laws.
- Not having the goods to meet customers' needs.

External supply chain risks include risk events caused by:

- Unpredictable or misunderstood customer demand;
- Interruptions to the flow of products, including raw materials, parts, and finished goods;
- Social, governmental, and economic factors, including the threat of terrorism;
- Supplier risk management, including concerns related to a supplier's physical facility and regulatory compliance;
- Natural disasters, such as earthquakes, hurricanes, and tornadoes.

An organization could fall victim to supply chain financial risk if something threatens financial health, such as higher component costs eating into profit margins. A company might suffer reputational risk if a supplier engages in unethical behaviour, such as bribery, child labour, or anything that could reflect poorly on the company's brand. Finally, a supplier's social media activity can also harm your brand.

Supply Chain Risk Examples

Supply chain risk includes a wide variety of problems with vendors, suppliers, shipping agents, resellers, and other third parties. Those issues can disrupt production, operations, sales, and projects. They can also lead to quality issues, accountability, and reputational conflicts. Here are some examples that expose supply risk:

- **Price Increases**
  Rising prices are caused by supply, demand, currency instability, and customs tariffs. Volatility in prices can jeopardize financial projections and profitability of the business.
- **Shortages**
  These can arise from lacking a component, material, or part needed to produce a finished product. Shortages may be short-term availability issues or long-term if the supplier has discontinued the required items.

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- **Supplier Relationships**
  If litigation or some other dispute ruptures your relationship with a supplier, the scenario will lead you to replace the supplier.
- **Quality Failures**
  Quality failures occur when shipments of certain parts do not meet the given specifications or perform as expected.
- **Delivery Failures**
  Carrier and logistical issues can result in late deliveries, damaged packages, or lost shipments.
- **Supply Shocks**
  Sudden worldwide or industry-wide drop in supply due to events such as a pandemic, natural disaster, labour dispute, or trade embargo.

What Are Supply Chain Risk Management Strategies?

Supply chain risk management tools exist to help you track and maintain your supply chain sustainability. These tools can make order intake, shipping, ordering supplies, and taking inventory much more efficient.

As more pieces of your supply chain become cloud-based or automated, using software to manage your supply chain risk management program becomes increasingly necessary. Unfortunately, older techniques and strategies aren't equipped to navigate the speed at which these technologies advance.

This kind of software can give you a competitive edge in a crowded market. It can centralize your workflows, improve stakeholder communication, and help protect you from risks you don't even know to exist yet.

Some strategies are:

Use a PPRR Risk Management Template

PPRR stands for prevention, preparedness, response, and recovery. It is a globally recognized supply chain risk management strategy employed by organizations. PPPR can especially help with business continuity planning. Various templates to walk an organization through the PPPR methodology are available online.

Enhance Your Supply Chain Risk Governance

Try the following supply chain risk management strategies to reinforce your cybersecurity defences.

- Set standards for supply chain compliance for all of your third-party suppliers;
- Define roles for users and apply security controls to narrow down who can log in to your system and what level of permissions they have, to prevent unauthorized meddling in your supply chain operations;
- Perform a thorough due diligence and risk assessment for all vendors and service providers before entering into any contract;
- Fully train all employees on cybersecurity protocols.

Systematically Monitor Risks

Investing in a scalable digital solution that automates the oversight of several aspects of your supply chain is the simplest way to monitor your risk management plans consistently. This will provide you with safety, reassurance, and precious insight into how to streamline supply chain operations.

Centralize Data

Using too many solutions in your software ecosystem can get in the way of risk management, especially if you keep business data in many separate disparate systems.

To make it easier to harness data analytics, predictive insights, and data sharing, invest in a comprehensive solution that maintains all of your data in a well-organized, centralized, single warehouse.

What Are the Benefits of Supply Chain Risk Management Software?

Supply chain risk management software can bring many benefits to your company beyond its intended purpose. For example, supply chain management software can help minimize ship times by allowing you to track the process from beginning to end. In addition, the metrics you can gather from these programs help your company achieve its long-term goals for product volume, customer satisfaction, and related issues. Many supply chain software options are scalable and cover multiple functions. It's ideal if you can centralize and streamline your processes for the entire lifecycle of your supply chain from demand to delivery.

Artificial intelligence and advanced analytics in many programs allow you to create more accurate predictions about supply availability, logistics bottlenecks, and related issues. The insights help you predict risk far in advance before it becomes a severe threat. The ability to integrate real-time data into your strategy also allows you to track changes in weather, infrastructure, and other concerns that could affect your supply chain. The more information you have, the greater your ability to create contingency plans to protect you in an emergency.

What Are Procurement Reports?

A procurement report allows an organization to demonstrate how its procurement activities deliver value for money, contribute to the realization of its broader goals and objectives, and provide a panoramic snapshot of the effectiveness of its procurement strategy.

By tracking the right procurement KPI, a company gains the power to enhance its strategy by preventing minor inefficiencies from becoming significant issues and providing a clear insight into the practices or supplier relationships that work, as well as those that don't.

Throughout the years these reports have been created and managed through traditional means of data management such as spreadsheets or static presentations but companies need to hurl these stone-age practices and start utilizing modern online reporting software that will transform your results, and ultimately, increase profits. Next, we are going to see their importance more in detail, alongside with most common challenges.

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Why Are Procurement Reports Important?

There are a host of benefits to a well-made procurement reporting structure. Some of them include:

1. **Improve the accuracy of the financial forecasting**
   You can easily increase financial efficiencies and save costs by identifying potential problem areas in your organization. If you track your costs on a regular basis, your purchasing department monthly reports will be filled with crucial financial analytics insights that will help you streamline your supplier management processes, identify if you need to train your staff on how to reduce costs, and ensure continuous monitoring to ensure your finances are being well managed and efficient. Financial forecasting is vital to the ongoing health of your procurement activities. Through the use of modern dashboards, you will be able to deliver your projections with pinpoint accuracy. But not only, but the use of interactive financial charts will also make your data exploration processes quicker and easier.

2. **Minimize errors throughout the supply chain**
   By monitoring your dependency on providers over a set time frame and identifying which ones deliver the right product or service at exactly the right time, you can analyze your suppliers' performance with ease while conducting comparisons throughout your business. With the help of a dashboard designer, you can simply drag-and-drop your values and create interactive visualizations that will point out errors immediately. That way you will be able to significantly reduce errors, and increase your productivity levels.

3. **Increase the efficiency of crucial KPIs**
   With so many areas to consider, deciding which KPIs to focus on while defining metric measurement periods can prove to be a challenge at the initial stages. Scaling the value of analytics across all areas of your procurement process might prove difficult in the beginning, but by ensuring that all key members of your team have access to your KPI reports and understand how to leverage the data to their advantage, the steps to take towards your strategy will swiftly become clear. For

example, you might want to track crucial order cycle times and order fulfilment speeds to be able to handle urgent orders and take into account providers that can fulfil your requirements quickly and without additional complexities.

4. **Understand which relationships are working**
   If you create regular purchasing reports, you can easily identify which suppliers are not only available during your urgent times, but also classify them based on a number of other criteria such as special discounts, reaction time, and other compliance parameters of your contract. That way, you can introduce categories for each provider and identify which ones keep a good relationship with your company on the one hand, and on the other, which need termination or replacement. We will see this in our examples below in the article.

5. **Take accurate measurements**
   Another benefit is how they provide a wealth of opportunities to improve your ROI based on your various procurement actions, initiatives, and activities. Both the short-term and long-term goals of your business will be fulfilled by offering a panoramic snapshot of every critical aspect of your procurement journey. By benchmarking your success accurately, you stand to increase your ROI while maintaining a standard of excellence that will drive you forward.

6. **Reduce and avoid unnecessary costs**
   With procurement being such a critical component, providing the oil that greases the organizational cogs and keeps everything flowing along with monitoring and analyzing all aspects of the process is essential. From costs and delivery to compliance rates and order cycle time, there is a wealth of insights to explore. As the company evolves and grows, scaling your common procurement efforts to reflect the new demands of the business might also prove challenging. However, by making a collaborative approach and following some dashboard best practices to remain in line with your key business goals and objectives, you'll be able to avoid data fragmentation and continue to benefit from the insights that are the most valuable.

7. **Improve responsivity and decision-making under pressure**
   Like in almost every business process imaginable, incidents can occur, and things can go wrong. By working with the right procurement analysis report, you can respond to potential challenges or changes 'at the moment' and create quick-fire solutions that will ultimately save time and money.

   A cohesive mix of accurate real-time and dynamic online data visualization means that you can pinpoint the issue at a glance and make strategic decisions with complete confidence. As such, your supply chain can remain fluent at all times.

8. **Gain 24/7 access to essential insights**
   Another stand-out benefit is the universal access to data those modern BI dashboards provide. Modern sourcing reports are accessible across a multitude of devices, including desktops, tablets, and smartphones. Rather than relying on data when you're in the office or at specific locations, modern procurement-based tools will empower you to access invaluable information and essential insights

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24/7 regardless of where you are in the world. As a result, you can measure your improvements, respond to potential issues, and develop strategies even when you're on the move. Now that you understand why a procurement report is important, we're going to focus on the how-to and see the best practices and tips you can utilize in your own procurement operation.

What Should Be in A Procurement Report?

When building these kinds of reports, it is important to consider a few fundamental items that should be included in order to have a successful process. Here it is important to remember that not all items need to be added into one single report, but they serve as a great starting point to build a data-driven procurement department.

- **Cost control:** This section is all about costs. Here you can include fiscal-year-to-date costs savings, costs incurred since last period, costs saving opportunities, as well as some potential threats related to costs that need further observation.
- **Supply risks:** Staying one step ahead of any issues is a great benefit from modern online data analysis. The supply risks portion will list all risks that have been identified alongside realistic solutions to mitigate the impact of each of them. This can be done with the help of advanced technologies such as predictive analytics. More on this later!
- **Internal customers relations:** An important aspect of a successful procuring process is the relationship with internal customers such as suppliers, shareholders, employees from other departments, among others. In this section, you can share all relevant information regarding completed collaborations with internal customers to make sure every aspect is being monitored.
- **Performance checks:** Every procurement department that wants to be successful in the long run need to ensure that the company is working with the best providers. That said, this item should monitor the performance of the different suppliers, list the challenges of each of them, and how they are improving in time. This is useful information as it allows you to ensure a healthy collaboration.
- **Processes improvements:** Besides checking providers, you should also monitor the development of the general processes in your procuring routine. Here you can track that every critical process is running smoothly as well as find improvement opportunities for extra efficiency.
- **Sourcing projects:** As its name suggests, this section should track all aspects related to sourcing projects. In order to make it as efficient as possible, you should separate each of these projects into stages, this way you can monitor each stage in detail and extract conclusions when needed.
- **Strategic collaborations:** Last but not least, an important area that can be beneficial for this kind of report is innovation and collaboration. Sometimes, companies might find themselves working with experienced suppliers that can offer innovative solutions that the business can apply to other projects or processes. For this reason, it is important to keep track of all these suggestions, and how they develop in practice and consider them in the future.

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These are only a few examples of areas that you can include, of course, this will depend on the needs and goals of each organization. Let's see this more in detail with some useful tips.

3.16 PROCUREMENT AND FINANCE COLLABORATION

When finance and procurement teams work in harmony, they make a far greater contribution to business goals than is possible when working in silos. Yet in many organizations, there's still a disconnect between the two. Our report, how dysfunctional finance and procurement leads to bad business outcomes, explores this disconnect in detail and we strongly suggest you read it.

As a more general overview, this blog post provides nine ways in which finance and procurement collaboration can produce better business outcomes – as well as how technology can help. Remember, though, that technology alone is never the complete solution – success in collaboration demands strong working relationships, ongoing communication, and a cross-disciplinary mindset.

1. **Connect finance and procurement processes to improve productivity**
   Finance and procurement tasks overlap in multiple areas. The more teams can do to share data and connect workflows, the more efficient they can become. Automation provides the tools essential for connecting processes and sharing data across the organization, speeding up activities, and eliminating manual errors and omissions. The purchase to pay process is a prime example. With automation, you can streamline every step - from raising the requisition and managing approvals through - to no-touch POs and on to automatic invoice matching.
2. **Optimize savings**
   Close finance and procurement collaboration allows you to both identify and explore the most appropriate savings opportunities and to better realize the savings that are negotiated. Integrated automated systems make it easy to share information such as supplier order history and category spend data, boosting procurement's negotiating power. Shared information can also help you make the most of agreed discounts and prevent unwanted and potentially costly contract rollovers. On top of this, closer collaboration over automation and systems integration brings greater control, so you can ensure people order the correct goods or services from the correct supplier.
3. **Provide richer and more accurate data for budgeting and decision-making**
   For budgeting, finance typically looks at what's been spent in the past to predict and plan future outgoings. Procurement, on the other hand, has a broader perspective and can shed light on trends and opportunities. For the most in-depth understanding, teams must work together. If the procurement team is working on specific category management projects or looking to bring more spend under management in a category, they will be hoping to bring down costs. Setting a budget based on the previous year's figures could prove over-generous and result in unnecessary spending. For monthly and other scheduled reporting, finance reports are only as accurate and up-to-date as the data in the system. A collaborative approach to using tech to integrate and speed up processes is essential in making sure reports provide real time information people can act on with confidence.

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4. **Control cash flow more effectively and free up cash**
   With close collaboration, finance and procurement can free up cash by ensuring that optimum payment terms are both negotiated and taken advantage of and that the suppliers who provide the best terms are the default choice for orders. The two teams can also work together to better understand what the optimum terms are in a particular scenario. For example, could what look like an attractive bulk discount for stock in fact result in working capital being tied up to cover storage costs? Integrated technology systems are key to speeding up processes and payments, and so enabling more accurate cash flow forecasts.

5. **Reduce risk**
   While finance and procurement have different risk management priorities, both share an interest in activities such as due diligence for new suppliers, ongoing compliance updates, internal controls, and the business impact of a supply chain failure. Collaboration over requirements, systems and processes will help you broaden the understanding of risk and strengthen risk management approaches.

6. **Stop operational issues from harming supplier relationships**
   A happy supplier is essential if procurement is to build a successful strategic relationship. But all too often, relationships get harmed by simple operational issues. The biggest of these is late payment. If finance is following a deliberate policy to stretch payment times, then procurement can advise which suppliers are able to handle a delay. If the delay is down to administrative issues such as missing PO numbers or inaccurate master data, then teams should be looking to implement integrated finance/procurement tech solutions that will prevent such problems. Other operational areas where closer collaboration helps keep suppliers happy include sourcing and onboarding, agreement on details, and using online questionnaires and self-serve supplier portals to collect correct information.

7. **Deliver stakeholder goals more effectively**
   Modern strategic procurement is about spending money wisely and in line with budget holder and stakeholder requirements – including corporate social responsibility objectives. Finance is more often about simply spending less money. Communication and collaboration are essential if you are to reach a shared understanding of where true value to the organization lies and deliver what's needed.

8. **Create a single source of truth**
   Many organizations run multiple IT systems that haven't been fully integrated, making it hard for people to find and access accurate information. When finance and procurement collaborate to bring systems together, they can create a single source of truth for everything from supplier contract details to up-to-the-minute order data. Data is entered only once and shared between systems, while cloud hosting options give access to authorized users wherever they may be.

9. **Improve business case evaluations**
   Finance teams responsible for business case evaluations can benefit hugely from the input of procurement colleagues. By contributing insights into the vendor landscape plus their knowledge of CSR and other stakeholder drivers, procurement

can help finance take account of a broader range of issues and so produce stronger evaluations.

The Importance of Finance and Procurement Collaboration

It might seem like a no-brainer to have your finance and procurement departments collaborating but recent studies show that these two departments often don't have the right tools for seamless collaboration or know how important it is for them to continually collaborate. It's essential, for the success of a business, for there to be a relationship between purchasing and finance departments. This relationship is essential for process efficiency, team structure, strategic leadership, and to know when and which technology to invest in.

As finance departments move from a back-office function to become a strategic partner of the business, the procurement department must do so as well to ensure the success of the business. Finance departments were once viewed merely as the bookkeeper of the organization but companies have realized that this department is essential to their prolonged success and CFOs have become a CEOs number two in business. CFOs are no longer just bookkeepers of the business and have begun to invest time to develop a deep understanding of the business, beyond the functional requirements of the finance role.

The finance and procurement job description is to assist with strategic financial management activities including annual budget development, financial planning and cash flow, and financial reporting. When these two departments collaborate, they have better success in organizing and maintaining comprehensive financial and procurement files and ensure all recording is compliant with audit, corporate, and client requirements.

3.17 STRATEGIC SOURCING AND PROCUREMENT ETHICS

Strategic sourcing refers to the process of identifying the spend profile of an organization and its supplier base to ensure their business requirements are aligned with the suppliers. The boom in the adoption of strategic sourcing implies that almost everyone has heard of it. However, being a term that encompasses a large number of sub-concepts, understanding strategic sourcing might get complex. Hence, this article attempts to cover what constitutes strategic sourcing, how it differs from tactical sourcing, and its driving forces and processes.

Difference between Tactical Sourcing and Strategic Sourcing

Understanding Strategic Sourcing

Strategic sourcing involves developing a proactive, holistic, and continuous evaluation and re-evaluation of the sourcing activities in an organization. Strategic sourcing aims to achieve the lowest Total Cost of Ownership (TCO) along with minimal supply chain risk. Hence, it reflects the organization's relationship with its sourcing partners as a loop instead of a one-way process—an in-depth profile of the suppliers and their core capabilities is developed and periodically aligned to the sourcing requirements of the organization. Strategic sourcing views suppliers as crucial value partners and aims to building sustained, collaborative relations. The customer-supplier loop is assessed at every stage of its lifecycle in order to ensure that the needs of the organizations are continuously and efficiently met. To accomplish this, strategic sourcing leverages spend analysis, supplier evaluation, supplier relationship management, and detailed market research. Strategic sourcing is,

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hence, a long-term process and for its successful implementation, it needs skilled personnel and relevant technology platforms and tools.

Understanding Tactical Sourcing

In contrast, tactical sourcing involves a short-term and traditionally reactive approach towards managing the sourcing activities of an organization. It aims to achieve the lowest possible cost without considering other factors like supplier relationship management, supply chain risk mitigation, etc. Consequently, the focus on building long-term relationships with suppliers and understanding how their core capabilities can meet the organization is minimal as communication with suppliers only occurs when problems arise. While tactical sourcing can bring gains in the short-term, it prohibits sustained optimization of its sourcing activities. Furthermore, compared to strategic sourcing, tactical sourcing doesn't necessitate large investments in advanced technological platforms and personnel skillsets.

Why do we Need Strategic Sourcing?

Now that the concept of strategic sourcing is clearer, it is important to understand its benefits and why it makes sense for more organizations to adopt strategic sourcing.

1. **Increased Level of Cost Savings**
   The most obvious benefit businesses will experience from strategic sourcing would be higher levels of cost savings. By identifying and selecting suppliers that will provide the highest value at the right pricing will enable an organization to continuously achieve higher cost savings. This is even more important as according to Zycus' Pulse of Procurement 2018, 54% of top procurement professionals have recognized cost savings as a key focus area.
2. **Better Alignment of Sourcing and Business Objectives**
   Aligning the sourcing activities of a business to its organizational goals and objectives is at the crux of strategic sourcing. Better alignment allows the business to achieve higher business performance with higher efficiency and minimal supply chain risks.
3. **Optimization of Ideal Suppliers**
   In order to effectively implement strategic sourcing in your organization, it is necessary to analyze the suppliers, their profiles, and core capabilities. Once this is accomplished, an organization is equipped with information that will allow them to match their business objectives to their ideal suppliers. This implies highest value-creation at lowest-possible cost.
4. **Long-term Relationship Building with Suppliers**
   Strategic sourcing helps an organization build long-term relationships with its suppliers. By reinforcing the focus on the core capabilities of the suppliers and assuring the right suppliers for the right sourcing objective, strategic sourcing helps create a synergy between organizations and its suppliers. Sustained relationship with suppliers also implies that when the suppliers are valued and considered in various sourcing decisions; they feel motivated to optimize their performance to meet the organizations objectives.

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How do we Implement Strategic Sourcing?

Understanding the advantages of strategic sourcing brings us to designing a process to implement strategic sourcing in an organization. While a single process might not match the specifications and requirements of every organization, we can outline a basic structure that can guide the strategic sourcing process:

- **Identification and Categorization of Spend Profiles**
  To initiate the strategic sourcing process, identify the spend areas existent across all the business areas in the organization and categorize it on the basis of how critical/non-critical the spend area is. Categorization will help prioritize the sourcing activities for each spend area. If required, other categorization criteria that better suit the business requirements can also be developed (e.g.: domestic/international spend, direct/indirect spend). In such cases, it is important to do a risk analysis of the chosen spend categories to help prioritize and develop strategies.
- **Building a Sourcing Strategy**
  The second step includes building a strategy on how each categorized spend area will be approached. This involves identifying the requirements of the business units that necessitate spending and defining goals, objectives, and corresponding timelines to fulfill the requirements. This also necessitates building a communication workflow so that all stakeholders relevant to the respective sourcing projects have clear visibility of upcoming updates.
- **Analysis of the Supplier Market**
  The third step is to execute an in-depth analysis of the current and future suppliers to understand and evaluate relevant supplier profiles. This includes analyzing the revenue or market share of suppliers to understand their market standing and industrial performance along with the risks and opportunities surrounding the supplier market.
- **Request for Supplier Information and Identification of Selection Criteria**
  Once the supplier market research is completed, the fourth step is to request RFIs/RFPs/RFQs from suppliers. It is important to communicate the exact requirements of the organization as well as the end-goals and performance expectations so that the suppliers have clear understanding of what the organization needs. This is important so that they provide an accurate roadmap and develop strategies to fulfill the business's objectives. The submitted information will provide insightful data—the pricing structure, delivery and warranty provisions, product/service specifications etc. After the submitted data is collated, the selection criteria can be identified for supplier selection.
- **Selection of Suppliers and Execution of Contracting Process**
  After the selection criteria are identified, the fifth step is to choose the suppliers that can offer the highest level of cost savings along with delivering quality. After supplier selection for the relevant spend areas, the contracting process starts to on-board the suppliers.
- **Measurement and Periodic Tracking of Supplier Performance**
  The process of strategic sourcing doesn't end at choosing a supplier. The sixth step is to effectively measure how suppliers perform vis-à-vis the requirements and

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objectives of the organization. It is important to engage in periodic tracking of supplier performance and identify areas for improvement. This can significantly help organizations understand supplier risks and design strategies to mitigate all possible supply chain disruptions.

- **Implementation of Supplier Relationship Management (SRM)**
  The seventh step is factoring Supplier Relationship Management (SRM) in the strategic sourcing process which makes the relationship between the organization and suppliers a loop instead of a one-way process. SRM enhances the level of collaboration between an organization and its suppliers by transforming a mere customer-buyer relationship into strategic value partners. Both parties participate in building propositions and innovative strategies that optimize the sourcing needs of the organization. The relationships that arise out of such synergized collaboration are long-term and can be leveraged to further improve supplier performance. More than just being the final step in the strategic sourcing process, SRM links suppliers and organizations in a way that both current and future requirements are met in the most efficient and value-maximizing manner.

Procurement Ethics

Ethics in procurement management is important, particularly because of your relationship with suppliers and vendors, typically to finish a job or a project.

Fundamentals of Ethics and the Pillars of Procurement

In general, there are six principles of ethics that hold true, no matter what field you work in, from sales and procurement to the healthcare field. These six principles include non-maleficence, justice, truth-telling, promise-keeping, beneficence, and autonomy. In healthcare specifically, justice is often split up into two types, for seven layers of ethics.

There are also five pillars of procurement, two of which ethics play an integral part in. These are:

- Equity
- Accountability and reporting
- Value for money
- Open and effective competition
- Ethics and fair dealing

While it's obvious that ethics in procurement management are prevalent in two of these five pillars, it is often important that those who work in procurement act ethically throughout. What are some issues that may come up that would be unethical?

Unethical Situations in Procurement

If you're trying to work on great procurement supplier relationship management, you may want to pull out all the stops to ensure that the relationship stays positive. However, situations may develop that can be uncomfortable and even unethical. Some examples of what you shouldn't do when it comes to ethics in procurement management include:

- **Accepting gifts from a supplier**. Even if it's around the holidays, you shouldn't accept gifts from a supplier. It should always be a completely professional relationship.
- **Having a conflict of interest**. If you or a close family member or friend has something to gain from using that particular supplier, then that is a conflict of interest.
- **Sharing confidential information**. Never share information with a supplier that they should not have access to.
- **Treating suppliers differently**. Your suppliers should always be treated the same.

To try to ensure that you avoid ethical problems, you should consider implementing some measures that avoid the above mistakes.

Working Toward Standards and Ethics in Procurement Management

As the procurement manager, you may be able to purchase and install procurement software that can help you organize tasks more efficiently so that the bidding process, as well as other procurement processes, are more streamlined, transparent, and fair. Keeping tasks organized can protect against costly mistakes. Another action you can take is to have an official ethics policy at the company that all employees can understand and follow. Another idea is to have an official ethics training. While this may be a little costly, it's well worth it to have everyone on the same page, including upper-level management. Another item to consider is asking your suppliers to agree to your ethics policy as part of your supplier on-boarding process. You can use an e-Sourcing solution like EC Sourcing to automate and streamline that process.

Procurement Ethics Concepts

To guide decision making and help to avoid unethical practices, keep the following fundamental principles in mind:

1. **Loyalty and Respect for Rules and Regulations** — Typically, officers sign an oath vowing to conduct themselves per the organization's rules, acting in its best interest, and not allowing outside influences into any decision-making process.
2. **Transparency** — All information related to procurement processes should be made available to all parties involved, including the general public unless there are legal restrictions in place. Tender announcements are required to contain sufficient information to inform the supplier of capability in bidding. Tender documents must be concise, detailing expectations, evaluation criteria, and dates.
3. **Integrity** — Strong moral principles and honesty are the pillars of integrity. The company's moral values should always be upheld; employees should not act with selfish motives or with the end objective of personal gain. When employees see evidence of unethical behaviour, they should submit a report.
4. **Unbiasedness** — To achieve fairness in operations, bias should not be shown to specific suppliers or co-workers. Decisions should be made with impartiality, and changes to any document or specifications should be distributed to all suppliers.
5. **Confidentiality** — In any business, information related to financials and personal information is protected and not made public as its release can jeopardize operations.

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Companies often have employees sign confidentiality agreements to ensure this remains intact.

6. **Avoiding the Appearance of Impropriety** — Officers should be aware of outside perceptions of behaviour deemed to constitute a conflict of interest. Circumstances involving improper contact should be identified beforehand and avoided as major scandals can erupt based only on assumptions.
7. **Due Diligence** — Duties should be undertaken with the utmost care to follow all company regulations and standards while avoiding shortcuts.
8. **Accountability** — Persons should be held responsible for any decisions made during the procurement process. Any actions contrary to the organization's rules should be investigated and the required steps taken.

3.18 CONCEPT OF MANAGEMENT OF INVENTORY

The following inventory management concepts can help you better understand the flow of your inventory from ordering through shipping and returns.

7 Key Inventory Management Concepts

1. **Ordering Products**

   How you choose to purchase your merchandise will define your ordering method and quantities you will need to reorder. This should be based on your return on investment. Large retailers have the benefit of using distribution warehouses and complex systems that break each item into smaller units to ship and to store as items are ordered.

   Smaller businesses need to watch ordering even closer because of space and financial limitations. Thus, monitoring sales trends and specific products to determine the needed replenishment amounts is absolutely essential. Start by acquiring an inventory book where you can record all items, as well as changes to them. Make note of fast- and slow-moving products and compare your revenue against carrying costs to figure out which products are the most profitable for you.

2. **Receiving a Shipment**

   A key point of loss is at the time of receiving inventory. Closely reviewing packing slips to catalog shipments is necessary for inventory management. You will also want to carefully inspect items before the shipping company leaves in case you need to file a damage claim. Each shipment should be closely checked, and this should include counting products and comparing them to the packing slip. Variances need to be noted, and if need be, a claim will have to be filed with the vendor responsible for the shipment.

3. **Storing Inventory**

   After receiving your products, you will need to decide where they should be placed. Will you be using your garage, a local warehouse, or a distribution facility that will both store and ship your products? Whatever you decide, develop a systematic way to be able to find your products. For example, a supplier of buttons might use bins with numbers to map out what she has in stock. Once this system is in place, you

will not only simplify for yourself the picking process when there is an order but also for any staff that you might hire to help you.

4. **Minimizing Loss**
   Most of us think of loss as theft. However, a substantial amount of loss simply occurs due to clerical mistakes. These mistakes can occur at any point during the inventory cycle. Incorporating loss prevention techniques can help prevent these costly problems. Managing your inventory effectively may require implementing a variety of loss prevention techniques including utilizing security cameras to reduce customer and employee theft, using security tags, limiting access to inventory, and carefully monitoring customer returns.

5. **Taking Regular Inventory**
   Inventory management also includes taking periodic inventory for tax purposes. Inventorying more often can also help you better understand loss trends and the amount of unsold merchandise. Consider having scheduled inventory days when employees check inventory for quality and age. This is the time to weed out old products by having clearance sales or special promos to liquidate merchandise.

6. **Inventory Management Solutions**
   If you sell products, an inventory management solution is something that you definitely need to consider. There are many to choose from that are designed specifically for small businesses. Most inventory systems currently available will help you oversee the flow of your products, create invoices and purchase orders, generate receipts, and control inventory-related accounting for you.

7. **Inventory Consultants**
   Very few small businesses have the luxury of being able to hire a dedicated inventory control manager. However, there are outside consultants that can help you develop and manage your internal inventory management system. A qualified consultant can help you maintain accuracy while helping you to manage shipping and receiving and order-picking operations.

Importance of inventory management

1. **Inventory Control Paves for Competitive Ability**
   The usage of Inventory Management and control benefits inventory control by enhancing market shares thus, paving the way for competitive ability. The best example is Apple's smart inventory management which gives them a competitive advantage. Commonalities with values, high factor loadings values, and significant mean values are factors taken into consideration in determining a business supports for competitive strength. These factors undoubtedly demonstrate the importance Inventory Management and control, enhances market share and improves competitive ability.

2. **Inventory Planning Improves Service Level**
   It remains the fact that good Inventory Management and power leads to what all business strive for continuity, the repeat clients. If you desire your hard-earned clients to come back to purchase your products and services, it is necessary always to improve your service level enough to be able to match customer request swiftly.

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Inventory Management and control aid businesses in meeting such demand by permitting you to provide the right levels of hands-on service immediately your customers require them with the desired lead time, highlighting the importance of inventory management,

3. **Inventory Planning and Management Reduces Storage Cost**
   These benefits of inventory management envisage on focusing upon Inventory planning and reducing storage costs as you maintain adequate inventories. The central values feature significant factor loadings and commonalities exhibited through proper Inventory Management and control. The factor lowers storage costs and increases revenue by using adequate inventory management and control emphasising importance of inventory management.

4. **High Inventory Turnover Brings Revenues**
   Applying Inventory planning to any business can serve as a bridge to bring in higher revenues. Through proper Inventory Management and control, a company is capable of increasing its profitability. If a business overlooks the benefits of inventory management in its trade, sales, and production, it is possible to hamper maximisation of its operational efficiency. Intrinsically, the inventory's cost of purchase and production has a substantial effect on gross profit. Using lessened cost of production, a business raises its gross profit. That is why proper inventory planning is required. And with all accounts placed as equal, such company would record superior revenues, which in effect, leads to more profits, again substantiating importance of inventory management.

5. **You Can Utilize Warehouse Space Better**
   Proper Inventory Management and control involve accounting for all production, purchase, and sale of goods that meets customers' demand. These benefits of inventory management affect management strategy that supports organisational warehouse in attaining better space management. If you have an unorganised warehouse, you would always find it difficult to handle your inventory effectively. Several businesses elect to enhance their warehouses by arranging higher selling products together in areas that are easily accessible within the warehouse. Performing this process aids in speeding up the order fulfilment and preserves customer's happiness.

6. **Inventory Control Makes Cost Accounting Activities Easier.**
   Better inventory management is surely going to make your financial controller happier and you can be easily in his good books! Business owners often develop internal strategies and measures that will guarantee better control and planning of production and sales. Such approaches involve binding every partaker in the business to delivering activities that make Accounting Activities Easier including managers. Usually, these strategies aid such industry to order, account for inventory values, keep inventory flow, along with assistance on how to control obsolete goods. By executing such plans in inventory planning, several businesses can be able to manage its cash flow well. To enhance your business cash flow, it is expected you set aside some investment into the most effective and practical inventory system that is powerful enough to meet your requirement and is also suitable to match

your business environ. For this reason, companies with well thought out plans can save a lot more from the use of active Cost Accounting Activities. Additionally, better Inventory Management and control aid your business in establishing cost benefit for you concerning the financial market conditions. Better cash flow lets companies attain better business and organisational goals.

7. **Inventory Control Is Consistent with Safety and Environmental Advantage.**
   Too much inventory in warehouse can be health and safety issue when employs struggle to walk on the shop floor, cannot moves goods easily and it is falling from the shelves. Good inventory management leads to inventory reduction which leads to less packaging which leads to less waste and contribute to environmental advantage. For me one of the best reasons to show importance of inventory management!

8. **Regular Supply at Reasonable Prices Builds Customer Confidence**
   Evidently, with better strategies in place, any given organisation can use inventory planning and control to improve its cash flow by providing higher customer service at consistent pricing. Inventory control and planning solution allows small business to gain insight into what products are selling more than others. This step will enable them to adjust their product line and to make intelligent business decisions.

9. **Inventory Holding Results in Effective Utilization of Human and Equipment**
   Proper Inventory Management and control solutions save time regarding human resources and equipment usage. Less time expended on managing inventory leads to higher productivity for your business and clients as well. With these benefits of inventory management, your business stays steps ahead of the game and continuously have enough number of products at hand based on inventory movements.

10. **Effective Inventory Control Enhances Market Share**
    For companies whose scale of operations does not permit the running of several inventories by product line or SKU, the usage of Proper Inventory Management and control solves it. Nevertheless, in some situations, your business size does not matter since roles and policies have to be set up irrespective of the size of the business. Such procedures and set up will help govern inventory spending and Enhance Market Share.

11. **Inventory Control Enhances Product Quality**
    The use of Inventory Management and control can assist in remarkably improving business efficiency and product quality. These benefits of inventory management would aid in eliminating waste, and enhances focus on producing Right First Time or Six Sigma Quality. It remains a fact that having a good inventory management system leads to better success and repetitive customers. If you desire your hard-earned customers always to keep coming, you have to enhance your product quality in the best ways possible.

12. **Effective Inventory Control Brings Potential Saving**
    Proper Inventory Management and control can Bring in Potential Saving as benefits of inventory management. By monitoring which product bring in more sales and

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what other potentials they have, your business can save more on every effort with an inventory recount to safeguard accurate records. Good Inventory Management and control strategy also benefits businesses in saving money that could otherwise be lost in slow-moving products. No one can deny this as top reason to show the importance of inventory management.

13. **Inventory Control Avoids Costly Interruptions in Operation**
    Inventory Management and control are beneficial in limiting the employee's ability to steal or disrupt your operations. Often costly interruptions in service in businesses can be averted with proper planning. Deprived of inventory control, companies may be none-the-wiser to such disruption. These benefits of inventory management ultimately improve business profitability. By avoiding costly interruptions, businesses can reduce any 'hidden' costs. Showing, the importance of inventories management.

14. **Inventory Control Strategy Facilitates Purchase Economies**
    Good Inventory Management and control aids in Facilitating Purchase Economies and maintaining steadiness in production operations. This approach is down to the maintenance of smooth flows in accessing raw materials. Consequently, there are no shortages experienced during the production process — these benefits of inventory management aids in reducing the risk of loss due to desuetude or deterioration of items, hence, highlighting the importance of inventory management. Such checks are placed on items regularly. Additionally, selling all slow-moving items promptly and maintains the right stock all Facilitates Purchase Economies.

Classification of inventory

Inventory is just another name for the stock a business keeps. Conventional examples include the raw materials a manufacturing company holds, as well as the merchandise retailers sell. Classifying inventory allows a business to have the right items at the right time in the right quantity. Understanding the different types of inventories and classifying them allows a business to reduce costs efficiently by not holding too much inventory, while maximizing sales by reducing stockouts. Inventory classification enables you to be laser-focused on the 20% of your inventory that generates 80% of your revenue.

1. **Raw Materials:**
   Raw materials are the materials a company uses to create and finish products. When the product is completed, the raw materials are typically unrecognizable from their original form, such as oil used to create shampoo.

2. **Components:**
   Components are similar to raw materials in that they are the materials a company uses to create and finish products, except that they remain recognizable when the product is completed, such as a screw.

3. **Work In Progress (WIP):**
   WIP inventory refers to items in production and includes raw materials or components, labor, overhead and even packing materials.

4. **Finished Goods:**
   Finished goods are items that are ready to sell.

5. **Maintenance, Repair and Operations (MRO) Goods:**
   MRO is inventory — often in the form of supplies — that supports making a product or the maintenance of a business.

6. **Packing and Packaging Materials:**
   There are three types of packing materials. Primary packing protects the product and makes it usable. Secondary packing is the packaging of the finished good and can include labels or SKU information. Tertiary packing is bulk packaging for transport.

7. **Safety Stock and Anticipation Stock:**
   Safety stock is the extra inventory a company buys and stores to cover unexpected events. Safety stock has carrying costs, but it supports customer satisfaction. Similarly, anticipation stock comprises of raw materials or finished items that a business purchases based on sales and production trends. If a raw material's price is rising or peak sales time is approaching, a business may purchase safety stock.

8. **Decoupling Inventory:**
   Decoupling inventory is the term used for extra items or WIP kept at each production line station to prevent work stoppages. Whereas all companies may have safety stock, decoupling inventory is useful if parts of the line work at different speeds and only applies to companies that manufacture goods.

9. **Cycle Inventory:**
   Companies order cycle inventory in lots to get the right amount of stock for the lowest storage cost. Learn more about cycle inventory formulas in the "Essential Guide to Inventory Planning."

10. **Service Inventory:**
    Service inventory is a management accounting concept that refers to how much service a business can provide in a given period. A hotel with 10 rooms, for example, has a service inventory of 70 one-night stays in a given week.

11. **Transit Inventory:**
    Also known as pipeline inventory, transit inventory is stock that's moving between the manufacturer, warehouses and distribution centres. Transit inventory may take weeks to move between facilities.

12. **Theoretical Inventory:**
    Also called book inventory, theoretical inventory is the least amount of stock a company needs to complete a process without waiting. Theoretical inventory is used mostly in production and the food industry. It's measured using the actual versus theoretical formula.

13. **Excess Inventory:**
    Also known as obsolete inventory, excess inventory is unsold or unused goods or raw materials that a company doesn't expect to use or sell, but must still pay to store.

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3.19 INVENTORY COSTS AND LEVELS

Inventory carrying cost, or carrying costs, is an accounting term that identifies all business expenses related to holding and storing unsold goods. The total figure would include the related costs of warehousing, salaries, transportation and handling, taxes, and insurance as well as depreciation, shrinkage, and opportunity costs. Total carrying costs are often shown as a percentage of a business' total inventory in a particular time period. The figure is used by businesses to determine how much income can be earned based on current inventory levels. It also helps a business determine if there is a need to produce more or less to maintain a favourable income stream.

3 categories of inventory costs

1. **Ordering costs**
   Every time your company purchases from a supplier, you'll have to consider the relevant ordering costs; even if the order in question is fairly small, there will always be ordering costs involved. To estimate how much an order is going to cost, you'll need to track purchase requisition, purchase orders and invoicing, labour costs, as well as fees for transportation and processing. While some of these costs will be relatively insignificant — like preparing invoices, for example — others, like purchase orders, will run much higher.
2. **Carrying costs**
   Inventory carrying costs (also referred to as 'inventory holding costs') are those fees a business pays for keeping its inventory items in stock. Carrying costs can be quite varied, in fact, and include anything from taxes and insurance, to employee costs and the price for replacing perishable goods. Having an accurate view of your carrying costs is critical in knowing how much profit your current inventory can make. Fortunately, businesses can reduce these costs by utilizing an efficient warehousing layout and leveraging innovative inventory management.
3. **Stockout costs**
   Stockout costs represent any lost (potential) sales from not having enough of a product — that is, the lost income and expense due to an inventory shortage. For instance, this can happen if a customer orders the last unit of a SKU you have in stock, but that item turns out to be defective. Since you can't ship a defective product (and you don't have available inventory to fulfil the order), it will be counted as a loss. Alternatively, stockout costs can occur if a customer sees the product they want is out of stock on your website, so they end up purchasing it elsewhere.

7 types of inventory costs to track

1. **Storage space costs**
   Storage space costs cover recurring payments like rent, security, lighting, heating, upkeep, and other utility fees. In addition, they also include the wages for your security workers and janitors (i.e., the labour needed to uphold a clean, safe, and organized inventory storage facility). Although these costs have a tendency to add up pretty quickly, they're still a necessity considering it's impossible to maintain an inventory if you have nowhere to store it.

2. **Handling costs**
   Handling costs assist with safe inventory handling at your warehouse; they're the tools and labour costs of employees who move stock from one location to another within your space. Common handling costs include material handling equipment, forklift truck drivers, and the people who manage your products. Even so, handling costs don't just include wages — they also extend to any taxes applied by your government, employee benefits, and extra duty hours.

3. **Working capital and capital costs**
   More often than not, capital costs are the highest carrying costs you'll have to deal with. Capital costs involve the one-time fees required to physically carry and house inventory, such as purchasing land, building, and equipment. However, they're also linked to any interests on your working capital, as well as the opportunity costs of all the money invested in your stock. You can figure capital costs for yourself by calculating the weighted average cost of capital (WACC).

4. **Taxes and insurance**
   Taxes and insurance always seem to present a challenge, and its likely business owners don't look forward to dealing with these aspects of their company. Still, retailers need to take these costs seriously, as there can be huge implications for your brand if you don't. Since we can't share any legal advice, you're encouraged to consult on these issues with a business lawyer who's familiar with your particular state (and your industry) who can offer more direction.

5. **Obsolescence**
   Obsolescence is an inventory risk cost that's related to the items in your inventory you can't shift, or might deteriorate before they sell (think flowers and foodstuffs). In truth, obsolescence can be rather pricey, because you're effectively leaving cash on the shelf. Products might sit in your inventory for months, causing you to accumulate carrying costs without ever making a profit. Small businesses often incur obsolescence costs, though many of these can be avoided.

6. **Investment**
   At its core, inventory is an investment. But for companies who haven't yet worked out an inventory management strategy, it can be a costly investment at that. Because every brand has a finite amount of money at their disposal, it's imperative to use caution as you spend it. When you're careful with how you invest, you'll have a better chance of striking the right balance with your resources, so make sure to work out a solid budget you can stick to.

7. **Criminal activity**
   If you fail to implement proper inventory controls, you're essentially leaving your inventory open to criminal activity, which can be incredibly costly. While theft might be the most obvious criminal activity to try and prevent, fraud and dishonest employees can pose a serious threat, as well. That's why it's so important to stay on top of when, where, and how your losses are happening, in an effort to protect your inventory and serve your customers well.

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Inventory levels

Inventory level control is referred to as controlling the threshold of inventory to avoid delay in production. It's the level of inventory that should be available within the warehouse all the time. An important concept of inventory level controls is to create a balance between capital tied up in the inventory and the availability of the inventory all the time for production. Adequate management of the inventory level helps to ensure that excess working capital is not tied in the working capital and inventory is available for production all the time. The concept of inventory level control starts with the question that how much should be the threshold of inventory to meet expected/unexpected demands of the production/sales. The answer to this question is dependent on the nature of the business, stock management policies, resources of the business, lead time of the inventory, cost of ordering and the cost of holding, etc.

The concept of inventory control applies to all types of inventories that include raw material, finished goods, and spare parts, etc. Normally, the businesses have two sides of stock management which include maintaining little or no inventory and holding higher stock.

Maintaining low/no inventory

Advantages

- The maintenance of the low inventory requires a lower cost of holding.
- It's a flexible approach to stock management and helps you to avoid the hustle of huge inventory management.
- There is a lower/no risk of inventory obsolescence.
- The cost of safety and holding of the goods is lower.
- The working capital tied up in inventory is lower that helps to increase profitability.
- The approach is the most suitable if the inventory is perishable and lead time short.

Disadvantages

- The cost of going out of stock can cost not only profit but the goodwill of the business and loss of customers.
- A little setback in the process can affect the entire chain of the business.
- If the supplier fails to deliver, it's the business that suffers.
- If the cost of ordering is higher, it may impair the profitability of the business.
- If the lead time is higher, it may further deteriorate the production efficiency.

Holding higher stock

Holding higher stock has the following advantages and disadvantages.

Advantages

- Holding higher stock gives an inner peace of the mind that sufficient stock is backed for production.

- It gives economies of the scale as business intends to accumulate higher level of stock. So, they can purchase more.
- The ordering cost of the inventory is lower as more stock is received in one order.
- It's a smart idea to order bulk quantity in times of inflation as the cost of goods in future order is expected to rise.

Disadvantages

- Holding cost is higher considering the volume of the stock.
- More money is tied up in the management of the inventory.
- The cost of security is higher.
- The risk of obsolete inventory is higher.

Methods for inventory level control

The concept of inventory level decision helps to bring a balance in high/low level of inventory considering advantages and disadvantages discussed above. The well-known methods to control the volume of inventory include minimum stock level, stock review, and JIT.

1. **Minimum stock level**
   The minimum stock level is when the business identifies the minimum quantity of the goods to be maintained in the warehouse. Once the level of the stock reaches a set threshold, the order is placed to the supplier.
2. **Regular stock review**
   The business managers make quantity reviews on a regular interval and calculate differential quantity to reach the predetermined level. The differential quantity is ordered to the supplier.
3. **Just in time**
   The just in time is a system of inventory management that believes in zero inventory. The business does not maintain inventory in the warehouse while an order is made and received on the demand. The business does not need a warehouse as they do not need to maintain the inventory level.

   The JIT approach works the best when the premises of the business and suppliers are in the vicinity. There should be no lead time required to transport the inventory from the supplier to the business.

   For instance, the clothing manufacturing business gets supplies of the thread from the factory adjacent to production premises and does not need to store the threads in their warehouse. The success of the JIT approach depends on the mutual understanding between the business and supplier.
4. **Economic order quantity – EOQ**
   If it's not suitable for the business to follow JIT and they decide to rely on the traditional method of minimum level stock and stock regular review, the business needs to decide what should be the quantity of the order. EOQ is the method of

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inventory management that uses a certain formula to calculate the threshold where inventory should be ordered.

It takes into account the annual volume of demand/consumption, cost of ordering, and the cost of holding, etc. The formula makes use of the mathematical concepts that keep the cost of ordering and holding minimum while meeting the demands for the product.

3.20 METHODS OF INVENTORY VALUATION AND ISSUES

The three most widely used methods for inventory valuation are First-In, First-Out (FIFO) Last-In, First-Out (LIFO) Weighted Average Cost. Inventory valuation method is the way to calculate the total value of the inventory owned by a company at any particular time. The inventory value is calculated based on the total cost incurred in purchasing the inventory and getting it ready for sale in the market. This is important in accounting where the valuation of any item plays a part in calculating Cost of Goods Sold and has a direct effect on the income statement & balance sheet.

How Inventory Is Valued

The three most widely used methods for inventory valuation in accounting are:

- First-In, First-Out (FIFO)
- Last-In, First-Out (LIFO)
- Weighted Average Cost

First-In, First-Out (FIFO)

According to the first-in-first-out (FIFO) valuation method, the inventory items are sold in the same order in which they are purchased or manufactured. The oldest inventory products are sold first as per the FIFO method. The FIFO valuation method is the most commonly used inventory valuation method as most of the companies sell their products in the same order in which they purchase it.

FIFO Valuation: Example

Let's say a business bought Laptops at different timing and prices.

First transaction- Ten laptops at Rs. 1,000 each

Second transaction- Five laptops at Rs. 1,100 each

At the end of the month, the store had sold eight laptops.

With the FIFO valuation method, costing is calculated from the first transaction when the user purchased ten laptops at Rs. 1,000 each.

So, after selling eight laptops:

Accounting balance for COGS = (8 laptops x Rs. 1,000 each) = Rs. 8,000

Two laptops are still left from the first purchase, cost at Rs. 1000 each, as well as the five laptops from the second purchase at Rs. 1,100 each. So:

Accounting balance of Inventory account = (2 laptops x Rs. 1,000 cost) + (5 laptops at Rs. 1,100 cost) = Rs. 7,500

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Last-In, First-Out (LIFO)

The last-in-first-out (LIFO) inventory valuation method is precisely the opposite of the FIFO valuation method. It assumes that the most recently purchased or manufactured items are sold first.

LIFO Valuation: Example

Let's say a business bought laptops at different timing and prices.

First transaction- Ten laptops at Rs. 1,000 each

Second transaction- Five laptops at Rs. 1,100 each

After selling 2 laptops:

Accounting balance for COGS = (2 laptops x Rs. 1,100 LIFO cost) = Rs. 2,200

Ten laptops are still left from the first purchase, cost at Rs. 1,000 each, as well as the three laptops from the second purchase at Rs. 1,100 each. So:

Accounting balance of Inventory account = (3 laptops at Rs. 1,100 cost) + (10 laptops at Rs. 1,000 cost) = Rs. 13,300

Weighted Average Cost (or Avg Cost)

With the Weighted Average Cost inventory valuation method, inventory, and Cost of Goods Sold (COGS) are calculated based on the average cost of all items purchased during a period. This method is mainly used by businesses that don't have variation in their inventory.

Weighted Avg Cost Valuation: Example

Let's say a business bought Laptops at different timing and prices.

First transaction- Ten laptops at Rs. 1,000 each

Second transaction- Five laptops at Rs. 1,100 each

Here you have a total of 15 laptops, which you paid Rs. 15,500 for in total (10,000 + 5,500)

So, your weighted average cost would be the Rs. 15,500 cost divided by the 15 laptops, which is 1,033.33 per laptop.

After selling 13 laptops:

Accounting balance for COGS = (13 laptops x Rs. 1,033.33 average cost) = Rs. 13,433.33

Accounting balance of Inventory account = (2 laptops remaining x Rs. 1,033.33 average cost) = Rs. 2,066.67

In the above examples, we saw how the FIFO, LIFO and Weighted Avg Cost methods impact the accounting balances of COGS and Inventory accounts. Consequently, it impacts the income statement which uses the COGS account as an input, and the balance sheet which uses the Inventory account as an input.

3.21 ECONOMIC ORDER QUANTITY (EOQ)

Economic order quantity (EOQ) is the ideal order quantity a company should purchase

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to minimize inventory costs such as holding costs, shortage costs, and order costs. This production-scheduling model was developed in 1913 by Ford W. Harris and has been refined over time. The formula assumes that demand, ordering, and holding costs all remain constant.

Formula for Calculating Economic Order Quantity (EOQ)

The formula for EOQ is:

where:

$$Q = \sqrt{\frac{2DS}{H}}$$

Q=EOQ units

D=Demand in units (typically on an annual basis)

S=Order cost (per purchase order)

H=Holding costs (per unit, per year)

Economic Order Quantity (EOQ) Explained

Economic order quantity is a useful metric for businesses that buy and hold inventory for manufacturing, resale, internal use or any other purpose. Businesses that follow EOQ look at all costs related to purchasing and delivery while also factoring in demand for the product, purchase discounts and holding costs.

Experienced business owners and managers understand that purchasing and finding the ideal inventory levels can be complex. When your vendors offer volume discounts and other incentives to purchase more, EOQ can help you decide on the right place to draw the line.

EOQ relies on the economic order quantity formula (found below). That gives you a data-driven result to help optimize business profitability.

Why Is Economic Order Quantity (EOQ) Important?

Economic order quantity is a key metric for your organization's sustainability because ordering too much can lead to high holding costs and take resources away from other business activities, like marketing or R&D, that could further boost sales or reduce costs.

Inventory is a type of working capital. Working capital represents business assets needed for regular operations. But too much working capital can eat into your profits, and it also represents a big opportunity cost.

EOQ may not be extremely helpful when managing your office supply closet. It's most important when looking at large, high volume or expensive purchases. As your orders and inventory grow and scale, EOQ has a greater impact on profits.

VENDOR RELATIONS AND PURCHASE MANAGEMENT, MANAGEMENT OF INVENTORY

What Does Economic Order Quantity (EOQ) Tell Businesses?

Economic order quantity tells businesses the ideal order size for every product they buy. The EOQ formula assumes annual demand for a product is relatively flat. If you are in

a growing business, EOQ may not be the best way to calculate your order size, as those numbers could change frequently.

Once you work through EOQ, you should know the optimal number of orders per year and the ideal order size. You may adapt the EOQ model to factor in pricing discounts, backorders, defective items and more.

With your EOQ results, you should have an optimal supply chain order schedule for the entire year.

Benefits of Economic Order Quantity (EOQ)

The main benefit of using EOQ is improved profitability. Here's a list of benefits that all add up to savings and improvements for your business:

- **Improved Order Fulfilment:** When you need a certain item or something for a customer order, optimal EOQ ensures the product is on hand, allowing you to get the order out on time and keep the customer happy. This should improve the customer experience and may lead to increased sales.
- **Less Overordering:** An accurate forecast of what you need and when will help you avoid overordering and tying up too much cash in inventory.
- **Less Waste:** More optimized order schedules should cut down on obsolete inventory, particularly for businesses that hold perishable inventories that can result in dead stock.
- **Lower Storage Costs:** When your ordering matches your demand, you should have less products to store. This can lower real estate, utility, security, insurance and other related costs.
- **Quantity Discounts:** Planning and timing your orders well allows you to take advantage of the best bulk order or quantity discounts offered by your vendors.
- Challenges of Economic Order Quantity (EOQ)

While many businesses want to use EOQ to determine order sizes, it isn't always easy to achieve. When determining EOQ, you may run into these challenges:

- **Poor Data:** One of the biggest challenges of determining EOQ is access to accurate and reliable data. Manual or spreadsheet-driven systems may provide low-quality or outdated information, which can lead to inaccurate calculations.
- **Outdated Systems:** Old and outdated systems may have incomplete data and lead to missing out on potential savings. An inventory management system or cloud-based ERP can solve this problem.
- **Business Growth:** The EOQ formula is ideal for businesses with consistent inventory needs. With a fast-growing business, relying on EOQ can lead to inventory shortages.
- **Inventory Shortages:** If you're just starting to use this method, it often generates smaller orders. If you are too conservative with your calculations, you could wind up under-ordering.

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- **Seasonal Needs:** Seasonality can make EOQ more challenging, but not impossible. This is because there could be major changes in customer demand throughout the year.

Calculating Economic Order Quantity (EOQ)

Calculating economic order quantity requires high school-level algebra. Once you get the variables from your inventory management system, it's easy to plug in the numbers and calculate EOQ. When you use a robust ERP, these calculations may all be handled for you, including order costs like inventory ordering costs, holding costs and stock out costs.

Limitations of EOQ

The EOQ formula assumes that consumer demand is constant. The calculation also assumes that both ordering and holding costs remain constant. This fact makes it difficult or impossible for the formula to account for business events such as changing consumer demand, seasonal changes in inventory costs, lost sales revenue due to inventory shortages, or purchase discounts a company might realize for buying inventory in larger quantities.

EOQ and discount offers

EOQ generally minimizes the total inventory cost. However, EOQ may not be optimal when discounts are factored into the calculation. The optimal order quantity when discounts are involved is either:

- EOQ; or
- Any one of the minimum order quantities above EOQ that qualify for additional discount.

The optimum quantity is determined by comparing the total inventory cost of the different order quantities listed above.

For example, if the EOQ is 1000 units and discounts of 2%, 5% and 8% are offered at 500 units, 1000 units and 2000 units, the order quantity that shall lead to the lowest total inventory cost will either be the EOQ (i.e., 1000 units) or 2000 units. In order to determine the optimum quantity, we need to compare the total inventory cost of order quantities of 1000 units and 2000 units. We can ignore the total inventory cost of 500 units as it is below the EOQ level.

Example

BIKO is a bike retailer located in the outskirts of Paris. BIKO purchases bikes from PMX in orders of 250 bikes which is the current economic order quantity. PMX is now offering the following bulk discounts to its customers:

- 2% discount on orders above 200 units
- 4% discount on orders above 500 units
- 6% discount on orders above 600 units

BIKO is wondering if the EOQ model is still the most economical and whether increasing the order size would actually be more beneficial. Following information is relevant to forming the decision:

- Annual demand is 5000 units
- Ordering cost is Rs. 100 per order
- Annual holding cost is comprised of the following:
- 5% insurance premium for the average inventory held during the year calculated using the net purchase price
- Warehousing cost of Rs. 6 per unit
- Purchase price is Rs. 200 per unit before discount

Solution

We need to compare the total inventory cost of the order quantities at the various discount levels with that of the economic order quantity.

Since the holding cost is partially determined on the basis of purchase price, we need to re-calculate the EOQ by applying a discount. As the EOQ seems likely to fall within the 200 to 400 units range, we should use 2% discount in our calculation.

EOQ = √(2 x 100 (Order Cost) x 5000 (Annual Demand)) / (0.05x(200×0.98) + 6 (Holding Cost))

≈ 252 units

Order Quantity	252 units	500 units	1,000 units
Number of orders (Annual demand ÷ Order Quantity)	5,000 ÷ 252 = 19.84	5000 ÷ 500 = 10	5,000 ÷ 1,000 = 5
Ordering Cost (number of orders × Rs. 100)	19.84 x 100 = Rs. 1,984	10 x 100 = Rs. 1,000	5 x 100 = Rs. 500
Warehousing Cost (Rs. 6 × Average number of units)	6 × 252/2 = Rs. 756	6 × 500/2 = Rs. 1,500	6 × 1000/2 = Rs. 3,000
Insurance Cost (5% × Purchase Price × Average Inventory)	0.05 × (200×0.98) × (252/2) = Rs. 1,235	0.05 × (200×0.96) × (500/2) = Rs. 2,400	Rs. 0.05 × (200×0.94) × (1000/2) = Rs. 4,700
Cost of Purchase (Purchase Price × Annual Demand × (100 - discount%)	200 × 5000 × (1.0-0.02) = Rs. 980,000	200 × 5000 × (1.0-0.04) = Rs. 960,000	200 × 5000 × (1.0-0.06) = Rs. 940,000
Total Inventory Cost	Rs. 983,975	Rs. 964,900	Rs. 948,200

Based on the above analysis, the optimum order quantity is 1000 units.

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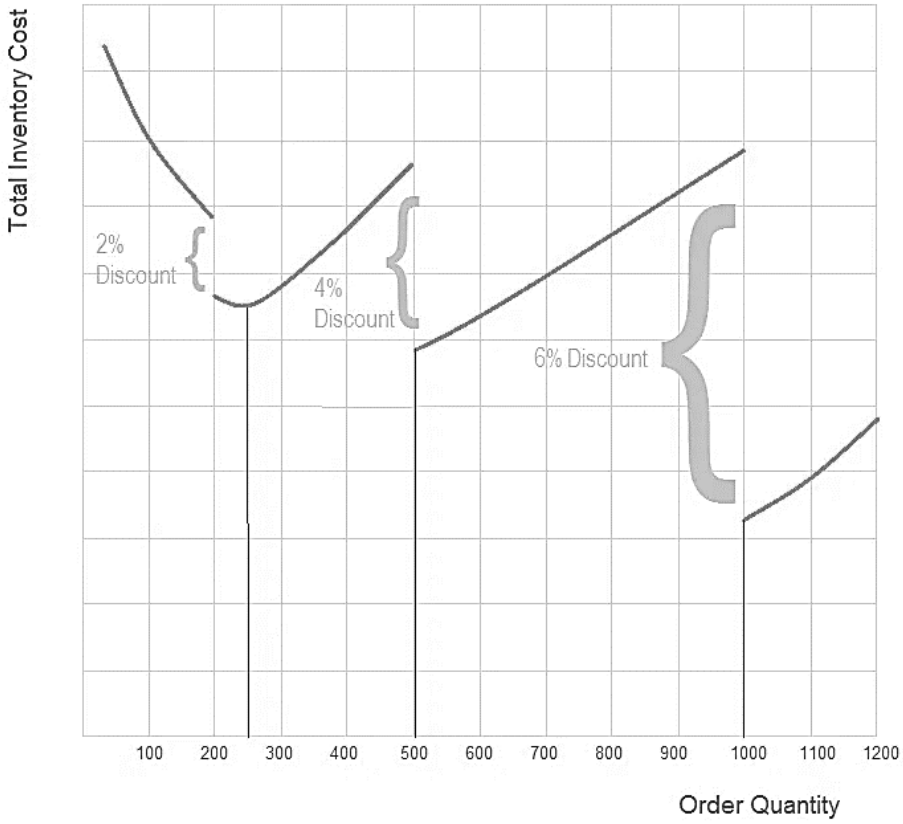
Note:

You may be wondering whether increasing the order size from 1000 units will result in more savings. The short answer is no. The behaviour of inventory cost can be illustrated in the following graph.



There is a pattern of stepped decrease in total inventory cost after every discount slab is reached followed by gradual increase in the cost. As noted earlier, whenever discounts are offered, the optimum order quantity will be either the EOQ or one of the minimum discount quantities above the EOQ level (i.e., 252 units, 500 units or 1000 units in the example above). Any quantity above or below these quantities will result in an increase in the total inventory cost and should therefore be ignored.

3.22 INVENTORY TURNOVER ANALYSIS

Inventory turnover refers to the amount of time that passes from the day an item is purchased by a company until it is sold. One complete turnover of inventory means the company sold the stock that it purchased, less any items lost to damage or shrinkage. Successful companies usually have several inventory turnovers per year, but it varies by industry and product category. For example, consumer packaged goods (CPG) usually have high turnover, while very high-end luxury goods, such as luxury handbags, typically see few units sold per year and long production times. A number of inventory management challenges can affect turnover; they include changing customer demand, poor supply chain planning and overstocking.

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What Is Inventory Turnover Ratio?

The inventory turnover ratio is the number of times a company has sold and replenished its inventory over a specific amount of time. The formula can also be used to calculate the number of days it will take to sell the inventory on hand.

The turnover ratio is derived from a mathematical calculation, where the cost of goods sold is divided by the average inventory for the same period. A higher ratio is more desirable than a low one as a high ratio tends to point to strong sales.

Knowing your turnover ratio depends on effective inventory control, also known as stock control, where the company has good insight into what it has on hand.

Inventory Turnover Ratio Explained

Calculating and tracking inventory turnover helps businesses make smarter decisions in a variety of areas, including pricing, manufacturing, marketing, purchasing and warehouse management.

Ultimately, the inventory turnover ratio measures how well the company generates sales from its stock. number of KPIs that can provide insights into how to increase sales or improve the marketability of certain stock or the overall inventory mix.

How Inventory Turnover Ratio Works

Average inventory is typically used to even out spikes and dips from outlier changes represented in one segment of time, such as a day or month. Average inventory thus renders a more stable and reliable measure.

For example, in the case of seasonal sales, inventories of certain items—like patio furniture or artificial trees—are pushed abnormally high just ahead of the season and are seriously depleted at the end of it. However, turnover ratio may also be calculated using ending inventory numbers for the same period that the cost of goods sold (COGS) number is taken.

Lastly, the formula can also be used to calculate how much time it will take to sell all the inventory currently on hand. Days sales of inventory (DSI) it is calculated like this for a daily context:

(Average inventory / cost of goods sold) x 365

How Do You Calculate Inventory Turnover Ratio (ITR)?

Companies can calculate inventory turnover This standard method includes either market sales information or the cost of goods sold (COGS) divided by the inventory.

Start by calculating the average inventory in a period by dividing the sum of the beginning and ending inventory by two:

Average inventory = (beginning inventory + ending inventory) / 2

You can use ending stock in place of average inventory if the business does not have seasonal fluctuations. More data points are better, though, so divide the monthly inventory by 12 and use the annual average inventory. Then apply the formula for inventory turnover:

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Inventory Turnover Ratio = Cost of Goods Sold / Avg. Inventory

Inventory Turnover Formula and Calculations

Whatever inventory turnover formula works best for your company, you will need to draw data from the balance sheet, so it's important to understand what these terms and numbers represent.

Cost of Goods Sold (COGS)

Cost of goods sold, aka COGS, is the direct costs of producing goods (including raw materials) to be sold by the company.

Average Inventory (AI)

Average inventory smooths out the amount of inventory on hand over two or more specified time periods.

Beginning Inventory + ending inventory / number of months in the accounting period

Inventory Turnover Ratio

The inventory turnover ratio is a measure of how many times the inventory is sold and replaced over a given period.

Inventory Turnover Ratio = Cost of Goods Sold / Avg. Inventory

Inventory Turnover Ratio Examples

Cherry Woods Furniture is a specialized supplier of high-end, handmade dining sets made from specialty woods. Over Q3, its busiest period, the retailer posted Rs. 47,000 in COGS and Rs. 16,000 in average inventory. To find the inventory turnover ratio, we divide Rs. 47,000 by Rs. 16,000. The inventory turnover is 3.

In the second example, we'll use the same company and the same scenario as above, but this time compute the average inventory period—meaning how long it will take to sell the inventory currently on hand. We already know the inventory turnover ratio is 3. To calculate how many days, it will take to sell the inventory on hand at the current rate, divide 365 days in the year by 3, which equals 121.67 days.

Why Do Inventory Turns Matter?

Inventory turns matter for several reasons. A slow turn can indicate decreased market demand for certain items, which can help a company decide to change pricing, offer incentives to deplete inventory faster or change the mix of goods offered for sale in the future. These are all important decisions—for a company to remain financially healthy and competitive, it needs to keep its product mix aligned with customer demand. A fast turn may indicate that a company's purchasing strategy is not keeping pace with market demand, that it's experiencing delays somewhere in the supply chain or that a particular item is seeing a surge in demand. This information can help a company decide whether to raise prices, increase its orders, diversify suppliers, feature a product prominently in its marketing or buy additional related inventory. Material requirements planning, or MRP, is a related process to understand inventory requirements while balancing supply and demand.

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3.23 SELECTIVE INVENTORY CONTROL

Devising an efficient system of counting and maintaining a stock of inventory items has long been a difficult task for many retail managers. It is said that excess of high inventory isn't a good sign because there is a cost associated with storing of the extra inventory. Similarly, on the other side it is believed that shortage of inventory is the root cause of all retail disputes.

Selective Inventory Management (SIM):

Therefore, to ensure optimum level of inventory, several classifications are employed to render selective treatment to different types of retail goods/items each classification emphasize on a particular aspect. The right choice of a method depends upon several factors like price of the item, criticality, consumption, lead time, procurement difficulties, etc.

Such application of varying levels of control to the total inventory enables retail managers to concentrate on significant matters only. For example, ABC analysis lays emphasis on usage value (consumption of the items in terms of price), VED analysis considers criticality; FSN analysis is based on demand for the items and their stock moving pattern; and HML analysis employs price criterion. Such classification helps the retail managers in controlling the inventory more systematically and scientifically.

These are discussed as follows:

Economic Order Quantity (EOQ) Model:

The primary function of inventory management is to determine

a. When to order? and
b. How much to order?

When to order?

This problem of inventory control deals with the issue of point of time when the order for fresh inventory is given. The problem of 'When to Order' is solved by fixing the appropriate re-order levels of each type of inventory. It is determined by compromising the cost of maintaining these stocks and the disservice to the customer if his orders are not delivered in time.

Re-order level:

'When to order' is an important query which requires suitable answer. Buying and issuing the inventories are the foremost tasks of all types of organizations. When the inventories fall below a particular level as decided in advance, they are refilled with fresh procurement. But what should be the quantity for fresh stock is always an alarming question requires suitable answer. In short, the re-order level is that level of inventory at which the order for additional stock should be placed.

Re-order level = Average usage x Lead time

i.e., $R = A_u L$

Re-order point example:

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Demand = 10000 units/year

Store open = 320 days/year

Average usage (A_u) = 10000/320=33.33 units/day

Lead time (L) = 10 days

R = A_u L = (33.33) (10) = 333.33 units

3.24 ABC ANALYSIS

ABC method of inventory control involves a system that controls inventory and is used for materials and throughout the distribution management. It is also known as selective inventory control or SIC. ABC analysis is a method in which inventory is divided into three categories, i.e. A, B, and C in descending value. The items in the A category have the highest value, B category items are of lower value than A, and C category items have the lowest value. Inventory control and management are critical for a business. They help to keep their costs under control. The ABC analysis helps the business to control inventory by letting the management focus on the highest value goods (the A-items) and not on the many low-value goods (the C-items).

ABC Method of Inventory Control

It has become an indispensable part of a business and the ABC analysis is widely used for unfinished good, manufactured products, spare parts, components, finished items and assembly items. Under this method, the management divides the items into three categories A, B and C; where A is the most important item and C the least valuable.

ABC inventory analysis is based on the Pareto Principle. The Pareto Principle states that 80% of the sales volume are generated from the top 20% of the items. It means that the top 20% of the items will generate 80% of the revenue for the business. It is also known as the 80/20 rule.

This method is significant to identify the top category of inventory items that generate a high percentage of yearly consumption. It helps the managers to optimize the inventory levels and achieve efficient use of stock management resources.

Need for Prioritizing Inventory

Item A:

In the ABC model of inventory control, items categorized under A are goods that register the highest value in terms of annual consumption. It is interesting to note that the top 70 to 80 percent of the yearly consumption value of the company comes from only about 10 to 20 percent of the total inventory items. Hence, it is crucial to prioritize these items.

Item B:

These are items that have a medium consumption value. These amount to about 30 percent of the total inventory in a company which accounts for about 15 to 20 percent of annual consumption value.

Item C:

The items placed in this category have the lowest consumption value and account for less

than 5 percent of the annual consumption value that comes from about 50 percent of the total inventory items.

Note: The annual consumption value is calculated by the formula: (Annual demand) × (item cost per unit)

Policies Governing the ABC Method of Inventory Management

The idea behind using the ABC analysis is to leverage the imbalances of sales. This means that each item must be given the appropriate amount of weight depending on their class:

Item A:

a. These are subjected to strict inventory control and are given highly secured areas in terms of storage

b. These goods have a better forecast for sales

c. These are also the items that require frequent reorders on a daily or a weekly basis

d. They are kept as a priority item and efforts are made to avoid unavailability or stock-out of these items

Item B:

a. These items are not as important as items under section A or as trivial as items categorized under C

b. The important thing to note is that since these items lie in between A and C, they are monitored for potential inclusion towards category A or in a contrary situation towards category C

Item C:

a. These items are manufactured less often and follow the policy of having only one of its items on hand or in some cases they are reordered when a purchase is actually made

b. Since these are low demand goods with a comparatively higher risk of cost in terms of excessive inventory, it is an ideal situation for these items to stock-out after each purchase

c. The questions managers find themselves dealing with when it comes to items in category C is not how many units to keep in stock but rather whether it is even needed to have to these items in store at all.

Uses of ABC Analysis

The ABC analysis is widely used in supply chain management and stock checking and inventory system and is implemented as a cycle counting system. It is most important for companies that seek to bring down their working capital and carrying costs. This done by analysing the inventory that is in excess stock and those that are obsolete by making way for items that are readily sold. This helps avoid keeping the working capital available for use rather than keeping it tied up in unhealthy inventory.

When a company is better able to check its stock and maintain control over the high-value goods it helps them to keep track of the value of the assets that are being held at a time.

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It also brings order to the reordering process and ensures that those items are in stock to meet the demands.

The items that fall under the C category are those that slow-moving and need not be re-ordered with the same frequency as item A or item B. When you put the goods into these three categories, it is helpful for both the wholesalers and the distributors to identify the items that need to be stocked and those that can be replaced.

For Example- 'H&M' manufactures 80% of its retail inventory in advance and introduces the remaining 20% based on the most current market trends.

Similarly, 'Amazon' does not keep stock of every single item offered on its website. The stocks of only the popular items that are frequently purchased are maintained. If there is an order for an unpopular item, then Amazon would request it from its distributor, who would then ship it to the company.

Advantages of Implementing the ABC Method of Inventory Control

- This method helps businesses to maintain control over the costly items which have large amounts of capital invested in them.
- It provides a method to the madness of keeping track of all the inventory. Not only does it reduce unnecessary staff expenses but more importantly it ensures optimum levels of stock is maintained at all times.
- The ABC method makes sure that the stock turnover ratio is maintained at a comparatively higher level through a systematic control of inventories.
- The storage expenses are cut down considerably with this tool.
- There is provision to have enough C category stocks to be maintained without compromising on the more important items.

Disadvantages of using the ABC Analysis

- For this method to work and render successful results, there must be proper standardization in place for materials in the store.
- It requires a good system of coding of materials already in operation for this analysis to work.
- Since this analysis takes into consideration the monetary value of the items, it ignores other factors that may be more important for your business. Hence, this distinction is vital.

The ABC model works in a manner as to get prime attention to the important items or the critical few and not have unnecessary attention be spent on the not so important items or the trivial many. Each category has a differing management control in place. This prioritization of attention and focus is vital to keep the costs in check and under control in the supply chain system. To get the best results it is important that items that involve a lot of costs are given the due management attention.

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3.25 CHAPTER SUMMARY

As the growing popularity of just in time and supply chain management, the supplier seems to be more significant role for manufacturing to achieve their customer satisfaction in terms of quality, delivery and business point of view. The smooth running of production line could be interrupted by the poor quality of material. The schedule to delivery will be affected by both poor qualities of material and poor delivery performance. Also, the manufacturing will get less profit if they select the non-reasonable price of material, as of the material is the cost of manufacturers. In order to achieve the Quality Manufacturing Excellence (QME), the Vendor Management System (VMS) is the one most important factor of success. The vendor/ supplier is the partnership that concerned to manufacturer not only the quality but also other business issues.

Ethics in procurement management is important, particularly because of your relationship with suppliers and vendors, typically to finish a job or a project. There can be many ethical issues in procurement management that arise, but one of them is always dealing with your vendors and suppliers fairly and honestly, and never giving one preference over the other or treating them in an Image of a scale for an article about ethics in procurement management. biased fashion. Inventory carrying cost, or carrying costs, is an accounting term that identifies all business expenses related to holding and storing unsold goods. The total figure would include the related costs of warehousing, salaries, transportation and handling, taxes, and insurance as well as depreciation, shrinkage, and opportunity costs. Total carrying costs are often shown as a percentage of a business' total inventory in a particular time period.

Inventory turnover refers to the amount of time that passes from the day an item is purchased by a company until it is sold. One complete turnover of inventory means the company sold the stock that it purchased, less any items lost to damage or shrinkage. Successful companies usually have several inventory turnovers per year, but it varies by industry and product category. For example, consumer packaged goods (CPG) usually have high turnover, while very high-end luxury goods, such as luxury handbags, typically see few units sold per year and long production times. Devising an efficient system of counting and maintaining a stock of inventory items has long been a difficult task for many retail managers. It is said that excess of high inventory isn't a good sign because there is a cost associated with storing of the extra inventory. Similarly, on the other side it is believed that shortage of inventory is the root cause of all retail disputes.

3.26 REVIEW QUESTIONS

SHORT ANSWER TYPE QUESTIONS

1. **Define the different types of procurement in brief.**
2. **How does the make or buy decision work?**
3. **What is Vendor Relationship Management (VRM)? State its benefits in brief.**
4. **Explain advantages of ABC method of inventory control.**
5. **What is ABC Method of Inventory Control?**

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LONG ANSWER TYPE QUESTIONS

1. **What Is the Difference Between Procurement, Purchasing, and Supply Chain? Explain in detail.**
2. **What exactly is a purchase order? How do purchase order's function?**
3. **Write a brief note on Selective Inventory Management (SIM).**
4. **Explain economic order quantity (EOQ) in brief and also explain its benefits.**
5. **Explain inventory levels with their advantages and disadvantages of levels.**

3.27 MULTIPLE CHOICE QUESTIONS

1. **_____is the function of checking items delivered to the business, either coming in as new stock or as supplies.**
   a. Goods Receiving
   b. Supply Chain
   c. Procurement
   d. Inventory
2. **_____is responsible for overseeing all the processes involved in acquiring the products, materials, goods and services needed for efficient business operations.**
   a. Logistics Management
   b. Procurement management
   c. Inventory
   d. Supply Chain Operation
3. **_____ initial steps in which the business identifies its needs, creates a purchase request and assesses vendors.**
   a. Purchasing Stage
   b. Payment Stage
   c. Sourcing Stage
   d. Supply Chain
4. **_____refers to obtaining anything that's required to produce an end-product.**
   a. Indirect Procurement
   b. Goods Procurement
   c. Servicing Procurement
   d. Direct Procurement
5. **_____are documents sent from a buyer to a supplier with a request for an order.**
   a. Purchase Orders
   b. Direct Procurement
   c. Supply Chain
   d. Logistic Management

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6. FIFO is a _____.

a. ABC method
b. One of the inventory methods
c. Economic Order Quantity
d. None of the above

7. _____ inventory turnover helps businesses make smarter decisions.

a. Calculating
b. Tracking
c. None of the above
d. Both A and B

8. There are _____ types of inventory costs to track.

a. 9
b. 8
c. 7
d. 6

9. There is _____ inventory levels.

a. 1
b. 2
c. 3
d. 4

10. (Average inventory / cost of goods sold) x _____.

a. 10
b. 75
c. 365
d. 45

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UNIT IV

INTRODUCTION TO LOGISTICS MANAGEMENT

STRUCTURE

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4.1 LEARNING OBJECTIVE

After completing this unit, students will be able to:

- Understand about the importance of logistics management.
- Know about the activities included in logistics.
- Learn about logistics costing.
- Know about warehouse management.
- Learn about Designing Distribution Networks.
- Learn about warehouse and transport management.
- Understand transport documentation.
- Learn about the importance of supply chain management.
- Learn about Supply Chain and Competitive Performances.

4.2 INTRODUCTION

As freight volume grows and transportation becomes complicated, the need for robust logistics management is increasing. With current industry challenges, well-planned logistics management becomes a primary factor in the success of any company's operations and directly impacts its bottom line. Additionally, meeting customers' demands and providing superior service are also goals of good logistics management.

Logistic management is known as the control and supervision of the movement of goods. However, the scope of managed processes reaches far more than that. It involves several factors, including transportation management, freight and inventory management, materials handling, and order fulfillment. Proper logistics management encompasses optimization processes to maximize revenues, cut manual labor, make informed decisions, and exceed customer expectations.

Logistics involves managing moving goods between the point of origin and point of consumption, including warehousing, transportation, third-party services and inbound and outbound logistics. Here's a closer look at some of its features:

Logistics management in supply chain management is part of the distribution channel. It includes all steps between supplier and customer, whether the customer is a wholesaler, manufacturer or the ultimate consumer.

It can be categorized into three major branches — inbound logistics, outbound logistics, and third-party logistics services. The logistics professionals ensure they deliver goods on time and safely. They plan, monitor and optimize material flow through the distribution channels.

A well planned and efficient flow of materials supports efficient utilization of resources like raw materials, suppliers and labor force, which eventually helps organizations to save money and increase profit margins. This is the basic logistics management definition. Depending on the activities of the organization, the needs of the logistics team can differ widely.

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Types Of Logistics Management

As we've seen, different kinds of logistics are appropriate for different businesses. Here are some types of logistics management:

Inbound Logistics

The inbound logistics process is responsible for receiving, storing and moving the product shipped from the supplier or manufacturer to an organization's warehouse. The inbound logistics manager is mainly concerned with receiving, storing, shipping, stocking and issuing goods within the warehouse.

Outbound Logistics

Outbound logistics involves planning and shipping goods from a business's location to the customer's location. The third-party service providers, like courier services and logistic firms, are also involved. The outbound process begins with order processing and ends with the delivery of goods to the customer. It includes expediting, transportation management, warehousing, picking, sorting and packing goods for shipments.

Third-Party Logistics (3pl)

Third-party logistics providers include freight forwarders, air and ocean carriers, 3PL service providers and more. The primary objective of 3PL is to manage customers' logistics activities and ensure that goods are delivered on time. Many businesses don't want an internal logistic function and rely entirely on third-party logistics to manage their supply chain processes.

Reverse Logistics

Reverse logistics is the process of returning products to the seller after they've reached the end-user. For instance, if a product has reached a customer's location and is found to be defective, the reverse logistics process begins with returning goods to the supplier, manufacturer or retailer. The reverse logistics process may also involve returning goods to the manufacturer for rework or refurbishing before shipping them back to the customer. Organizations involved in the manufacture or sale of products may require all these types of logistics management for the efficient functioning of their business.

Benefits Of Effective Logistics Management

By now, the importance of logistics management in supply chain management is clear. It can have a wide-ranging impact on a business's operations. Here are a few of the benefits of getting types of logistics management right:

- **Increased Profits**
  Logistics management helps organizations reduce the expenses associated with the transportation of goods. It helps improve the efficiency of the distribution channel.
- **Enhanced Customer Satisfaction**
  Logistics management in supply chain management plays a vital role in controlling delivery time to the customer. It also ensures goods are delivered in optimal condition.

- **Improving Damage Rates**
  The process of logistics management involves order processing, picking, packing, transporting and delivering goods to a customer's location. With proper inventory management, damage can be reduced through the cycle.
- **Reduced Warehousing Needs**
  With efficient logistics management, less warehouse space is needed. One of the aims of logistics management is to ensure the outgoing orders are moved at the correct time, making space for new stock. This reduces the total amount of goods held in inventory at any given time. These are a few benefits possible when organizations make the most of the logistics management definition. For organizations involved in manufacture or retail, it's a large part of running a successful operation.

4.3 IMPORTANCE OF LOGISTICS MANAGEMENT

The purpose of logistics management is to manage several processes in the supply chain and provide the highest degree of accuracy to meet the customer demands. It creates visibility with real-time data to optimize the delivery process and avoid disruptions. Let's learn about the importance of logistics management.

1. **Boost Business Profitability**
   It has the ability to improve the operational excellence which is necessary to grow and expand your business. Managing logistics is extremely crucial as it helps the organizations to gain deep insights of the supply chain. This also increases the order fulfillment rate and enables strong business outcomes. Providing value to customers by implementing the latest technological innovations can improve the productivity and profitability of the operations.
2. **Improve Customer Experience**
   Track different aspects of the supply chain are the essence of the logistics process. It allows companies to communicate effectively with the customers and provide fast and quality service to them. Hence, smooth logistics operations create enormous value to the customers, which in turns build the brand reputation. Providing better customer services is a key to success for businesses.
3. **Reduce Operational Cost**
   Logistics management leads to transparency and visibility in the operations. This tends to improve overall efficiency of the business as it provides route optimization to enhance on-time delivery and reduce the fuel cost. It is an important element to keep your expenses lower by analyzing and monitoring the real-time data. Also, an effective logistics management leads to supply chain transparency which is necessary for businesses to optimize asset utilization.
4. **Ensure Seamless Delivery**
   Professionally organized logistics tends to deliver the right products at the right time. In the modern world, delivery processes are continuously evolving as fast and safe shipping adds value to the customer experience. Logistics management focuses on delivering the products to the customers on time or ahead of schedule. Therefore, the on-time delivery is the primary focus of the well-organized SCM strategies.

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5. **Success of Supply Chain**
   Logistics management deals with numerous aspects of supply chain such as production, automating functions, material handling, distribution and so on. Monitoring these networking within the supply chain is a major component for the efficient functioning of the business operations. Moreover, a successful supply chain management helps you boost your business value. Additionally, organizations can gain a clear advantage over the competition.

6. **Improve Warehouse Management**
   When you optimize the logistics activities, it allows you to control and monitor your warehouse operations. Centralizing the complex task by developing warehouse inventory plans is always advisable for the businesses to operate effectively. Warehouse management activities involve storage and material handling of goods. It is a core pillar in the transportation industry that starts from auditing and tracking to distributing the goods to its final destination.

7. **Enhance Visibility**
   Managing your logistics is important for business growth as it plays a major role in improving connectivity, interoperability, and visibility of the operations. You can analyze every stage of your supply chain in real-time. Gaining essential information enables businesses to control cost and figure out efficiencies. Therefore, transparency across the supply chain tends to reduce failures and help you in meeting the customer demands. Ensuring synchronized supply chains is a vital process to benefit both the companies and customers.

8. **Intelligent Route Planning**
   Executing delivery and logistics operations with an intelligent route planning software can lead to great customer service and minimal expenses. Optimization of routes is considered to be an important aspect of logistics management as implementing route planning software reduces the manual dependencies and amplifies timely delivery. In addition, it also increases safety of drivers, products and vehicles. Importance of logistics management to handle the transportation is enormous for business growth.

9. **Risk Management**
   Preparing a risk management plan enables business owners to clearly understand the disruptions in an effective way. Assessing your supply chain activities to evaluate the impact of operations can guide the business to predict the supply and demand beforehand. Logistics management can develop an effective approach of risk management to minimize the impact of business threats. Streamlining the logistics planning processes is important for creating value for customers.

10. **Scalability**
    Managing and monitoring the distribution network is necessary to meet the industry's growing demands. The software has the ability to create the business more scalable by quickly responding to disruptions. Therefore, embracing cutting-edge software focuses on demand-driven logistics expansion and scalability. Optimizing the logistics planning activities and identifying the emerging trends can also enhance the accuracy of the operations.

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4.4 OBJECTIVES OF LOGISTICS MANAGEMENT

These are some of the objectives of Logistics Management.

1. **Cost Reduction and Profit Maximization:**
   Logistics management results in cost reduction and profit maximization, primarily due to:
   a. Improved material handling
   b. Safe, speedy and economical transportation
   c. Optimum number and convenient location of warehouses etc.
2. **Efficient Flow of Manufacturing Operations:**
   Inbound logistics helps in the efficient flow of manufacturing operations, due to on-time delivery of materials, proper utilization of materials and semi-finished goods in the production process and so on.
3. **Competitive Edge:**
   Logistics provide, maintain and sharpen the competitive edge of an enterprise by:
   a. Increasing sales through providing better customer service
   b. Arranging for rapid and reliable delivery
   c. Avoiding errors in order processing; and so on.
4. **Effective Communication System:**
   An efficient information system is a must for sound logistics management. As such, logistics management helps in developing effective communication system for continuous interface with suppliers and rapid response to customer enquiries.
5. **Sound Inventory Management:**
   Sound inventory management is a by-product of logistics management. A major headache of production management, financial management etc. is how to ensure sound inventory management; which headache is cured by logistics management.

4.5 ACTIVITIES INCLUDED IN LOGISTICS

Following is a brief account of key activities involved in logistics management:

1. **Network Design:**
   Network design is one of the prime responsibilities of logistics management. This network is required to determine the number and location of manufacturing plants, warehouses, material handling equipment's etc. on which logistical efficiency depends.
2. **Order Processing:**
   Customers' orders are very important in logistics management. Order processing includes activities for receiving, handling, filing, recording of orders. Herein, management has to ensure that order processing is accurate, reliable and fast.

   Further, management has to minimize the time between receipt of orders and date of dispatch of the consignment to ensure speedy processing of the order. Delays

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in execution of orders can become serious grounds for customer dissatisfaction; which must be avoided at all costs.

3. **Procurement:**
   It is related to obtaining materials from outside suppliers. It includes supply sourcing, negotiation, order placement, inbound transportation, receiving and inspection, storage and handling etc. Its main objective is to support manufacturing, by providing timely supplies of qualitative materials, at the lowest possible cost.

4. **Material Handling:**
   It involves the activities of handling raw-materials, parts, semi-finished and finished goods into and out of plant, warehouses and transportation terminals. Management has to ensure that the raw-materials, parts, semi-finished and finished goods are handled properly to minimize losses due to breakage, spoilage etc. Further, the management has to minimize the handling costs and the time involved in material handling.

   Material handling systems, in logistics management are divided into three categories:

   a. Mechanized systems

   b. Semi-automated systems

   c. Automated systems

5. **Inventory Management:**
   The basic objective of inventory management is to minimize the amount of working capital blocked in inventories; and at the same time to provide a continuous flow of materials to match production requirements; and to provide timely supplies of goods to meet customers' demands.

   Management has to maintain inventories of:

   a. Raw-materials and parts

   b. Semi-finished goods

   c. Finished goods

   Management has to balance the benefits of holding inventories against costs associated with holding inventories like – storage space costs, insurance costs, risk of damage and spoilage in keeping stocks etc.

6. **Packaging and Labeling:**
   Packaging and labeling are an important aspect of logistics management. Packaging implies enclosing or encasing a product into suitable packets or containers, for easy and convenient handling of the product by both, the seller and specially the buyer. Packaging facilities the sale of a product. It acts as a silent salesman. For example, a fancy and decorative packaging of sweets, biscuits etc. on the eve of Diwali, makes for a good sale of such items.

   Labeling means putting identification marks on the package of the product. A label provides information about – date of packing and expiry, weight or size of product, ingredients used in the manufacture of the product, instructions for sale handling

of the product, price payable by the buyer etc. Labeling is a strong sales promotion tool. The consumer who is persuaded to read the label may, in fact, try to buy the product; even though he/she had no such premeditation (advance idea).

7. **Warehousing:**
   Storage or warehousing is that logistical activity which creates time utility by storing goods from the time of production till the time these are needed by ultimate consumers.

   Here, the management has to decide about:

   a. The number and type of warehouses needed and

   b. The location of warehouses.

   The above two decisions depend on the desired level of customer service and the distance between the supply source and final destination i.e. markets.

8. **Transportation:**
   Transportation is that logistical activity which creates place utility.

   Transportation is needed for:

   a. Movement of raw-materials from suppliers to the manufacturing unit.

   b. Movement of work-in-progress within the plant.

   c. Movement of finished goods from plant to the final consumers.

   Major transportation systems include:

   a. Railways

   b. Roadways

   c. Airways

   d. Waterways

   e. Pipelines.

   The choice of a particular mode of transportation is dependent on a balancing of following considerations:

   a. Speed of transportation system

   b. Cost involved in transportation

   c. Safety in transportation

   d. Reliability of transportation time schedules

   e. Number of locations served etc.

4.6 LOGISTICS VALUE PROPOSITION

One popular and important marketing exercise is defining a logistics value proposition – your company's "promise" to the market. You want it to be BOTH accurate and memorable, certainly. But too many companies focus on the accurate part. They look in the mirror and describe what they see. The result is a stultifying barrage of sameness designed to avoid, not attract, attention.

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"Integrated supply chain services designed to help companies streamline logistics operations and continuously improve service levels and efficiency blah, blah, blah…"

If getting the attention of a busy logistics executive is akin to a "Where's Elmo?" challenge, then guess what? You lose with a generic approach like this. That's because busy decision makers don't have time to find Elmo in noisy, crowded logistics space. You need to make it easy by giving them a simple and obvious reason to remember you.

Using the B.I.D.S. Method to Evaluate Your Logistics Value Proposition

One way to evaluate your current logistics value proposition or positioning statement is to use the B.I.D.S acronym. The first thing you need to do is get the hell out of your own head and into the head of your prospect.

In fact, the best way to evaluate value propositions is to get direct feedback from your target audience. In the absence of that, you at least need to think like a prospect when evaluating whether your logistics value proposition meets the following criteria:

Believable – can you actually pay off the promise?

Important – does the value suggested touch on an urgent prospect pain point?

Differentiating – does it distinguish you in some way and separate you from the pack?

Simple – is the promise easy to understand and memorable?

In the B.I.D.S. assessment approach, all elements are important and must be present. But "Differentiating" and "Simple" are particularly important in an increasingly crowded and competitive space.

4.7 INTEGRATED LOGISTICS

Integrated logistics is a business management model that is increasingly used to accelerate product delivery and improve customer service. In this model, all departments, processes and resources are aligned to work in perfect sync and operate as one cohesive unit. This results in seamless operations and ensures that customer orders are dispatched quickly.

As logistics involves several departments, the integrated model emphasizes the need for teamwork to optimize performance. Cross-functional collaboration also gives companies a competitive advantage and helps them adapt quickly to changes in consumer demand.

The architecture of integrated logistics

Therefore, the **integrated logistics architecture** on the one hand provides for the correct management of warehouses, transport and materials. On the other hand, it integrates with different functions of the business process. For example:

- Production function
  - Production planning
  - Optimization of material supply flows
  - Organization of storage areas
  - Material *handling* systems

- Supply function
  - Selection and control of suppliers
  - Purchasing planning
- Marketing function
  - Correct definition of services
  - *Packaging* design
  - Marketing campaigns design

To these, then, depending on the production process, which is characteristic of each production system, can be added numerous others. In any case, the variation of each of them will inevitably also change the **logistical processes**. Integrated logistics, therefore, proceeds precisely with a view to **logistical efficiency** and the reduction of **logistical costs**.

Management and measurement in integrated logistics

In this sense, the work of **logistics** professionals, particularly in an **integrated logistics** system, never stops. Not only with regard to the proper performance of typical tasks. Rather, it is about the constant monitoring of the efficiency and cost-effectiveness of the entire logistics system. To this end, a constant measurement of the results obtained is essential in the logistics sector, particularly in an integrated system. In this respect, the technicians take into account a number of indicators:

- **Volume**: measures workloads (e.g. number of orders handled, managers, etc.);
- **Effectiveness**: indicates the quality of the process (e.g. customer evaluation);
- **Efficiency**: measures the costs and resources of carrying out a given process.

For this reason, in the construction of an **efficient logistics system**, it is necessary to use professionals in the sector, who are able to evaluate these and many other parameters.

4.8 LOGISTICS COSTING

Logistics costs are defined differently by different companies. Some companies do not account interest and depreciation on inventories as logistic costs. Others include the distribution costs of their suppliers or the purchasing costs. In some cases, even the purchase value of the procured goods is included in the logistic costs. So, there is no generic definition of this term but every company needs to define the logistics costs for itself and the KPI's it will be tracking to lower the costs. Generally, logistics costs include:

1. Transportation costs
2. Inventory carrying costs
3. Labor Costs
4. Customer service costs
5. Rent for storage costs
6. Administration costs
7. Other costs

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4.9 LOGISTICS PERFORMANCE MEASUREMENT

Performance measures appear as a logical consequence of an ABC system. Activity descriptions include financial and non-financial information. The financial view indicates the costs or resources necessary for performing the activity. The non-financial view describes the activity in terms such as the time required, quality, number of transactions, or schedule attainment. The company can use the non-financial information to develop performance measures for the activity. The performance measures describe the work done and the results achieved in an activity. Performance measures can be used to track product returns, damage, claims or data entry errors. The linkage between the performance measures and the activity provides a relatively straightforward means for computing the cost of poor or improved performance.

The ABC model can be used to re-engineer business processes by eliminating redundant or unnecessary tasks and optimizing resource allocations to activities adding the most value to the product or customer. The ABC baseline model identifies the inputs, outputs, resources, costs and activities employed in the enterprise. The information can be used to concentrate on "big cost items" for improvement or to develop actions to simultaneously attack waste at multiple levels within the organization.

4.10 DESIGNING DISTRIBUTION NETWORKS

A distribution network can be seen as the flow of goods from a producer or supplier to an end consumer. The network consists of storage facilities, warehouses, and transportation systems that support the movement of goods until they reach the end consumer. The process of ensuring the consumer receives the product from the manufacturer is done through direct sales or by following a retail network. Depending on the size of an enterprise or business, distribution networks vary in structure and size. Companies like Amazon or Apple are likely to own more sophisticated and complicated distribution networks, transportation, and logistics systems. When defining the structure of a distribution network, the most crucial factors are the product demands of the end customer, customer experience, product variety and product availability, response time, and finally, product return ability.

Building the Ideal Distribution Network or Model

Distribution networks transform over time as businesses expand and aim to reach more consumers. Therefore, they need to be set up in a way that allows for long-term optimization. In order to determine the ideal and efficient distribution network and supply chain, the satisfaction of customer demand comes into play. Satisfying overall customer demand has to be done at low costs and required service levels. It requires strategic planning and specialized supply chain management and planning.

Distribution networks are built by considering all key service and cost drivers. One of the most important drivers for distribution and supply chain modeling is **customer location**. Businesses need to identify where their customers are located in order to find a distribution structure that works efficiently, at a cost that is low and will not result in a large impact on the price of the product for the end consumer. The location of the customer allows for logistics planning. Another key driver is the **order quantity and frequency**. It is pivotal for

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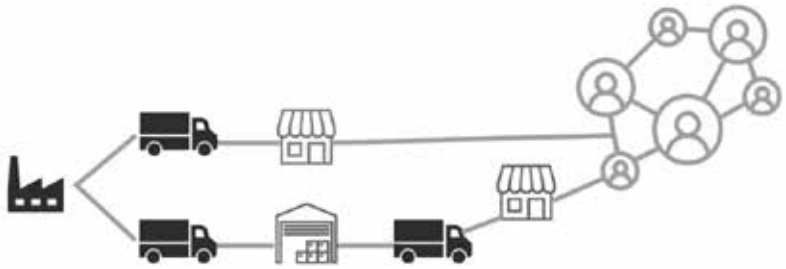
a business to know how often consumers purchase a product and the purchase volumes associated with the product. It aids in inventory delivery management. **Transportation costs** and the **mode of transportation required** are also key drivers in building a distribution model. Determining the order frequencies and the location of consumers aid in selecting the right type of transport needed and the costs associated with the transportation modes and vehicles required.



Warehousing is also an important driver in designing an efficient distribution network. The business must determine the ideal warehouse locations, size, ease of access, and costs, to ensure that the proper selection is made to best suit the distribution needs and ensure overall customer satisfaction. In cases where the goods are being exported or imported, it is also important for the businesses to identify points of entry. Other key drivers include **factory and supplier locations** and **service level requirements**.

Benefits of Deciding on a Distribution Network

The two forms of distribution that a manufacturer can decide on are either direct distribution or indirect distribution. Direct distribution is a direct sale from the manufacturer to the end consumer, whereas the indirect distribution involves setting up or linking to an existing distribution network, which normally encompasses warehousing, etc. The benefits of making use of existing distribution networks or setting one up include (but are not limited to):

1. **Reduction in costs**
   Setting a new distribution point could be costly for certain businesses and manufacturers. An existing distribution network provides speed and ease, as well as increasing reach for products (geographically), thereby eliminating the costs and challenges associated with time, human resources, and capital required.
2. **Greater customer reach**
   An efficient distribution network allows for wider customer reach because it should ideally enhance the speed at which products reach the end consumer and opens up opportunities to reach other geographic areas.

4.11 E-BUSINESS MODELS

E-commerce business models can generally be categorized into the following categories.

Business - to - Business

A website following the B2B business model sells its products to an intermediate buyer

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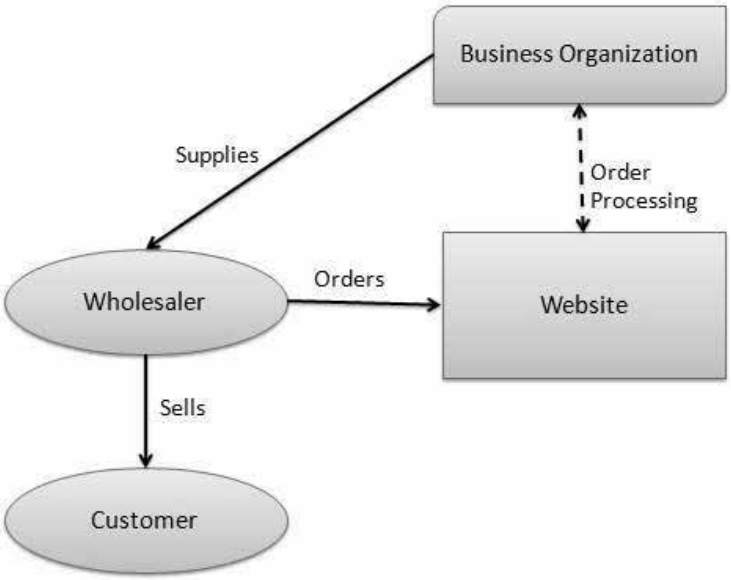
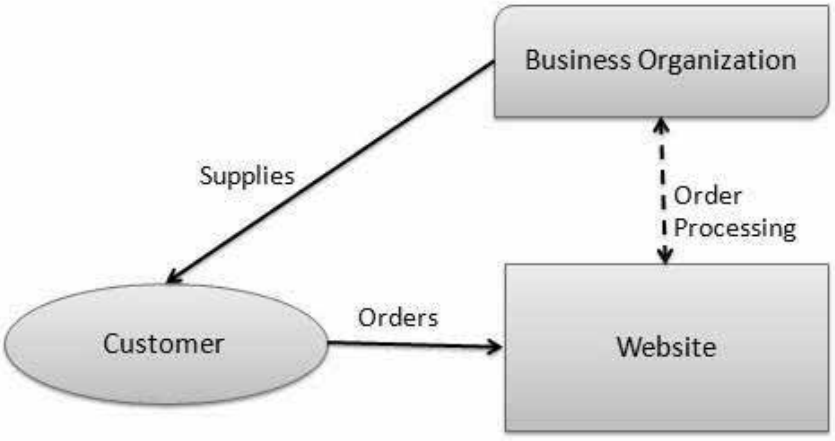
who then sells the product to the final customer. As an example, a wholesaler places an order from a company's website and after receiving the consignment, sells the end product to the final customer who comes to buy the product at one of its retail outlets.



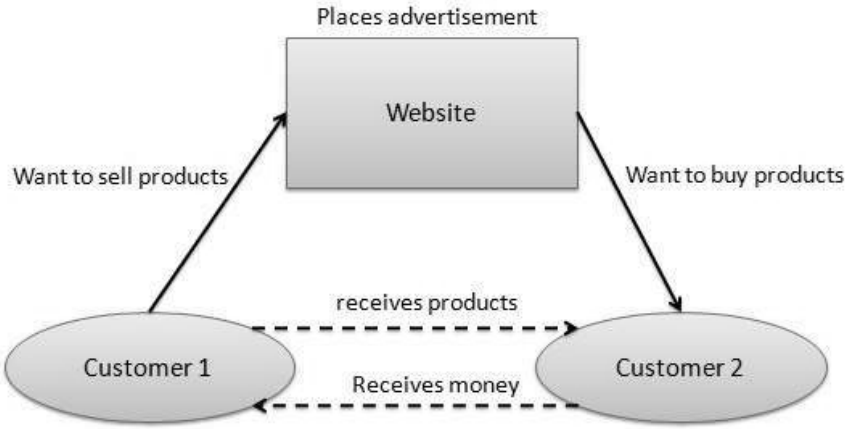
Business - to - Consumer

A website following the B2C business model sells its products directly to a customer. A customer can view the products shown on the website. The customer can choose a product and order the same. The website will then send a notification to the business organization via email and the organization will dispatch the product/goods to the customer.



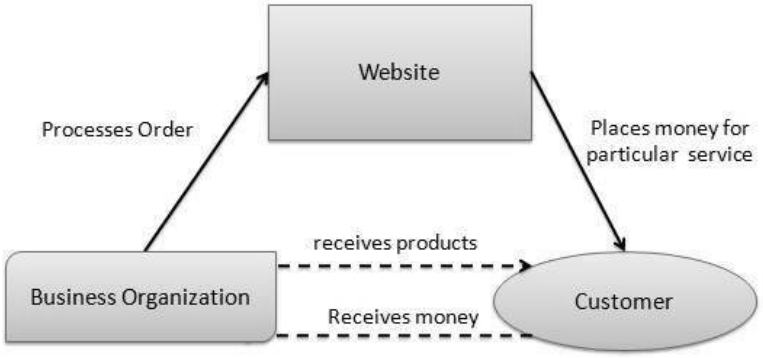
Consumer - to - Consumer

A website following the C2C business model helps consumers to sell their assets like residential property, cars, motorcycles, etc., or rent a room by publishing their information on the website. Website may or may not charge the consumer for its services. Another consumer may opt to buy the product of the first customer by viewing the post/ advertisement on the website.



Consumer - to - Business

In this model, a consumer approaches a website showing multiple business organizations for a particular service. The consumer places an estimate of amount he/she wants to spend for a particular service. For example, the comparison of interest rates of personal loan/ car loan provided by various banks via websites. A business organization who fulfills the consumer's requirement within the specified budget, approaches the customer and provides its services.



Business - to - Government

B2G model is a variant of B2B model. Such websites are used by governments to trade and exchange information with various business organizations. Such websites are accredited by the government and provide a medium to businesses to submit application forms to the government.

Government - to - Business

Governments use B2G model websites to approach business organizations. Such websites support auctions, tenders, and application submission functionalities.

Government - to - Citizen

Governments use G2C model websites to approach citizen in general. Such websites support auctions of vehicles, machinery, or any other material. Such website also provides services like registration for birth, marriage or death certificates. The main objective of

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G2C websites is to reduce the average time for fulfilling citizen's requests for various government services.

4.12 INTRODUCTION TO WAREHOUSE MANAGEMENT

Warehouse management encompasses the principles and processes involved in running the day-to-day operations of a warehouse. At a high level, this includes receiving and organizing warehouse space, scheduling labor, managing inventory and fulfilling orders. Zoom in closer and you'll see that effective warehouse management involves optimizing and integrating each of those processes to ensure all aspects of a warehouse operation work together to increase productivity and keep costs low.

What is a warehouse management system?

A warehouse management system (WMS) is software designed to optimize operational processes in a warehouse. By implementing a WMS you have full visibility into real-time inventory levels and storage, staff productivity, demand forecasting, and order fulfillment workflows within a warehouse. Warehouse management systems are important as they eliminate manual processes and guesswork and instead streamline processes that, save time and provide a more accurate snapshot of what's going on inside a facility without needing to conduct continuous warehouse audits.

This information helps warehouse managers identify areas of improvement and track progress to drive optimizations throughout the supply chain, from when inventory hits the loading docks to when it's shipped out to its next destination. Warehouse management software provides the tools to drive strategic big picture improvements as well as those to monitor the day-to-day. What a management team sees in the warehouse management system will be different from a picker or packer who relies on the system to know what to pick or pack next on the warehouse floor.

Each warehouse management system may have different functionality deployed depending on the business it serves (e.g., what a direct-to-consumer ecommerce seller needs isn't the same as a large brick and mortar store chain).

3 ways growing ecommerce stores rely on warehouse management

If you're experiencing growth and fulfilling orders in an ecommerce warehouse, you need proper warehouse management and oversight in place. This requires experienced experts to manage the warehouse along with the tools and facilities to support not only your volume today but projected growth as well.

1. **Enable logistical growth**
   With growth come new challenges related to fulfillment logistics. Fast-growing brands understand the impact of warehouse efficiencies, from the number of dock doors that can be used at once and the use of space in the facility, to the number of pickers and packers you have on the floor each hour of the day. Warehouse management should choose the right technology, shipping carriers, and delivery options to use as well as secure the best warehouse that will meet your future growth without you outgrowing the space immediately. Together, these things help

you receive inventory more efficiently, pack boxes quicker, and deliver more orders on time.

2. **Packages are processed and shipped faster**
   Warehouse management makes operations leaner and improves supply chain efficiency. Stations are designated in each area of the warehouse for each step of the fulfillment process (e.g., separate areas for warehouse picking, packing, labeling, returns, etc.). Each fulfillment associate is focused on one task per shift to maximize their output. Setting up each functional area for success also means reducing the physical steps needed to get from one place to the next and routing everything in a streamlined way. The faster all of this work is done; the sooner packages are ready to go out the door.

3. **Better storage allocation**
   Warehouse management helps you store each SKU in a separate dedicated storage location (e.g., in a shelf, bin, or on a pallet or warehouse rack) that makes the most sense for the layout of the warehouse and item in question. Once the inventory is in its place, a warehouse management system helps pinpoint the exact location of any SKU so it can be retrieved quickly. Accurate warehouse management also helps you keep tabs on real-time inventory levels, so you never run out of stock or run out of space. If you sell products that have expiration dates or are subject to recall, you can also store them by lot number and ship the oldest goods out first.

Warehouse management with a 3PL: 5 advantages

Because warehouse processes are so complicated and expensive, many brands choose to outsource the entire fulfillment process to a third-party logistics (3PL) company. Unlike an on-demand warehousing company that finds warehouses with excess space, 3PLs run their own fulfillment centers and should have standardized warehouse management across all of them.

Here are some of the advantages of working with a professional logistics company to store inventory and ship orders.

1. **Logistical optimizations**
   3PLs work with thousands of companies — including seasonal brands, high growth brands, and everyone in between — so they have a lot of data and can do everything from analyzing shipping zones to forecast demand and inventory. Continuously aggregating and learning from data helps optimize each warehouse for greater efficiency as well as provide reduced shipping costs and transit times for your customers, all of which help you grow.

2. **Multiple warehouses and larger geographic footprint**
   When you run your own warehouse, you are only shipping from that one location. Partnering with a 3PL means you can store inventory in several of their fulfillment centers to keep inventory closer to more customers. If you ship nationwide, it's a must that you have warehouses coast-to-coast. For example, Ship Bob has a presence in the largest US cities and regions all over the United States, so you can ship orders via ground to large populations very quickly. This helps meet customer

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expectations around 2-day shipping by reducing the distance traveled and delivery timelines.

3. **Huge time savings**
   Ecommerce order fulfillment services from a 3PL eliminate the most time-consuming logistics tasks (inventory storage, picking, packing, shipping, order tracking, replenishing supplies, returns, kitting, etc.) and the stress of managing a warehouse. While they take care of these tasks for you, you can monitor their performance and use the data they provide to grow and make better business decisions.

4. **Better uses of warehouse space**
   If you're on the verge of outgrowing your warehouse space, working with a 3PL can make your life a lot easier. Even once you've outsourced fulfillment to a 3PL, you can either repurpose your old warehouse space to focus on a different aspect of your business (e.g., growing your B2B ecommerce or wholesale fulfillment channels in-house), or let the lease end.

   A 3PL can help you pay for only the space you need — even if that's by the bin, shelf, pallet, or any combination of those for your products. That way, you'll never have to worry about outgrowing (or never growing into) the space you're paying for.

5. **Real-time insights**
   Just because you're not working inside the 3PL's warehouse doesn't mean you won't know what's happening. Through their technology, you should be able to see your inventory flow, including when inventory is being received, stowed or put away, picked, packed, shipped, and any other movement.

   With Ship Bob's proprietary warehouse management software, you can search orders by tracking number, destination country, the number of items it contains, filter by sales channel, fulfillment center location, as well as get full transparency into performance such as fulfillment speed, orders fulfilled on time, accurately, claim-free, and much more.

4.13 STOREHOUSE OPERATIONS

Storehouse operations are an integral part of a company's business strategy. Efficient storehouse operations can ensure that a company ships and receives vital stock in time for replenishment on store shelves or in manufacturing facilities. Efficient storehouse operations do not happen by accident, but through adherence to a series of best practices initiatives. It affects retail order fulfillment, storage, inventory management, shipping, and distribution. Having an all-in-one solution lets you see what's happening across different functions of the storehouse in real-time such as inventory being received, orders being packed, shipments being labeled, and any other movement of goods.

- **Receiving**
  The receiving dock is the first place a company can begin to ensure an efficient warehouse. A receiving clerk should be in charge of receiving and securing all inventory and should also collect all shipping documents from the carrier at the

time of delivery. A receiving log should be maintained to ensure that all inventory expected for the day has been received. The receiving log can be a useful source of information for other departments within the company, such as purchasing and accounting. All inventory received by the shipping clerk should be moved from the receiving dock to its appropriate place in the warehouse to prevent damage and deter theft.

- **Inventory Movement**
  The movement of inventory throughout the warehouse should be done by experienced materials handlers with certifications or licenses to operate forklifts and boom lifts. These materials handlers should be able to move from one section of the warehouse to another with ease due to aisles that are not full of unsorted inventory. Inventory that has not been placed in its proper bin or warehouse location can cause problems with inventory systems, especially under a FIFO, or First In, First Out, inventory system. A FIFO system ensures that the inventory that was received yesterday is moved to the shipping dock before the inventory that was received today. This inventory system reduces the chance of obsolete inventory sitting in warehouse bins.
- **Shipping**
  A company should ensure that the inventory being shipped out of the warehouse facility is secured until it is loaded onto the carrier's truck. The warehousing manager should consider a risk-based approach to shipping dock procedures, put more security on items that are of higher value or are easier to steal. A more intense effort to secure inventory should be made on shipping docks where the risk of theft or spoilage is highest. Only authorized personnel should be permitted to access the shipping dock. Companies can enforce this through the use of identification and swipe cards to access certain areas of the warehouse and shipping docks to ensure that inventory is secured until time for shipment. As with the receiving period, all documentation received from the carrier should be collected and the shipments should be recorded in a shipping log.
- **Warehouse Safety**
  The safety of warehouse employees should be paramount on the facility manager's checklist. Aside from providing employees with essential safety gear, management should adhere to the best practice of not permitting horseplay on warehousing equipment. As mentioned in the inventory movement section, all equipment operators should be certified and licensed, and tested for competence on a regular basis. Adherence to best safety practices helps to keep the company free of unnecessary legal action and prevents the assessment of fines and penalties from OSHA and other governmental agencies.

4.14 MATERIAL HANDLING

Material handling is a far-reaching concept in supply chain management. It's a foundational process including several types of equipment and activities that are either:

Manual: Workers use their hands to transport objects within a warehouse or to a transportation vehicle. This includes filling, lifting, carrying, and emptying. Manual

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material handling poses serious workplace safety risks. According to the Occupational Safety and Health Administration (OSHA) the most frequently reported cause for "lost or restricted work time" is musculoskeletal disorders.

Semi-Automatic/Automatic: Automatic machinery exists to reduce the number of manual movements. Nevertheless, most automatic machines fall into the category of semi-automatic material handling as they require employees to load and unload goods or to drive the equipment. At present, fully automating these processes is too expensive for most warehouses. A warehouse has a lot of moving parts. Literally. It's why poor material handling brings sweeping consequences. For better or for worse, it impacts production flow, employee safety, and employee morale. That said, understanding material handling systems and implementing best practices significantly improves the function of your warehouse.

Why Does Warehouse Material Handling Matter?

Material handling directly impacts productivity in warehouses, manufacturing plants, and distribution centers. An inefficient facility causes errors and delays, eroding customer loyalty and making it easier for your competition to snatch away business. Something else that's interesting? Effective material handling isn't only about sorting your goods into unit loads. Successful businesses invest time into monitoring and improving their material handling system in order to protect:

- The integrity of their goods
- The productivity of their retail warehouse,3PL warehouse, distribution center, or manufacturing plant
- The physical and mental health of their workers

When a shipment arrives, a good material handling process ensures goods get from the dock to the appropriate rack in good time. It also accounts for proper control of materials. You can mitigate theft, damage, and spoilage with a material handling process that limits access to certain parts of your warehouse to particular employees. Finally, proper material handling allows warehouses to store goods in an organized manner that makes it easy to pick and pack inventory for outgoing shipments.

Improve Your Employee Morale

Beyond inventory management, effective material handling can also increase employee morale. Well-designed systems and processes help employees complete work faster. A poorly designed warehouse positions machinery with little to no regard for specific processes. Frustratingly, a machine used for Step 2 of production may be placed all the way on the other side of the warehouse. Now your employee's time on task is doubled. It can also result in workers to moving heavy loads over unnecessarily long distances. Not only does poor material handling pose physical risks, but it also poses mental risks, too. According to one study, useless or inefficient activities lead to reduced mental health in workers, and unhappy workers are unproductive workers. They're also more likely to take time off or quit, increasing turnover and raising your recruitment costs.

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What Role Does Warehouse Layout Play in Material Handling?

Your warehouse layout significantly influences your material handling system. It can be the difference between an efficient warehouse and a warehouse that can't keep it together. A poor warehouse layout causes bottlenecks, increases motion waste (moving more than necessary within the warehouse), and raises the risk of injury due to manual material handling. A well-designed warehouse layout streamlines processes, decreases worker movements, and positively impacts employees' physical and mental health.

Prioritize Flow, Accessibility, and Space in Warehouse Design

If you're moving shop or opening up a new warehouse, you're in the perfect position to start off right. Keep the following warehouse layout optimization tips in mind.

Flow Keeps Ops Moving

Does your design enable the uninterrupted flow of goods through your facility? Is machinery set next to the machines workers subsequently use in a given process? Are materials for each workstation nearby?

Optimize Accessibility to Increase Worker Speed

Are pallets stored in a way where workers can access goods without moving other goods out of the way? Are racks safety and readily accessible by forklifts and pallet jacks?

Use Space Efficiently

Have you accounted for all your warehouse needs, storage-related or otherwise such as offices and washrooms? Do you have space to store empty pallets or batteries? By keeping flow, accessibility, and space at the forefront of your mind, you can design an effective warehouse layout.

Determine Your Warehouse Objectives

What processes do you want to prioritize in your warehouse? Your particular business may want to improve inventory management while another wants to implement cross-docking while another wishes to improve picking and packing. Once you've zeroed in on the goal you want to achieve, you can structure your warehouse thoughtfully.

Calculate How Much Inventory You'll Store

An overloaded facility has a detrimental effect on material handling. Improperly stacked loads can topple causing injuries. Poorly stored goods require workers to move one product to gain access to another. Understanding how much inventory you'll store at a given time and how big the average item will be helps you make smart decisions about pallet rack height and aisle space.

The Different Types of Material Handling Equipment

There are different types of material handling equipment. The types of equipment you order, and how you organize them in your warehouse, impact your material handling processes.

- **Storage and handling equipment:** Stores goods in the time between receiving and shipping. Examples of such equipment are stacking frames, racks, and shelves.

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- **Engineered systems:** Automated units that efficiently move goods through a warehouse and reduce the need for manual intervention. Examples of such equipment are automated storage and retrieval systems (AS/RS), robotic delivery systems, automatic guided vehicles, and conveyor systems.
- **Industrial trucks:** Powered vehicles that move materials around a warehouse. Examples of such vehicles are forklifts, hand trucks, side loaders, and pallet jacks.
- **Bulk Material Handling Equipment:** Equipment that assists workers with handling large loads. Examples of such equipment include bucket elevators, stackers, and silos.

Conveyors move materials from Point A to Point B, limiting the amount of heavy lifting required. They also take goods through different stages of the distribution process including receiving, packaging, and shipping. Overhead handling methods supplement conveyors. Rather than occupying floor space to move goods, overhead handling methods, such as hoists and cranes, use overhead space to move goods from Point A to Point B. Additionally, they allow warehouse operators to use floor space for storage rather than as maneuvering room for shifting shipments. Industrial trucks, like forklifts, offer more maneuverability around the warehouse, allowing stock pickers to navigate aisles and handle pallets.

How Do You Make the Most of Your Material Handling Equipment?

- **Investing in Automated Systems**
  Increasing your inventory of automated tools, like those listed in the engineering systems category, introduces additional efficiency and improves material handling. For instance, if your business works with a large volume of goods and limited space, you could benefit from an automated storage and retrieval system (AS/RS). This computer-controlled system automatically stores and retrieves goods from pre-defined locations within the warehouse.
- **Organizing Your Warehouse Intelligently**
  While automation is incredibly effective, it may not always be the best solution. There are some problems that can't be solved by simply adding more technology. For instance, an automated system requires pre-defined rules, and if you don't

understand what the most efficient layout of your warehouse is, your gadgets won't be as efficient. Moreover, automation isn't as nimble and intuitive as humans. At present, solutions like an AS/RS are most effective in instances where storing and picking are the only tasks. Processes that require workers to "add value" to a good by changing or processing it in any way wouldn't be suitable for an AS/RS. Organizing your warehouse intelligently means keeping it clean, sorting inventory in a sensible system, and putting materials away when they're not in use.

- **Implementing a Warehouse Management System (WMS)**
  WMS software gives you visibility over your entire warehouse operation. While a WMS offers countless benefits, with regard to material handling, it's especially useful thanks to the use of advance ship notices (ASN). An ASN alerts a warehouse when shipments are en route, allowing them to plan ahead by scheduling staff and freeing up equipment.
- **Improving Put-Away Processes**
  Putting goods away the same day they're received reduces errors, frees up much-needed warehouse space, and reduces the risk of damage or theft. It also speeds up order fulfillment, since items are already in the pick rack ready for retrieval. Direct put-away systems, the process of putting goods away the same day, relies on an advanced warehouse inventory management system.
- **Incorporating RFID Tags and Scanners**
  RFID scanners present numerous benefits over traditional barcodes. RFID scanners don't need line of sight access the way barcodes do, limiting the amount of material handling. Moreover, RFID scanners can pick up the presence of inventory from up to 40 feet for a fixed reader, 20 feet for a handheld reader, and over 100 feet for an active UHF RFID system. RFID scanners empower warehouses to collect more data about their operations, setting the stage for further insights into material handling improvements.

Material Handling Tips for Unavoidable Manual Processes

At times, there's no choice but to move materials manually. In this case, it's important to train employees on proper handling techniques to limit injuries. The National Safety Council recommends that employees observe the following do's and don'ts when manually handling materials.

Do	Don't
Lift in areas with sufficient lighting	Lift materials from the floor
Lift in areas with enough space to keep your footing	Lift materials while seated
Modify activities and objects to make lifting easier	Lift with sudden movements
Stay in shape	Lift loads over obstacles
Start lifts close to your body	Twist or bend while lifting
Store goods in containers made of lighter materials	Perform repetitive, heavy lifts

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Are There Best Practices for Effective Material Handling?

If your business needs a starting point, here are specific material handling principles that can guide you for improvement projects.

1. **Planning Principle:** Set clear objectives and specifications.
2. **Standardization Principle:** Standardize equipment and software without compromising on production, modularity, or flexibility.
3. **Work Principle:** Reduce the amount of warehouse movements without sacrificing on operating levels or productivity. Solutions shouldn't lead to a reduction in output.
4. **Ergonomic Principle:** Prioritize worker health and safety while undertaking improvement efforts. Attempting to increase efficiency by making unreasonable or dangerous demands of employees is counterproductive and in some cases illegal.
5. **Unit Load Principle:** Ensure unit loads are the correct size and actually facilitate the flow of goods through a warehouse rather than causing bottlenecks.
6. **Space Utilization Principle:** Treat space like the finite resource it is and use it effectively through practices like direct put-away.
7. **System Principle:** Integrate your storage activities and material handling systems to cover everything starting from reception all the way to transportation and possible claims handling.
8. **Automation Principle:** Limit the amount of manual intervention by automating processes where possible.
9. **Environmental Principle:** Assess the environmental impact and effect on your company's footprint when considering new equipment.
10. **Lifecycle Principle:** Evaluate the expected life cycle of potential equipment and how much the ongoing maintenance costs will be.

Proper Material Handling Protects Your Warehouse's Employees and Facilitates Productivity

Your material handling process underpins your warehouse's entire productivity efforts. Ignore the former and it'll be to the detriment of the latter. Effective material handling processes keep production flowing, ensure goods reach customers in time, prevent workplace injuries, and elevate overall employee morale. In other words, it's an essential part of a healthy supply chain. Routinely monitoring and improving it will ensure your warehouse stays in top operational shape well into the future.

4.15 PACKAGING

Packaging affects many aspects of your supply chain like storage, access and flow of goods within your Distribution Centre. Revenue growth and cost reduction can be tied directly to the way you package and ship your products.

Packaging Types

Firstly, we need to differentiate internal from external packaging. Internal packaging is what consumers see on the shelf. The objective of internal packaging is to clearly describe

the product contained within and its ingredients (abiding by legal requirements of its category) as well as attract the attention of consumers. The external packaging is only used for storage and distribution purposes. It's designed to protect the internal packaging from damage, to allow efficient storage and transport and to display identifying information for warehouse staff (barcodes and RFID tags).

There are many types of external packaging, but the main ones that are used in most warehouses are:

1. **Containers** – hold, protect and organize products during storage and transport:
   - **Bin** is a box used for storage and organization of small parts prior to use in manufacturing and assembly
   - **Tote** is a box transported by hand, often with moulded-in handles
   - **Bulk container** feature four straight walls built on pallet-sized footprints with fork openings on two or four sides. Generally used for discrete component parts delivered to assembly lines
2. **Pallets** are generally made of wood, plastic or metal (steel or aluminium). They are designed to be handled by forklift trucks. Pallets are used as a returnable, reusable surface for assembling, storing, stacking, handling and transporting of goods as a unit load.
3. **Dunnage** is the materials or devices used in the securing and/or bracing of products during shipments. Since it's impractical for most facilities to stock multiple container sizes to accommodate shipping different product weights and sizes, most items get shipped in boxes that are too big. Void fill—crumpled paper, flowable peanuts (polystyrene or biodegradable materials) or inflatable air pillows—fills the open spaces and protects the contents from damage during shipping.
4. **Unitizers** materials that hold several items together to form a complete load. They can be applied as a tie down or means to secure a load to a pallet. Some examples of unitizers are stretch film, shrink wrap and strapping.

The Role of Packaging for Warehouses

1. **Damage protection**
   The main role of packaging is to protect products during transport, distribution and storage. Forklifts drops, product falls from conveyor belts and broken pallets are common occurrences in warehouses. The result is not only loss of revenue due to spoilage but also health and safety risks. Therefore, you should look for robustness when selecting your packaging solution.
2. **Operations**
   Packaging can directly drive efficiency and productivity of all warehouse processes including receiving, put-away, picking, packaging and dispatching. When package is readily stackable and labels are properly displayed (and contain all relevant information), products move faster throughout the warehouse, with less touches.
3. **Helps to Manage Space in Warehouse**
   The layout of your warehouse is paramount to its smooth operation. You can make the most of your floor space by using packaging that is easy to store and stack.

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4. **Efficient Transportation**
   A more productive and efficient operation, your turnaround windows will be shorter. Products will move seamlessly through all processes, from rack, through transport to the end consumer. This constant movement of goods consolidates loads, which in turn reduce transportation costs. Moreover, an effective packaging and labeling system greatly facilitates cross-docking, reducing the need for storage.

Packaging best practices

We have stressed how packaging choices are crucial to the day-to-day operations of your warehouse. But what are the best strategies for improving and streamlining packaging?

1. **Plan your packaging**
   Don't leave your packaging decisions until the very end of the production process or you might end up stuck with large, clunky and expensive pre-made designs that do not suit your product line. Outline how much space on the shelf each of your products will need then research the cost of each choice of package. Most importantly, draw a clear outline of the information needed on the packaging and labels to ensure maximum efficiency.

2. **Gather and analyze usage data**
   Record and monitor metrics for your packaging material usage and waste. Then keep tabs on price changes in the materials you use. Some material prices can fluctuate frequently. Purchase materials in bulk when possible for cost savings.

3. **Automate**
   Packaging automation can offer huge cost-savings along with the ability to run a faster and safer operation. For example, adding a stretch wrapper to eliminate hand wrapping of pallets will significantly reduce your labour costs. Streamlined packaging equipment will also help with injury prevention such as back injuries from manually wrapping pallet loads and carpal tunnel syndrome from repetitive motion during package assembly. Its worth to note that custom package automation comes at a cost – a high one. However, the long-term cost-savings benefits far outweigh the initial investment you'll need to make.

   Additionally, through carbonization, a robust warehouse software solution will help you with making the best packaging choices. The software assesses every and each item from an individual order to define the number and size of each carton needed to ship that order. It uses height, length, weight and width as parameters for its algorithm to determine the best way to pack individual cartons. The goal is to pack the order in the smallest cube size thus reducing material wastage as well as shipping costs.

4. **Go green**
   Sustainability is at the forefront of business conversations today as customers and investors are increasingly pressuring companies to up their environmental responsibility game. Consequently, many businesses are seeking innovative methods of boosting eco-friendliness. In addition to reducing material waste with your WMS' cartonization, favour recycled and/or easily recyclable packaging materials.

Recognizing the impact that packaging has on the overall operation of your distribution centre is crucial to sustaining growth and reducing costs. Take the time to properly analyse your current packaging practices and how they're affecting your business – positively or otherwise. Record your usage and wastage so you make smarter purchasing decisions.

Next, redesign your external packaging if necessary, to better suit your current racking system and operational procedures. Make sure to select eco-friendly materials that are robust and will protect your internal packaging.

We couple best-in-class functionality controlled by a series of switches and parameters with an available set of user-driven tools that allow you to build unique business processes. Your Operations and IT teams can own optimization and build differentiation -- no source code modifications or high services bills required. The result? Your supply chain becomes more agile in how it responds to organizational needs and environmental pressures with the lowest total cost of ownership.

4.16 SCRAP/WASTE DISPOSAL

Taking out the trash has never been an attractive task, but it is one that every company must contend with. Americans produce many millions of tons of waste annually, and about half of it is generated by commercial facilities, according to a study conducted by the U.S. Environmental Protection Agency. With a little forethought, planning and strategy, your waste removal tasks can benefit your company. After all, waste removal costs money and takes up time and space. By reducing the amount of waste generated, and changing the way garbage is sorted and handled, companies can cut costs and reduce their carbon footprints.

Separate Your Recycling

An effort to increase recycling in your facility has several perks. From the perspective of a consumer, a recycling program can boost your corporate image by showing that you're making a conscious effort to be more environmentally friendly. From a cost-cutting standpoint, increasing recycling also means reducing the amount of waste disposal needed. To begin or expand recycling in your warehouse, you'll need to first identify the materials you can recycle, then set up a way to collect those materials. Common recyclable materials include:

- Cardboard
- Plastic
- Cloth
- Metal
- Glass

Once items are sorted and collected, companies need to arrange transportation for the recycled material to the appropriate recycling facility. Some larger recyclables will require compacting, perhaps with help from balers strong enough to bind and press materials. Shredders can also lower the space requirements of paper waste. These pieces of equipment

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will reduce the space recyclable waste takes up at your facility as well as in vehicles hauling recyclables away. When you can increase the amount of waste being removed in one run, you reduce the total cost of commercial waste disposal.

Compact Your Other Waste

Reducing the amount of space that waste takes up as a means to lower waste removal costs also applies to non-recyclable materials. Compactors work similarly to balers, but instead of compressing recyclables, they're primarily used for garbage. Since fewer hauls are required to remove garbage, fees may be reduced. Another benefit of compacting trash at your facility is a lowered risk of pests. Rodents, insects and birds are attracted to garbage, so compacting waste can make your buildings less enticing to these disease- and contaminant-carrying animals. Think of it as a proactive form of pest control.

4.17 TRANSPORTATION MANAGEMENT

A key component of supply chain management is TMS or transportation management systems. A functional TMS helps simplify some fulfillment tasks and helps companies transport products in a very cost-effective manner. In addition, TMS also involves intermodal freight movements, comprising inbound, outbound, domestic, international and commercial shipments. The best thing about TMS is that it can seamlessly function within your company, or with a third party logistics provider (3PL) if you outsource your fulfillment.

Companies Implementing TMS

In basic terms, TMS is a supply chain tool that helps reduce additional freight costs. Employing a TMS strategy helps organizations immensely, as they can pair up logistics with functional analytics and optimization techniques to better manage their supply chain.

- **Warehouse Efficiency**
  While some might argue that a transportation management system has nothing to do with warehouse management, there is a direct correlation between the two. With a functional TMS solution on-board, companies can quickly dispatch the shipments, thereby saving a lot of time for performing warehouse duties. Moreover, with the TMS integrated alongside the ERP (enterprise resource planning), data entry issues and associated errors can be avoided. In a nutshell, TMS and WMS work together for improving the efficiency of the concerned supply chain framework.
- **Better Delivery Options**
  TMS helps optimize the shipping techniques for companies. It allows a brand to offer a wide variety of fulfillment options to the customers. Be it the inbound shipping programs or the pool-point shipping ideas, having a robust TMS can open diverse opportunities for the customers. This approach to shipping and fulfillment also covers multiple locations and serves as a precursor to the omni-channel customer experience. Lastly, a single point person with remote access can easily manage the entire delivery system for multiple networks.

- **Reduction in Inventory**
  Organizations dealing with surplus inventory issues are best served by having a TMS in their strategy. As companies can now ship products at a faster rate, it becomes easier for them to plan out the stocks in a better manner. This eventually minimizes the issues related to surplus stocks and can help businesses improve productivity.
- **Improved Cash Flow**
  A functional TMS can also help an organization improve the overall cash flow. With freight accounting made easy, improved cash flow is something businesses can expect going into the future. Moreover, TMS offers a leeway to the shippers as they can now save a lot of money by tweaking the structure of inbound logistics. By cutting out duplicate payments, inaccurate charges and other logistical pitfalls a company that implements a TMS is in a place to save on inefficiencies and improve their cash flow.
- **Advanced Analytics**
  The associated analytics that TMS provides will help identify low-cost shipping options for businesses, thereby helping companies further save money. With shippers having fewer issues to worry about, the entire management team can concentrate more on warehouse and inventory control.
- **Bottom Line**
  Over the past few years, it has become easier to implement a TMS solution to compliment the entire process of warehousing, fulfillment and inventory control. Because of the support and consolidation opportunities, businesses can save on additional costs without having to compromise on customer satisfaction levels. Linking a robust TMS with a highly efficient warehouse management system promotes better visibility of the entire supply chain, and can also improve the process of inventory forecasting and minimize errors along the way.

4.18 TRANSPORTATION DOCUMENTATION

When items are transported either domestically or internationally the delivery must be accompanied by the relevant documentation. The amount of documentation varies depending on if the shipment is within the US or to another country. As far as interstate transportation of goods in the US, there are three documents that are of the greatest importance; the bill of lading, freight bill, and the Free On Board (FOB) terms of sale.

Bill of Lading

The bill of lading is the most important document that is used in transporting goods. The legal definition of a bill of lading is a contract for the carriage of goods and a document of title to them. It provides any and all information that the carrier will need to transport the items. It contains the shipment origin and the contract terms for the transportation and is required by a carrier before the shipment is taken.

The bill of lading should include the name and address of the consignor and consignee, and often it will have the routing instructions for the carrier. It will contain a description of

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the goods to be transported, the quantity for each of the commodities, and the commodity class and rate.

The bill of lading will contain the terms of the contract for the movement of goods by a common carrier. This is the contract between the shipper and the carrier to transport the goods on the bill of lading to the consignee (i.e., the buyer). The bill of lading contract has nine terms:

- **Common Carrier Liability**: The carrier is liable for loss and damage of the goods being transported, except if the goods were improperly packed by the shipper or if the goods themselves would be liable to a normal loss like through evaporation. The carrier is not liable for acts of God, public enemy or public authority.
- **Delay in Transit**: The carrier cannot be held liable if the loss or damage is due to a delay in the transportation of the goods.
- **Freight Not Accepted**: If the goods are not accepted within the time allocated, the carrier can store the goods at a cost to the owner.
- **Extraordinary Value**: The carrier is not liable and does not have to carry items of extraordinary value that are not on the rated in the published classifications or tariffs unless a special agreement with the shipper has been negotiated.
- **Explosives**: The carrier has to be given full written disclosure when they are shipping dangerous material; otherwise, they are not liable for any losses.
- **Recourse**: The carrier cannot make additional charges to the shipper after making a delivery.
- **Substitute Bill of Lading**: If the bill of lading is a substitute or exchange for another bill of lading then the current bill of lading has to include all the clauses from previous documents.
- **Alterations**: The carrier must note any changes or additions to ensure that they can be enforceable.
- **Claims**: This clause specifies the details on how to file a claim against the shipper and the time period after delivery in which the claim will be accepted.

Freight Bill

The freight bill is the carrier's invoice to the shipper for all the charges that the carrier has incurred. The carrier's freight bill will include the details of the shipment, the items being shipped, the consignee, the origin, and destination, as well as total weight and total charges.

Some carriers can ask for prepayment from the shipper if the value of the items being shipped is less than the total expected freight charges. If the charges are not prepaid, then the carrier can present a freight bill on collect. This implies that the carrier will present the freight bill on the day of delivery.

FOB Terms of Sale

Free on Board (FOB) terms of sales documents which party will be liable for the transportation costs, which party is in control of the movement of the goods, and when

the title passes to the buyer. If the FOB terms of sale indicate that it is FOB Delivered, then this implies that the shipper will be responsible for all of the carrier's costs. If the terms of sale show FOB Origin, this means that the buyer will take the title of the goods when they are shipped and they will incur all the transportation costs.

4.19 INTRODUCTION TO SUPPLY CHAIN MANAGEMENT

Supply chain management (SCM) is the discipline that manages the flow of supplies through all of the stages of a production cycle. SCM applies to any organization that executes projects, produces goods or provides services, as those activities require a supply chain to maintain a steady flow of resources. That's where supply chain management comes in.

Supply chain management is very important in the business administration field because it affects other key business areas such as operations management, inventory control and quality management. But what really makes SCM so important is that it can also become an important competitive advantage for businesses.

A **supply chain** is like a network which provides facilities and options like distribution which perform operations like Procurement of material, transformation of these materials to specific intermediates and after than finish product and the distribution procedure starts which starts distributing respective products to customers. Following are some key points regarding supply chain.

In the previous times, all the organizations like marketing, distribution, planning, manufacturing and purchasing organizations work independently along the supply chain. Organizations have their independent objectives which are sometimes conflicting also. To work in an efficient manner there arises a need for through which these different functions are able to integrate together. Therefore, Supply chain management is a strategy came into arise through which such integration can be achieved.

Flows in supply chain:

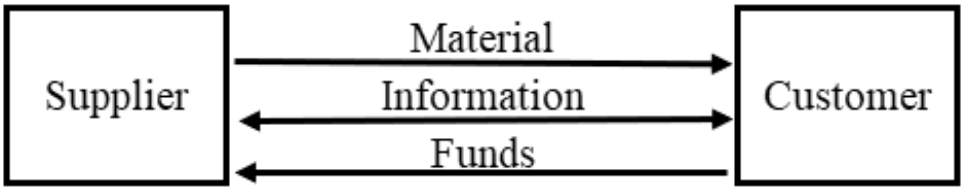

Figure: Flow in supply chain

Flow resembles a chain reaction. In this, there is a flow of material from supplier to customer. Both supplier and customer shares information. There is also a flow funds from customer to supplier.

Supply Chain Management in Supply Network:

- Supply chain management is responsible for management and control flows of material, information, and finances in supply chains.

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- Task of Supply chain management is to design, plan, and execute activities at different stages so as to provide desired levels of service to supply chain customers profitably.

Supply Chain Management Process

The supply chain process is fundamental to good supply chain management. It is used by companies to make their supply chain as efficient and cost-effective as possible and deliver customer value and give them a competitive advantage. There are five steps to the supply chain process. They are as follows.

1. **Planning**
   In order to control inventory and the manufacturing process, companies must plan to match demand with supply. This prevents overspending on warehouse space or not having raw materials needed for your manufacturing and slowing down delivery of product.
2. **Sourcing**
   This step involves finding those vendors who can get the goods and services you need when you need them. Sourcing is how you get supplies when you need them and meet the demand of your customers.
3. **Making**
   Here is where those raw materials you procured are made into the products that meet your customers' demand. This is where assembling, testing and packing occurs. Getting customer feedback is key to delivering customer value.
4. **Delivering**
   Getting your finished product to the customer is the next crucial step in the SCM process. If you're not able to get what you make to your customers all the previous steps are for naught. This makes delivering key to supply chain performance.
5. **Returning**
   Returning or reverse logistics is part of what's called post-delivery customer support process. It is important to have a clear channel for returns or risk tarnishing your brand. The company can then take these low quality, defective or expired materials and return them to their suppliers.

Parts of a Supply Chain Model

To get the most out of SCM requires looking at the big picture in terms of an organization's management. No longer is managing an individual company function enough. The integration of all activities involved in the supply chain is necessary: that means integration between different departments, such as purchasing and marketing. Supply chain management also needs integration and collaboration between buyers and suppliers, joint product development, common systems and shared information. Here are the most important parts of any SCM system or model.

- **Customer-Relations Management:** There must be a managed approach to interacting with the company's current and potential customers in order to understand what they want and expect.

- **Customer-Service Management:** This differs from customer-relations management in that it focuses on the interactions between the customer and the company instead of a more strategic management process. It helps facilitate a mutually satisfying goal for both customer and the company, as well as eliciting customer feedback and maintaining communications between the two parties, so there are positive feelings from both parties.
- **Demand-Management Style:** A methodology to forecast, plan for and manage the demand for products and services. This can address both macro-levels, as in global economics, but also micro-levels within the company.
- **Order Fulfillment:** The process that encompasses everything from point-of-sale interest to delivery of that product or service to the customer. It is the way a company responds to customer orders.
- **Manufacturing-Flow Management:** Manufacturing is a process, and supplies feed that process based on historic data surrounding how it has been done and what was needed historically. But that process needs flexibility as quantities change. Therefore, one must manage all activities related to planning, scheduling and managing the manufacturing process.
- **Supplier Relationship Management (SRM):** Supplies likely are coming from a third party, and those interactions must be strategically planned for. SRM is key to a healthy supply chain.
- **Product Development and Commercialization:** To reduce time to market, customers and suppliers are integrated into product vision and the product development process. Shortening the product life cycle keeps the company competitive. This process includes coordinating with customer relationship management to know customer needs, selecting materials and suppliers with procurement and developing a production technology in the flow of manufacturing to integrate the best supply chain flow for the product and market. When successful, this has a positive impact on cost, quality, delivery and market share.
- **Returns Management:** There will always be returns and the better they're managed, the more productive and competitive the SCM process. Management of this aspect of the SCM means fast and easy returns management, automation and deciding how to process returned materials. Make sure information is visible to capture early in the process. Then control the flow of product, including receipts and reconciliation, noting if there are any quality issues.

4.20 IMPORTANCE OF SUPPLY CHAIN MANAGEMENT

1. **Supply chain planning and collaboration** –
   With SCM user can model his/her supply chain, set goals, optimize and schedule time. It enables users to maximize returns on assets and ensures a profitable match of supply and demand.

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2. **Supply chain execution** –
   It enables users to carry out supply chain planning and generate high efficiency at the lowest possible costs.
3. **Supply chain visibility design and analytics** –
   SCM gives user a network-wide visibility across your extended supply chain to perform strategic and as well as day-to-day planning.
4. **Business benefits** –
   It allows his users to transform a traditional linear supply into an adaptive network with the following benefits :
   - Faster response to changes in supply and demand
   - Increased customer satisfaction
   - Compliance with regulatory requirements
   - Improved cash flow
   - Higher margins
   - Greater synchronization with business priorities

4.21 EVOLUTION OF SUPPLY CHAIN MANAGEMENT

Supply Chain Management is the process in which a company manages the flow of its goods and services from the point of origin to the point of consumption. This process involves movement & storage of raw materials, work-in-process inventory, finished goods, end to end order fulfillment, movement of finished goods from manufacturer to warehouse, and then to the destination of final consumption. While this process sounds easy, it takes a ton of workforce to complete this process, especially for companies with a large number of products/services, multiple vendors, different warehouse locations, different retail stores, etc.

The Stages of evolution in Supply Chain Management

There are a total number of 5 stages in the evolution of the supply chain industry. These 5 stages include:

- **Stage 1 – Consolidation**
  Starting from the early 1980s, businesses focused on products. They focused more on quality and the key performance metrics were – inventory turns and production cost. For the purpose of achieving inventory turns, small companies began merging into larger organizations. This also led to organized planning of the production cost which further resulted in becoming a good solution for most businesses.
- **Stage 2 – Integration**
  In the late 1980s, businesses shifted their focus from products to the volume of output. Keeping a close eye on the cost, the key performance metrics for Stage 2 of the supply chain evolution turned out to be production capacity and throughput. Companies that started making profits in the earlier stage now analyzed that just production cost will not help them in making more profits. And for this reason,

the rate of production and the volume of production became important. By the end of this stage, companies found their solutions.

- **Stage 3 – Market Value**
  Then came the third stage of the supply chain evolution which began in the early 1990s. Organizations in this stage started to focus more on market-driven results. The key factor of this stage of evolution was product availability and the performance metrics were clearly – market share and order fill rate. Now the problem was not about making more products but about delivering them to the markets. So, by the end of this stage, businesses had the solution again and were onto their next stages of growth for even better results.
- **Stage 4 – Brand Value**
  During the late 1990s, firms analyzed that customers were the game changers for revenue generation. This is when they shifted their business strategies and made 'lead time' the key factor in their goals. With this, the key performance metrics changed from market share and order fill rate to customer satisfaction, value-added, and response time. Companies now had the time to analyze that products that were made with a prime focus on customers were what sold out more. That's how companies started focusing on products that added value to their companies.
- **Stage 5 – Automation**
  The twenty-first century is more driven by knowledge and that is why having more information is preferred to be ideal for a company's supply chain management. The key performance metrics for the 5th stage of supply chain management is real-time communication and business intelligence. Over the years, with a growth in each segment of the supply chain, employment has also increased. With more people in the circle, communicating every little detail to each person has become a task. The process of storing information also began to get hectic and for all these reasons, automation started out to be the focus for companies to grow.

4.22 SCM PRACTICES

In the current highly competitive economic environment it is necessary to transform and improve your supply chain management practices so that you can produce great results while containing costs. One of the best ways to go about this is to adopt the processes, methods, and philosophies of the supply chain management best practices. With a wide range of supply chain management courses available today, there is no excuse in failing to prepare your organization adequately to be as efficient as possible, and implement supply chain best practices.

1. **Create A Supply Chain Management Council:**
   The work of the governing council is to provide direction and align the supply chain best practices with the organization's general strategy. The members of this council are drawn from all the top managers in the firm to the top corporate executives. This council helps to eliminate obstacles to success within the various parts of the organization by providing a highly effective cross-functional forum for communication.

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2. **Use Technology to Use Your Benefit:**
   Most companies are choosing software that they hope is going to improve their efficiency, and then they arrange their processes and workflows around that selected technology. In this case, the supply chain management best practices require that you first review your processes to determine which ones need improvement. It is only after this review that you should choose the right technology that meets those specific process needs.
3. **Establish Relationships With Your Main Suppliers:**
   One of the supply chain best practices is to create a lasting partnership with suppliers long after signing a deal. However, to completely maximize this relationship, it must be a two-way communication where both the seller and buyer are actively managing the relationship. With a good alliance management system in place, it will be easier to capitalize on your buyer/supplier relationship to ensure sustained value and constant improvement.
4. **Let Contracts Be Part of the Supply Chain Functions:**
   Buying and procurement teams usually negotiate high potential during sourcing but never realize those huge saves fully. More companies today are choosing to move the contract management responsibility to be handled by the supply chain unit, rather purchasing, operations, finance or legal. This is one of the supply chain best practices that allow managers to leverage the organization's expenditure, especially in areas where there are great opportunities for risk mitigation and cost reduction.
5. **Green Initiatives Must Be Taken Seriously:**
   Reducing the carbon footprint of your supply chain is not just nice any longer, but a necessary practice. Besides improving your overall efficiency, going green will also help you reach more consumers who are considering environmental impact when they select suppliers. It is also helpful for cost reduction in logistics management and supply chain management. That is why more services providers and suppliers are being asked to provide tangible information about what green initiatives they are taking in their supply chain best practices.

4.23 DESIGNING SUPPLY CHAIN

An effective network design should be able to answer the following questions:

- What roles do the facilities play and what are the processes performed by them?
- Where must these facilities be located?
- Which markets shall these facilities serve?
- How much capacity shall these facilities be allocated so as to perform consistently?

Once a facility is clear about these decisions, then it is very easy for them to perform consistently and become all the more "Flexible" in their operations. Capacity allocation has a significant impact on the supply chain's performance. This is because capacity of any facility can be altered easily as compared to the location of the facility. However, even these decisions need to be made correctly, as proper allocation of capacity to a facility helps to

maintain or reduce costs and thereby optimum utilization of the facility can be achieved. But, if more capacity is allocated to a facility or even less capacity is allocated, then it becomes difficult for a company to satisfy the demand of the customers that are closer or further from the facility.

The allocation of the various supply sources and also the allocation of particular markets for a particular facility has a significant impact on the supply chain performance. This in turn it affects the production and transportation costs and also the inventory that a supply chain must serve in order to satisfy the customer demand. Thus, this decision must be reviewed from time to time so that the allocation of capacity, markets and supply sources can be altered as and when the demand arises.

The whole supply chain configuration can be altered on the basis of the decisions made on the supply chain network design. These decisions also help to prepare restrictions within which the inventories, transportation and most importantly, information can be utilized to increase or decrease the supply chain responsiveness and the supply chain costs.

4.24 SUPPLY CHAIN AND COMPETITIVE PERFORMANCE

A supply chain is the network of relationships between the upstream and downstream activities with all stakeholders who are involved in this chain of relationships. To take an example, if a particular good or service has to be delivered to the customer, there are raw materials that are needed for the manufacture, the forms of transport and means of storage for the raw materials, the transport of the finished goods to the retailers and the logistics involved in getting the goods to the customer are all parts of the supply chain that extend from the suppliers to the customers. In other words, there is a chain of relationships between the firm and the partners involved in this chain.

Therefore, supply chains are comprised of all these stakeholders and the relationships between them determine the effectiveness of the supply chain. In contemporary times, supply chains can be sources of competitive advantage as efficient management of the supply chain leads to cost savings and synergies between the components of the supply chain leads to greater profitability for the firms. It is for this reason that many business leaders have focused their energies on optimizing the supply chains for increasing the top line as well as the bottom line.

Supply Chains as Strategic Levers

In times of economic recessions, supply chains can be used as strategic levers as they can be optimized to perform better than the rivals do so that more profits can be extracted and lesser costs incurred. The optimization of the supply chain through just in time or JIT methods of holding inventory, focus on reducing the COGS or the Cost of Goods Sold by rationalizing the expenditure on the components of the supply chain all lead to a situation that can be extremely beneficial to the firms. It is for this reason that many firms like Wal-Mart, Proctor and Gamble, Tata Motors, and Unilever has focused on rationalizing the activities that form the supply chain. The point here is that with astute management of the supply chain, the firms can derive value from the process, which can then translate into greater profits and lesser costs. Apart from this, the supply chains can also be of strategic

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and competitive advantage because a major portion of the cost of goods sold or COGS is made up of the logistics and the supply chain expenses.

4.25 CHAPTER SUMMARY

The purpose of logistics management is to manage several processes in the supply chain and provide the highest degree of accuracy to meet the customer demands. It creates visibility with real-time data to optimize the delivery process and avoid disruptions. Integrated logistics is a business management model that is increasingly used to accelerate product delivery and improve customer service. In this model, all departments, processes and resources are aligned to work in perfect sync and operate as one cohesive unit. This results in seamless operations and ensures that customer orders are dispatched quickly.

As logistics involves several departments, the integrated model emphasizes the need for teamwork to optimize performance. Cross-functional collaboration also gives companies a competitive advantage and helps them adapt quickly to changes in consumer demand.

Warehouse management encompasses the principles and processes involved in running the day-to-day operations of a warehouse. At a high level, this includes receiving and organizing warehouse space, scheduling labor, managing inventory and fulfilling orders. Zoom in closer and you'll see that effective warehouse management involves optimizing and integrating each of those processes to ensure all aspects of a warehouse operation work together to increase productivity and keep costs low.

4.26 REVIEW QUESTIONS

SHORT ANSWER TYPE QUESTIONS

1. **Why Does Warehouse Material Handling Matter?**
2. **What do you understand by Freight Bill?**
3. **Explain the process of supply chain management in brief.**
4. **What is a supply chain? Give a detail account of evolution in supply chain management.**
5. **Why Does Warehouse Material Handling Matter?**

LONG ANSWER TYPE QUESTIONS

1. **What do you understand by supply chain and competitive performance?**
2. **Explain SCM Practices in detail.**
3. **Explain Transportation Management in detail.**
4. **What are the best strategies for improving and streamlining packaging?**
5. **Explain the different E-Business models in detail.**

4.27 MULTIPLE CHOICE QUESTIONS

1. **The goal of logistics is _____.**
   a. To achieve a target level of customer service at lowest possible cost.
   b. To achieve a targeted level of customer service.

c. Increase in the market share.
d. All of the above.

2. **The purpose of supply chain management is_____.**
   a. Provide customer satisfaction
   b. Improve quality of a product
   c. Integrating supply and demand management
   d. Increase production

3. **Logistics is the part of supply chain involved with the forward and reverse flow of :**
   a. Goods
   b. Services
   c. Cash
   d. All of the above.

4. **The major decision areas in supply chain management are _____.**
   a. Planning, production, distribution, inventory
   b. Location, production, scheduling, inventory
   c. Location, production, inventory
   d. Location, production, distribution, marketing

5. **Distribution requirements planning is a system for _____.**
   a. Inventory management
   b. Distribution planning
   c. Both 'a' and 'b'
   d. None of the above.

6. **Which can be defined by having the right item in the right quantity at the right time at the right place for the right price and is the science of process and incorporates all industry sectors _____.**
   a. Logistics
   b. SCM
   c. Transportation
   d. Shipment

7. **Activities associated with storing and physically distributing the products to the buyers are included in which logistics _____.**
   a. Inbound
   b. Outbound
   c. 3PL
   d. 4PL

8. **The following is not a part of logistics functions of any organization _____.**
   a. Procurement
   b. Payment follow-up
   c. Storage
   d. Distribution

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9. Which is the systematic, strategic coordination of the traditional business functions :

a. SCM
b. Logistics
c. Transportation
d. Dispatching

10. 3-PL stands for :

a. Three points logistics
b. Third party logistics
c. Three points location
d. None of the above

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UNIT V

GLOBALIZATION IN BUSINESS

STRUCTURE

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5.1 LEARNING OBJECTIVE

After completing this unit, students will be able to:

- Understand about the management of Global Logistics.
- Know about the Global Supply Chains.
- Learn about Global Logistics.
- Understand the Process of Global Logistics Management.
- Understand about the Process of Global SCM.
- Know about Global Sourcing and Global Distribution.
- Know about Free Trade Zones.
- Learn about the Role of IT in Logistics Management.
- Know about CAD and CAM.
- Learn about CIM, ERP and MRP.
- Know about Logistics Information Systems.

5.2 INTRODUCTION

This unit will help students understand globalization, its history, the elements it comprises, and the current trends. It also provides resources for keeping current with the latest research on the subject for further exploration. Global integration, driven by technology, transportation, and international cooperation, has resulted in our present-day interconnected world. Increased flow of goods, knowledge and people across borders brought prosperity to many countries, lifting many people out of poverty. Countries benefit from comparative advantage of specializing in what they do best as participants of the global economy by producing more goods at lower prices that lower-income households can afford thus raising their living standards.

Current labor market landscape reflects our deep economic interconnections. While many manufacturing workers lost their jobs to cheaper labor overseas there are a number of industries dependent on migrant workers. Critics of globalization point at the loss of manufacturing jobs as a downside of globalization. Many economists, however, have concluded that overall benefits of globalization outweigh the costs to individual workers or groups and suggest putting in place domestic policies that help workers adapt to the changing job market rather than limiting free trade. This and many other debates on pros and cons of globalization, and current trends are discussed in the resources included in this guide.

Even though the term 'globalization' came into more common use in the 1980s, it is not a 20th century phenomenon. This guide offers sources for exploring the history of globalization that can be traced back for centuries. While our interconnections encompass nearly every aspect of life this unit focuses on globalization, mainly technological progress.

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5.3 MANAGING GLOBAL LOGISTICS AND GLOBAL SUPPLY CHAINS

The globalization of the supply chain continues despite disruption and trade tensions. New services and technologies offer value to managing global logistics and supply chains.

Management of Global Logistics Means More Risks and Volatility

Technology advances and growing awareness about the benefits of supply chain management solutions is driving growth. Global logistics market growth is forecast to continue at a 6.5% CAGR from 2021-2029, according to Research and Markets. Global supply chains are inherently longer. They present more exposure to risks and disruption. Natural disasters, health epidemics, changing tariffs, and aging infrastructure affect supply chain volatility. Uncertainty becomes self-propagating, resulting in additional risks throughout the industry. For instance, rising ocean shipping rates and U.S. diesel fuel prices, as well as changing surcharges can drive higher transport across the supply chain. These risks contribute to the likelihood of less available capacity, undermining efficiency, and leading to volatility, notes Logistics Management.

Global Logistics Leads to More Variability and Trouble in Demand Planning

The complexity of managing global logistics also leads to added variability. Variability describes the difference between expectations and actual events. Longer supply chains are subject to more risks, so the final activities may not reflect the planned activities. This creates challenges in demand planning, such as ordering raw materials, working with business-to-business retailers, and available capacity.

Longer Supply Chains Often Lack Visibility

Longer supply chains typically translate to less visibility. Decreased visibility derives from the continuous transition between carriers, freight brokers, third-party services, and modes. Estimates of the lack of visibility remain near 40%. Without visibility, revenue losses become more severe and disruption risk increases.

Language and Cultural Barriers Remain

Barriers between countries, ports, trade regulators, freight forwarders, 3PLs, and business-to-business partners are another challenge in managing global logistics. Failure to consider the obstacles may result in inaccurate shipment processing and the inability to collect payment. Meanwhile, incompatible systems may lead to additional delays and headaches for shippers and logistics service providers.

Solving the Challenges with A Global Transportation Management Platform

Investing in a transportation management system (TMS), or a dedicated platform, overcomes the challenges of managing global logistics in several ways. Benefits include:

- **Data-driven capabilities help manage volatility.** Since the TMS gives you better control over all your transportation data, shippers and users can apply this data to handle fluctuations and changes in demand.
- **Decreased variability.** More information improves your ability to ensure actual activities reflect planned activities.

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- **Improved, centralized controls increase visibility.** Breaking down data silos and sharing information through a centralized TMS increases visibility, improving responsiveness along the way.
- **Cross-border use ensures compliance with applicable regulations and overcomes language and cultural barriers.** Keeping all documents and compliance measures within the TMS improves compliance and eliminates concerns over language and cultural barriers.
- **Advanced systems rely on EDI and APIs** to connect to "incompatible" systems. Modern systems can communicate automatically and reduce the risk of lost information, while also optimizing scheduling and management.

What Is a Global Supply Chain?

A global supply chain definition is pretty straightforward: It is the worldwide system that a business uses to produce products or services. That sounds simple enough, yet a global supply chain can be anything but. There are so many facets that need to be in sync. Employees—the information they need to keep the system running, the resources that they use—and even the tools businesses use to stay compliant with government regulations can be considered part of a global supply chain.

Global Supply Chain Benefits

Granted, at first glance, you wouldn't think extending a supply chain around the planet would help a business bring down the price of their final product or service. (Freight and transportation obviously will always add numbers to the bottom line.) But many countries have lower production costs that make it attractive to expand a supply chain to other parts of the world.

You also may be able to bring down expenses by purchasing goods and services from a supplier when the dollar is stronger against the national currency of the country that you're doing business with.

But another benefit is that a global supply chain can make it easier to sell to customers around the world. If your company has outposts in the supply chain throughout, say, Asia and Europe, your business may find it easier to start selling to those parts of the world as well. You're also potentially spreading your risk by having a global supply chain. Let's say you didn't have a global supply chain, and your supply chain was relegated to one particular region. If that area had a severe natural disaster, you could see your entire business come to a halt for a few days, weeks or even longer, depending on how bad of a disaster we're talking.

Of course, you could argue that you're increasing your risks by having a global supply chain. Odds are, something will go wrong somewhere along the chain. But the better the supply chain management, the lower those risks can be.

What Types of Business See the Most Success from Global Supply Chains?

Many manufacturing companies can benefit from a global supply chain, and certainly any business that wants to be an international force and sell to countries around the world is going to need a robust system for getting its products or services from Point A to Point B.

Food and beverage, mining companies, oil and gas, electronics and the textile industries are just a few of the many that thrive with global supply chains. If your business produces a product to sell to the public on large scale, you may do well to have a global supply chain, if you don't have one already.

5.4 GLOBALIZATION OF BUSINESS

Globalization refers to the way that people around the world have become more connected politically, economically and socially. We are moving away from self-contained countries and toward a more integrated world. Globalization of business is the change in a business from a company associated with a single country to one that operates in multiple countries.

Impact of Globalization

The impact of globalization on business can be placed into two broad categories: market globalization and production globalization. Market globalization is the decline in barriers to selling in countries other than the home country. This change will make it easier for your company to begin selling products internationally, since lower tariffs keep consumer prices lower and fewer restrictions when crossing borders makes it easier for a company to enter a foreign market. It also means that companies must consider other cultures when developing their business strategies and potentially adjust the product and marketing messages if they aren't appropriate in the target country. This may not be an issue in the camera industry, but a hamburger company entering India would definitely need to revisit their product and strategies to be successful!

Production globalization is the sourcing of materials and services from other countries to gain advantage from price differences in different nations. For example, you might purchase materials and components for your cameras from multiple countries and then assemble the product in yet another international location to reduce your costs of production. This change should lead to lower prices for consumers since products cost less to produce. It also impacts jobs, since production may shift from one country to another, usually from more developed countries to less developed countries with lower average wage rates.

5.5 GLOBAL LOGISTICS

What Is Global Logistics?

Global logistics connects critical components of the supply chain from a product's point of origin to its point of consumption—to ensure timely and efficient distribution of goods from producers to consumers. In 2016, the global volume of merchandise trade was Rs. 16 trillion, according to the World Trade Organization. The global logistics industry facilitates this worldwide flow of goods.

Global logistics is the process—largely a science but also an art—of managing the flow of goods through the supply chain, from the place where they are made to the place where they are consumed. It might involve shipping seeds and fertilizer to a grain farmer, sending harvested grain to a processing mill, trucking flour to an industrial bakery, sending containers full of loaves of bread to a distribution center, and then delivering them to restaurants. Global logistics involves the movement of goods—by truck, train, ship, or

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plane—as well as preparation, packaging and storage of goods in distribution centers and other logistics real estate facilities.

What kinds of companies operate in the Global Logistics Industry?

Global logistics requires close and intricate collaboration between a host of business partners. Shipping companies, airlines, railroads and trucking companies move goods. Global delivery services manage the movement of goods. Logistics real estate companies own and operate facilities that are essential nodes for transport, management and storage, while a host of service providers provide the software, security, labor and business intelligence that keep the global logistics system working. Prologis, a leading global logistics company, provides efficient logistics real estate solutions around the world. Prologis, the leading global logistics company, provides efficient logistics real estate solutions around the world.

What drives demand for the Global Logistics Industry?

Growth in global logistics is fueled by three fundamental trends: increasing consumption, rising e-commerce and ongoing reconfiguration of the supply chain to move goods more quickly and efficiently. The enduring strength of these trends across the world means is an indication that global logistics will continue to play an essential role in the world economy.

What considerations do companies make in considering where to build components of the Global Logistics System?

Time, cost and quality are key drivers of success in global logistics. As a consequence, location is a leading consideration. Other considerations include cost and availability of suitable labor; presence and reliability of essential business partners; geopolitical and geographic risk and stability. Because global logistics connects critical components of the supply chain—from a product's point of origin to its point of consumption—to ensure timely and efficient distribution, location is a key success factor for distribution centers, transport hubs, terminals and other infrastructure. Typically, the most functional and compelling infrastructure is located near or adjacent to highly trafficked transport routes and dense population centers to serve large numbers of consumers.

5.6 GLOBAL LOGISTICS STRATEGIES

Global Logistical considerations have always played a strategic role in business. Among retailers and wholesalers, they transcend inventory management and transportation to include one of the most critical factors in business success—location in relation to markets or sources of supply. Among manufacturers, logistics concerns itself with matters as basic as plant location, sourcing of raw materials, and standards of customer service. In recent years, changes in the business environment have forced companies both large and small to pay particularly close attention to how this function relates to others. Government regulation, the health of the nation's transportation system, energy restrictions, and technological developments all represent important considerations in the formulation of a business strategy. As the author shows in this article, many companies have responded to these challenges by developing competitive strategies based in part on such concepts as postponement and speculation, standardization, consolidation, and differentiation. These are companies in which management has conducted either formal or informal logistics

audits, has redesigned systems to provide more effective support for corporate strategies, and has taken steps to ensure continued appraisal of opportunities over the long run.

Global Logistics can spell the difference between success and failure in business.

Logistics-oriented strategies are also important in large companies. As an example, one of the world's largest chemical manufacturers recently had to replace its ships. The ships carried materials in bulk from plants in the Caribbean to Gulf and East Coast ports for subsequent transfer to barges and rail cars for delivery to terminals at which customers' orders were packed into containers for final delivery by rail and truck. Instead of merely replacing its ships with more modern versions of the same design, the company instead is converting its entire distribution system to one using containers.

This system requires that orders processed in Puerto Rico be shipped in containers that will be delivered direct to customers in the eastern United States by a combination of river barge, rail, and truck. As a result:

- Repackaging at all inland terminals eventually will be eliminated
- Material handling costs and capacities at Gulf and East Coast port facilities will be greatly reduced
- Because of the increased frequency of departures of ocean-going container barges from plants, orders will be delivered to customers with little or no increase in order response time and only a small increase in total inventory in the system.

Because of the company's sales volume, it is unlikely that competitors will be able to emulate the program even though their geographic production and transport patterns are similar.

What do these examples have in common? They all involve decisions that are long-term in their implications. All involve actions that are big-dollar in relation to the overall size of the companies in which they are implemented. All provide a competitive advantage that, unlike pricing or other actions, is hard for competitors to duplicate. And they all are based on nontraditional approaches to logistics, encompassing those activities that facilitate product movement and the coordination of supply and demand in accomplishing specified cost and service objectives, as suggested in Exhibit I.

These are but three of a growing number of companies that place major reliance on logistics in their business strategies. In this article I shall explore the reasons behind the rebirth of interest in this method of developing competitive advantages, the common elements of successful logistics-oriented strategies, the questions to be asked in auditing the extent to which your management has taken advantage of opportunities for making logistics an integral part of its strategy, and the ways of factoring logistics into strategy formulation.

5.7 GLOBAL LOGISTICS MANAGEMENT PROCESS

No matter what the idea or concept, its success depends on effective and efficient management and implementation. This is especially true in the case of supply chain management. There are several factors that contribute to effective logistics management. Automation and perfect coordination are two of these factors that enable efficiency in

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logistics management, and make it more effective. However, improvement is a constant process, and must never come to a standstill.

As the business experiences growth and expansion, the logistics planning processes must get updated and streamlined to improve general output, and make the management processes more effective. A know how of some crucial tips to manage logistics more effectively is of great value.

The Key Tips for Effective Global Logistics Management process include:

1. **Proper Planning**

   A good planning structure is the foundation of any management process. Planning encapsulates many factors, like procuring of goods, storage facilities, and delivery of products to the exact locations. Time, transportation, and costs are the other factors that are a significant part of a planning structure. A supply chain operative should be equipped to devise the flow chart for the whole operation. Maximum output on minimum input is the mantra of efficiency. A good planning aims to attain maximum work in the least possible time, and also, at the same time, the planning aims at maximizing the profits.

   When devising a good and effective logistics management plan, an experienced manager is an asset as they are able to plan and prepare for the unforeseen circumstances as well. These unforeseen situations can be related to and involve: -

   - The products
   - Unavailability of transportation
   - Any internal issue in the organization
   - Research and selection of the correct Freight

   A contingency plan is needed to tackle emergency situations, and must be put in place to avoid any logistics failure. All Logistics planning processes are incomplete without an emergency plan in place.

2. **Automation**

   In the digitalized, technology dependent scenario of today, Automation plays a major role in increasing the efficiency of an organization. Also, automation is a vital factor in business process optimizations. Logistics industry is fast becoming technology driven. There are valuable software available, which can be deployed in the logistics processes to improve its efficiency and effectiveness. Business process software, that provides timely updates regarding the movement of goods, can be integrated to track movement, create transparency, empower safety network and provide good customer experience, and thereby improve efficiency of the management process.

   Through the business process software that tracks movement of goods, the operator and the client can be provided with details regarding: -

   - Goods that are dispatched from the supplier
   - Procurement of goods at the warehouse
   - Delivery of the goods at the destination

This saves a considerable amount of time because manual interference is eliminated. Moreover, automated tracking system provides accurate tracking, and thereby helps in improving overall process management and makes the logistics planning effective. Automation also helps in managing and organizing the account details and employee details accurately, by using specific software developed for these tasks. Therefore, the logistics firm should embrace technology to enhance and increase productivity.

3. **Value Relations**

For any organization, its team is a most crucial component. The team is responsible for the growth and success of the company. The delivery guy, the warehouse manager, everyone has a defined role and importance, and all should be perfect in their respective field of work. To ensure work efficiency, it is important to invest in proper training of the employees. Regular training workshops help to keep the employees updated with the latest trends in the logistics industry. This helps in enhancing and increasing work and management efficiency, and also enriches the customer experience, and ensures customer satisfaction.

At times plans go awry and things don't unfold according to the plan. Such situations need to be tackled sensibly, without panicking. At such moments, a reliable person who can sort out the sticky issues with utmost efficiency is most needed. Hence, undoubtedly a Logistics manager equipped with impeccable interpersonal skills is a crucial asset for the organization. It is an added advantage if the manager has authoritative contacts in the industry as this opens business opportunities for the company.

4. **Warehouse Management**

A good warehouse management is an integral part of effective logistics management. Warehouse operations structure and planning vary with the type of goods they deal in. Perishable goods, such as dairy products, need refrigeration facilities. Grains are stored in moisture free environment. Similarly, the specifications of the warehouse operations and management depend upon the type of products and goods. It is important for the logistics firm to develop an accurate warehouse inventory to ensure that there is minimum wastage of goods.

It is also important to maximize the storage capacity of the warehouse. Vertical storage columns are a great way to maximize storage space utilization and is highly recommended. When there is bulk storage, locating a product can become chaotic and time consuming. A software application for sequencing the products is of great value as it effectively and efficiently locates the product when needed, without delay. Software applications and other warehouse operations need skilled handling. Hence, all the warehouse staff should be well-trained for the warehouse operations.

5. **Efficient Transportation**

Efficient management of Transportation department can help reduce the expenses of the logistics firm, and make it more cost-effective. The transportation department can be revamped for faster delivery of the products, making it more time-effective. For efficient transportation management and operations, it is important to Determine the best delivery route. A logistics firm should opt for

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the shortest, yet safest route. This is both, cost-effective and time-effective. Create cost-effective packaging that ensures low investment and safety of goods as well. Optimized packaging that occupies less volume and does not increase the weight of the package, is important and

6. **Measure and Improvise**
   For a complete Logistics network optimization, integrating measurement, analysis, and feedbacks is essential. Whenever new strategies are deployed in the system, the output needs to be measured. This is important as it intimates the success or failure of the strategy. Measurement tools and software applications that easily determine and classify the information, as per the requirement, are an asset and crucial for the efficiency of logistics management. The future planning is majorly dependent on the measured information, as it helps define the future course of action, upgrades, corrections etc. Metrics related to different operations must be analyzed thoroughly. Metrics include:
   - Cycle time metrics
   - Cost metrics, and
   - Service metrics

5.8 GLOBAL SUPPLYCHAIN MANAGEMENT

Global supply chain management involves planning how the entire supply chain will function as an integrated whole, with the aim of generating an optimum level of customer service while being as cost efficient as possible. Other aims include increasing the speed by which your product reaches your customers, as well as flexibility in dealing with customer transactions. It incorporates management processes that integrate the network of suppliers, manufacturers, warehouses and retail outlets so that the right type of goods are sourced, supplied, produced and shipped in the right quantities, to the right locations, at the right time and are received in sound condition. To achieve successful integration, flows of information (such as purchase orders, shipping notices, waybills and invoices), materials (including raw and finished products) and finances (payments and refunds) through the supply chain must be co-ordinate effectively.

The benefits of global supply chain management

In the modern global marketplace, advances in communications and transportation technologies have led customers to expect a steady and regular supply of products in good condition at the lowest possible price, despite the long distances most products, commodities and foodstuffs are shipped. Companies must always be looking for ways to improve the functioning of their supply chains to ensure that their supply meets projected demands cost effectively. If they do not produce sufficient product to meet demand, they will lose customers. If they produce too much product, they must pay for expensive warehousing of the excess inventory, which they might not be able to sell. If supplies are not sourced carefully and production is not monitored, companies might be faced with mass product recalls or returns. These can result in financial ruin for a company. The cost savings provided by supply chain management enhance additional cost-cutting

manufacturing methods and strategies that many international companies have already instituted. **These strategies include the following:**

- Just-in-time (JIT) manufacturing (reducing inventory levels, overall costs, product variability and production times, and also improving product quality)
- Lean manufacturing (producing goods using less manpower, raw materials, time and space)
- Total quality management (embedding awareness of quality in all operational strategies)

Global supply chain management has many benefits for a company. It enables business processes to be organized using international organizations that be reduced, companies can react rapidly to unforeseen market conditions, transport strategies can be improved, costs can be minimized and waste can be eliminated. You can get your product to market substantially more quickly. Small- and medium-sized businesses benefit as well. These smaller organizations, especially with niche technologies or specializations, can now sell to multinational organizations or to their suppliers. Many of these large firms have started outsourcing activities that were carried out internally in the past.

5.9 PROCESS OF GLOBAL SCM

The supply chain management process is composed of four main parts: demand management, supply management, S&OP, and product portfolio management.

1. **Demand management**
   Demand management consists of three parts: demand planning, merchandise planning, and trade promotion planning.
   - Demand planning is the process of forecasting demand to make sure products can be reliably delivered. Effective demand planning can improve the accuracy of revenue forecasts, align inventory levels with peaks and troughs in demand, and enhance profitability for a particular channel or product.
   - Merchandise planning is a systematic approach to planning, buying, and selling merchandise to maximize the return on investment (ROI) while simultaneously making merchandise available at the places, times, prices, and quantities that the market demands.
   - Trade promotion planning is a marketing technique to increase demand for products in retail stores based on special pricing, display fixtures, demonstrations, value-added bonuses, no-obligation gifts, and other promotions. Trade promotions help drive short-term consumer demand for products normally sold in retail environments.
2. **Supply management**
   Supply management is made up of five areas: supply planning, production planning, inventory planning, capacity planning, and distribution planning.
   - Supply planning determines how best to fulfill the requirements created from the demand plan. The objective is to balance supply and demand in a manner that achieves the financial and service objectives of the enterprise.

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- Production planning addresses the production and manufacturing modules within a company. It considers the resource allocation of employees, materials, and of production capacity.
- Production/supply planning consists of:
- Supplier management and collaboration
- Production scheduling
- Inventory planning determines the optimal quantity and timing of inventory to align it with sales and production needs.
- Capacity planning determines the production staff and equipment needed to meet the demand for products.
- Distribution planning and network planning oversees the movement of goods from a supplier or manufacturer to the point of sale. Distribution management is an overarching term that refers to processes such as packaging, inventory, warehousing, supply chain, and logistics.

3. **Sales and operations planning (S&OP)**
   - Sales and operations planning (S&OP) is a monthly integrated business management process that empowers leadership to focus on key supply chain drivers, including sales, marketing, demand management, production, inventory management, and new product introduction.
   - With an eye on financial and business impact, the goal of S&OP is to enable executives to make better-informed decisions through a dynamic connection of plans and strategies across the business. Often repeated on a monthly basis, S&OP enables effective supply chain management and focuses the resources of an organization on delivering what their customers need while staying profitable.
4. **Product portfolio management**

   Product portfolio management is the process from creating a product idea creation to market introduction. A company must have an exit strategy for its product when it reaches the end of its profitable life or in case the product doesn't sell well.

   Product portfolio management includes:

   - New product introduction
   - End-of-life planning
   - Cannibalization planning
   - Commercialization and ramp planning
   - Contribution margin analysis
   - Portfolio management
   - Brand, portfolio, and platform planning

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5. **Supply chain management best practices**

To succeed in a growing global market, you need a supply chain that's connected from start to finish, across your enterprise and beyond. Here are five steps we recommend to achieve connected supply chain planning.

- **Make the move to real-time supply chain planning**

  When using ERP systems and spreadsheets for planning, companies typically rely only on historical data, resulting in little wiggle room for changes should any disruptions occur in demand or supply. For example, based on the previous year's numbers, a company can estimate the number of products it will sell in the next quarter. But what if a massive hurricane destroys a key distribution center, leading to too little supply on the shelves? With Ana plan's real-time connected supply chain planning solution, you can create "what-if" scenarios and plan more effectively so you're ready when disruptions occur.

- **Unify supply chain planning with enterprise planning**

  A vital second step is connecting traditionally siloed supply chain planning to sales and operations planning and financial planning. Companies can benefit from synchronizing their short-term operational planning with their wider business planning processes to make real-time updates to inventory forecasts and supply. Deploying real-time S&OP solutions that enable enterprise-wide collaboration means that key stakeholders across the business can create new scenarios and quickly assess how to use their resources to optimize profitability when an unforeseen event happens.

- **Anticipate the demand of the end customer**

  For consumer packaged-goods companies, anticipating what customers want and when they want it is an ongoing challenge. A solution like Anaplan allows end-to-end visibility across the supply chain and beyond an existing network of wholesalers and retailers to sense demand signals from customers. When changing consumer sentiments can be rapidly identified and changes to demand for the product assessed, the company, partners, and customers benefit from improved profitability, margins, and lead time.

- **Leverage real-time data across all points of the supply chain**

  Because supply chain planning typically involves a myriad of suppliers, channels, customers, and pricing schemes, models can become large and potentially unwieldy—especially when spreadsheets are the primary planning tools. Incorporating a solution that uses real-time data allows planning with great accuracy and reduces the risk of stock-outs or surplus inventory.

- **Ensure the flexibility to cope with change**

  When technology facilitates efficient planning and quick reactions, disruptions aren't disruptive because re-planning and re-forecasting is easy—resulting in time and money saved and increased profitability.

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5.10 GLOBAL SOURCING

Global Sourcing is a procurement strategy used by businesses wherein goods and services are sourced from the global market to obtain the highest levels of efficiency possible. The goal of Global Sourcing is to lower production costs while maintaining the exacting quality standards required for products and services. Another key consideration is to confirm that the value pricing, quality, and deliverability is sustainable for the long-term. Over the last several years, China has led the world in manufacturing production and value. Labor costs are significantly lower in China, yet production quality is extremely high. That's why China parts sourcing has been, and continues to be, the most popular way to have component parts manufactured for many top US-based companies. However, due to the recent tariffs imposed on products from China, India product sourcing is starting to emerge as a viable alternative to China factories. Global sourcing involves more than just searching for products globally. It is also an effort to improve certain aspects of manufacturing, such as:

- Supplier selection and performance
- Speed to market
- Estimation of product costs
- Trade compliance
- Auditing

To help develop and maintain an effective global supply chain, many companies use product sourcing services from China or India buying agents, such as Axia Sourcing. The buying agents have established a network of fully-vetted factories in China, India, and other markets. A good China buying agent or India buying agent can match your specific manufacturing needs with the right factory. The product sourcing services also include manufacturing management, onsite quality inspections, shipping/logistics, and domestic warehousing. Considering the complexities of global parts sourcing, it makes sense to explore the benefits of using a China or India buying agent as a part of your global sourcing strategy.

Risks of Global Sourcing

With the reward of lower production costs and higher product quality comes certain risks in global product sourcing. Mitigating these risks must be a part of any successful global sourcing strategy:

- Time Differences
- Language Barriers
- Quality Expectations
- Compliance Issues
- Production Scheduling
- Logistics

5.11 GLOBAL DISTRIBUTION

If you use a travel management company (TMC), travel agency or are in the market for either, you may have come across the term Global Distribution System, or GDS. In travel management, the term Global Distribution System (GDS) relates to a system that distributes travel products to agents around the world. Travel agencies traditionally relied on GDS for services, products & rates in order to provision travel-related services to the end consumers. A GDS can link services, fees and bookings. It consolidates products and services across all three travel sectors – airline reservations, hotel reservations and car rentals. For air ticketing, GDS remains the dominant distribution channel. However, in other areas, online travel agents are now cleaning up in terms of the sheer volume of listings and bookings.

A GDS is a worldwide conduit between travel bookers and suppliers, such as hotels and other accommodation providers. It communicates live product, price and availability data to travel agents and online booking engines, and allows for automated transactions. The GDS is often used to tap into the corporate travel market because it has the ability to present hotels, flights, and car rentals in one simple interface which is convenient. Many companies organizing trips for their staff will use the GDS as their preferred booking method. The history of global distribution systems dates back to the 1960s when a more sophisticated method was needed to keep track of flight schedules, availability, and prices. As early as the 1970s GDSs were some of the first companies in the world to facilitate business to business (B2B) electronic commerce (now more commonly known as ecommerce). Airlines realized that by automating the reservation process for travel agents, they could make the travel agents more productive and essentially turn them into an extension of the airline's sales force.

5.12 FREE TRADE ZONES

Free-trade zone, also called **foreign-trade zone**, formerly **free port**, an area within which goods may be landed, handled, manufactured or reconfigured, and re-exported without the intervention of the customs authorities. Only when the goods are moved to consumers within the country in which the zone is located do they become subject to the prevailing customs duties. Free-trade zones are organized around major seaports, international airports, and national frontiers—areas with many geographic advantages for trade. Examples include Hong Kong, Singapore, Colón (Panama), Copenhagen, Stockholm, Gdansk (Poland), Los Angeles, and New York City. Alternative devices such as the bonded warehouse and associated systems are used in some large seaports (e.g., London and Amsterdam).

The primary purpose of a free-trade zone is to remove from a seaport, airport, or border those hindrances to trade caused by high tariffs and complex customs regulations. Among the advantages of the system are the quicker turnaround of ships and planes through the reduction in formalities of customs examinations and also the ability to fabricate, refinish, and store goods freely.

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Why use a Foreign Trade Zone?

Global firms use FTZ to maintain the cost competitiveness of their U.S. based operations in relation to their foreign-based competitors. Zone status provides an opportunity to reduce certain operating costs associated with a U.S. location that are avoided when operating from a foreign site. Furthermore, importers, manufacturers, and distributors can realize cost-savings benefits because normally when foreign cargo lands on US soil, it is subject to clearance through Customs and requires immediate payment of US Customs duties. This tariff and tax relief is designed to lower the costs of US-based businesses engaged in international trade and thereby create and retain the employment and capital investment opportunities that result from those operations.

What types of activities are permitted in an FTZ?

Foreign Trade Zones operate under the oversight of the Foreign Trade Zones Board, which allows for any merchandise that is not expressly prohibited from U.S. entry to be admitted into an FTZ. Activities allowed in an FTZ include assembly, exhibition, cleaning, mixing, processing, relabeling, repackaging, salvage, repair, sampling, testing, storage, and display of merchandise. The FTZ Board must specifically authorize production activity, which is defined as the substantial transformation of a foreign article or an activity that changes the condition of an article to such an extent that its customs classification or eligibility for entry into the U.S. for consumption is also changed. Retail trade is not permitted in Foreign-Trade Zones.

While FTZs are designated as international commerce sites, they remain within the authority of all applicable local, state, and federal agencies, which may still require import licenses or permits for activities within the FTZ. If a product is determined to be harmful to public safety or health, or if FTZ facilities do not meet storage and handling requirements, the FTZ Board may exclude it from entry.

How is a Foreign Trade Zone established?

The FTZ Board reviews and approves applications to establish, operate and maintain Foreign Trade Zones. The FTZ Board may approve a zone or subzone that it deems necessary to serve adequately "the convenience of commerce." U.S. Customs and Border Protection must approve activation of the zone before any merchandise is admitted under the Foreign-Trade Zones Act.

How can automation help LSPs with FTZ operations?

For Logistic Service Providers (LSPs) operating an FTZ, there are detailed chain of custody, access, shipment release, and recordkeeping requirements in place. The good news is that these standards are clearly defined and can easily be formalized as rules, which makes them an excellent target for automation through technology. Since most LSPs that operate an FTZ also perform other work and services for their customer base including shipment management, customs clearance, classification, or warehousing, technology that can automate a broad range of LSP tasks is required to be successful.

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5.13 INFORMATION TECHNOLOGY IN PRODUCTION AND SUPPLY CHAIN MANAGEMENT

The role that IT plays in supply chain management or SCM is so important. IT provides the tools which can pick up relevant information, break it down for proper analysis and execute it for optimum performance of the supply chain. Data is pivotal to the execution of the supply chain, primarily because it provides the base on which the supply chain managers can take decisions. Real-time or almost real-time information is the key to proper supply chain management. With information about the various stages of the supply chain, decision-makers can plan, manage, and adjust processes to achieve goals in procurement, inventory, manufacturing, etc.

Why is technology important in supply chain management?

Business processes have been digitalized in the past couple of decades, and it has become a necessity rather than an option. Why not? IT integrates various operations carried out by different companies in the supply chain. It speeds up the business processes and prevents bottlenecks. Companies are closer to achieving on-time procurement, shorter inventory, and better efficiency, especially in manufacturing. IT allows companies in the supply chain to meet the needs of consumers.

The Role of IT in Supply Chain Management

IT is leaving a mark everywhere. Nothing remains untouched. No wonder every aspect of a business is now under its command! The role of IT in Supply Chain Management is highlighted in the following points.

- **Integrated and Coordinated Supply Chain**
  A supply chain can only work efficiently when it is properly integrated and well-coordinated. IT performs this crucial task by bringing in multiple technologies and combining them to optimize the supply chain. These technologies make data collection possible and much easier and more accurate. In turn, this allows precise and detailed data analysis leading to sound business decisions.
- **Increased Productivity**
  Smooth flow of information, new technologies and effective communication increase the productivity of all entities in the supply chain. It is like a trigger for product movement. Instead of going back and forth, IT provides the link that passes the needed information continuously.
- **Cost Reduction**
  IT permits optimum utilization of resources and assets. Old data is used to study the trends, and technology is used to analyze it for improving performance. When resources are used optimally, they result in cost reduction. In a supply chain, the role of IT becomes more prominent because it motivates all parties to use their respective resources in the most cost-efficient manner. When IT is used as it should be, there is a dramatic fall in overall expenses.
- **Product Improvement**
  IT consists of tools and applications which can be used to gain early awareness. In a market where consumers always want something new, the product will either

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have to evolve or it will go out of demand. To stay in business, you must introduce product improvement and innovation sooner rather than later. The kind and extent of product improvement can be validated with the help of IT.

- **Supply Chain Visibility**
  Information makes the entire supply chain visible to supply chain managers. The manner in which the information flows from one collaborator to the other and the impact it has on others is used by the managers in making strategic decisions.

The Functional Roles of IT in Supply Chain Management

Apart from the above-mentioned basic roles, there are three functional roles of IT in supply chain management. These are:

- **Transaction Execution**
  When information flows efficiently between the participants of the supply chain, the number of transactions between them is reduced. IT increases the efficiency of repetitive data exchanges. This data is usually appropriate for delivery verification, order processing, billing, and dispatch advice.
- **Collaboration and Coordination**
  IT renders the flow of information. This makes for easier planning, coordination and improved collaboration between all participants. Demand forecasts make it possible to plan for the future, and order tracking makes knowing the physical location of each order a reality. Neither of these activities is possible without IT.
- **Decision Support**
  Good decisions cannot be pulled out of thin air. They are and should be based on data. IT is a huge benefit in decision support. It can collect even the most complicated set of data and convert it to easy-to-understand charts and reports. In this context, IT extends decision support to all managers.

The Final Word

The secret behind successful Supply Chain Management lies in IT. From the very beginning of the supply chain to its very end, data plays a key role in bringing the entire set together. IT tools provide the necessary communication link between all entities and allow them to work independently and yet in a coordinated manner. The role of IT in supply chain management is undeniable. It is the chain that binds everyone and everything together. It is vital!

5.14 ROLE OF IT IN LOGISTICS MANAGEMENT

The information technological boom seen in the 20th century has catapulted the entire logistics industry into new soaring heights. Enterprises with cutting edge latest tech abilities are currently ruling the industry. In today's logistics services landscape, information technology is fast transforming into a key driver of an enterprise's success, competitive edge, and innovation. Growing demand has paved the way for a simultaneous rise in information technology adoption. IT has had a transforming role for logistics services in all aspects whether tracking, visibility or processing.

- **Consumer Demand**
  The rise of the internet has escalated the demands of patrons and changed the way the entire supply chain worked earlier. From a prior concept of receiving products at the right place and right time, customers have shifted to demanding services anytime and at any place. IT makes it possible to cater to these surging orders by cutting down latency and delays.
- **Access to Cloud Software**
  Previously inaccessible and highly expensive software is now easily accessible by all sizes of enterprises. This has made it possible to make use of management systems for warehouse, transport, ERPs etc. for effective communication. This unperturbed data exchange has lead to automated order picking, shipping, and fulfillment.
- **Real-Time Data**
  Today's population is information driven. Real-time tracking and location access is enabling the logistics services to become more transparent. Real-time data also helps in efficiently managing the supply chain by cutting down on wasteful activities and assists in sticking to the schedule.
- **Transportation**
  Self-driven cars and high load trucks or forklifts have reduced the human effort and time involved in the movement of cargo to exceptional scales. Cargo handling by using robots expedites not only the process but also ensures safe handling of shipments. IT advancement is the reason behind the use of specialized transportation machinery in warehouses.

5.15 COMPUTER AIDED DESIGN (CAD) AND COMPUTER AIDED MANUFACTURING (CAM)

Computer aided design or CAD involves using computers to help with engineering and design for a wide range of projects in various industries. It has been important in applied computer science for decades. Metal fabrication, carpentry, and 3D printing are some common applications for CAD that are valuable in manufacturing.

Another similar type of process to CAD is called computer-aided geometric design (CAGD). In CAGD processes, though, the computer science focuses specifically on creating geometric shapes, which is often used in applications like animation and graphic design, and perhaps less used in 3D manufacturing. CAD is also known as computer-aided design and drafting (CADD). Today, many manufacturing processes are being automated with robots and software. Computer aided design is an essential part of this process. As a driver of refined manufacturing, CAD tools have changed over the years, and the best practices and standards have changed with them. Computer-aided design (CAD) involves creating computer models defined by geometrical parameters. These models typically appear on a computer monitor as a three-dimensional representation of a part or a system of parts, which can be readily altered by changing relevant parameters. CAD systems enable designers to view objects under a wide variety of representations and to test these objects by simulating real-world conditions. Computer-aided manufacturing (CAM) uses geometrical design data to control automated machinery. CAM systems are associated

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with computer numerical control (CNC) or direct numerical control (DNC) systems. These systems differ from older forms of numerical control (NC) in that geometrical data are encoded mechanically. Since both CAD and CAM use computer-based methods for encoding geometrical data, it is possible for the processes of design and manufacture to be highly integrated. Computer-aided design and manufacturing systems are commonly referred to as CAD/CAM.

The Origins of CAD/CAM

CAD had its origins in three separate sources, which also serve to highlight the basic operations that CAD systems provide. The first source of CAD resulted from attempts to automate the drafting process. These developments were pioneered by the General Motors Research Laboratories in the early 1960s. One of the important time-saving advantages of computer modeling over traditional drafting methods is that the former can be quickly corrected or manipulated by changing a model's parameters. The second source of CAD was in the testing of designs by simulation. The use of computer modeling to test products was pioneered by high-tech industries like aerospace and semiconductors. The third source of CAD development resulted from efforts to facilitate the flow from the design process to the manufacturing process using numerical control (NC) technologies, which enjoyed widespread use in many applications by the mid-1960s. It was this source that resulted in the linkage between CAD and CAM. One of the most important trends in CAD/CAM technologies is the ever-tighter integration between the design and manufacturing stages of CAD/CAM-based production processes. The development of CAD and CAM and particularly the linkage between the two overcame traditional NC shortcomings in expense, ease of use, and speed by enabling the design and manufacture of a part to be undertaken using the same system of encoding geometrical data. This innovation greatly shortened the period between design and manufacture and greatly expanded the scope of production processes for which automated machinery could be economically used. Just as important, CAD/CAM gave the designer much more direct control over the production process, creating the possibility of completely integrated design and manufacturing processes.

The rapid growth in the use of CAD/CAM technologies after the early 1970s was made possible by the development of mass-produced silicon chips and the microprocessor, resulting in more readily affordable computers. As the price of computers continued to decline and their processing power improved, the use of CAD/CAM broadened from large firms using large-scale mass production techniques to firms of all sizes. The scope of operations to which CAD/CAM was applied broadened as well. In addition to parts-shaping by traditional machine tool processes such as stamping, drilling, milling, and grinding, CAD/CAM has come to be used by firms involved in producing consumer electronics, electronic components, molded plastics, and a host of other products. Computers are also used to control a number of manufacturing processes (such as chemical processing) that are not strictly defined as CAM because the control data are not based on geometrical parameters.

Using CAD, it is possible to simulate in three dimensions the movement of a part through a production process. This process can simulate feed rates, angles and speeds of machine

tools, the position of part-holding clamps, as well as range and other constraints limiting the operations of a machine. The continuing development of the simulation of various manufacturing processes is one of the key means by which CAD and CAM systems are becoming increasingly integrated. CAD/CAM systems also facilitate communication among those involved in design, manufacturing, and other processes. This is of particular importance when one firm contracts another to either design or produce a component.

Advantages and Disadvantages

Modeling with CAD systems offers a number of advantages over traditional drafting methods that use rulers, squares, and compasses. For example, designs can be altered without erasing and redrawing. CAD systems also offer "zoom" features analogous to a camera lens, whereby a designer can magnify certain elements of a model to facilitate inspection. Computer models are typically three dimensional and can be rotated on any axis, much as one could rotate an actual three dimensional model in one's hand, enabling the designer to gain a fuller sense of the object. CAD systems also lend themselves to modeling cutaway drawings, in which the internal shape of a part is revealed, and to illustrating the spatial relationships among a system of parts. To understand CAD it is also useful to understand what CAD cannot do. CAD systems have no means of comprehending real-world concepts, such as the nature of the object being designed or the function that objects will serve. CAD systems function by their capacity to codify geometrical concepts. Thus the design process using CAD involves transferring a designer's idea into a formal geometrical model. Efforts to develop computer-based "artificial intelligence" (AI) have not yet succeeded in penetrating beyond the mechanical—represented by geometrical (rule-based) modeling.

Other limitations to CAD are being addressed by research and development in the field of expert systems. This field is derived from research done in AI. One example of an expert system involves incorporating information about the nature of materials—their weight, tensile strength, flexibility, and so on—into CAD software. By including this and other information, the CAD system could then "know" what an expert engineer knows when that engineer creates a design. The system could then mimic the engineer's thought pattern and actually "create" more of the design. Expert systems might involve the implementation of more abstract principles, such as the nature of gravity and friction, or the function and relation of commonly used parts, such as levers or nuts and bolts. Expert systems might also come to change the way data are stored and retrieved in CAD/CAM systems, supplanting the hierarchical system with one that offers greater flexibility. Such futuristic concepts, however, are all highly dependent on our abilities to analyze human decision processes and to translate these into mechanical equivalents if possible.

One of the key areas of development in CAD technologies is the simulation of performance. Among the most common types of simulation are testing for response to stress and modeling the process by which a part might be manufactured or the dynamic relationships among a system of parts. In stress tests, model surfaces are shown by a grid or mesh, that distort as the part comes under simulated physical or thermal stress. Dynamics tests function as a complement or substitute for building working prototypes. The ease with which a part's specifications can be changed facilitates the development of optimal dynamic efficiencies, both as regards the functioning of a system of parts and the manufacture of any given part.

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Simulation is also used in electronic design automation, in which simulated flow of current through a circuit enables the rapid testing of various component configurations.

The processes of design and manufacture are, in some sense, conceptually separable. Yet the design process must be undertaken with an understanding of the nature of the production process. It is necessary, for example, for a designer to know the properties of the materials with which the part might be built, the various techniques by which the part might be shaped, and the scale of production that is economically viable. The conceptual overlap between design and manufacture is suggestive of the potential benefits of CAD and CAM and the reason they are generally considered together as a system. Recent technical developments have fundamentally impacted the utility of CAD/CAM systems. For example, the ever-increasing processing power of personal computers has given them viability as a vehicle for CAD/CAM application. Another important trend is toward the establishment of a single CAD-CAM standard, so that different data packages can be exchanged without manufacturing and delivery delays, unnecessary design revisions, and other problems that continue to bedevil some CAD-CAM initiatives. Finally, CAD-CAM software continues to evolve in such realms as visual representation and integration of modeling and testing applications.

5.16 FLEXIBLE MANUFACTURING SYSTEM (FMS)

A Flexible Manufacturing System (FMS) is a manufacturing system in which there is a certain degree of flexibility that allows the system to react in the case of changes, whether predicted or unpredicted. Flexibility is the speed at which a system can react to and accommodate change. To be considered flexible, the flexibility must exist during the entire life cycle of a product, from design to manufacturing to distribution. Flexible Manufacturing System is a computer-controlled system that can produce a variety of parts or products in any order, without the time-consuming task of changing machine setups.

The flexibility being talked about is generally considered to fall into two categories, which both contain numerous subcategories. The first category, Machine Flexibility, covers the system's ability to be changed to produce new product types, and ability to change the order of operations executed on a part. The second category is called Routing Flexibility, which consists of the ability to use multiple machines to perform the same operation on a part, as well as the system's ability to absorb large-scale changes, such as in volume, capacity, or capability. The main advantage of an Flexible Manufacturing System is its high flexibility in managing manufacturing resources like time and effort in order to manufacture a new product. The best application of an FMS is found in the production of small sets of products like those from a mass production.

FM systems are supposed to provide the manufacturer with efficient flexible machines that increase productivity and produce quality parts. However, FM systems are not the answer to all manufacturers' problems. The level of flexibility is limited to the technological abilities of the FM systems. FM systems are being used all over the manufacturing world and though out industries. A basic knowledge of this kind of technology is very important because FM systems are involved in almost everything that you come in contact with in today's world. From the coffee maker to your remote control FM systems are used all over.

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History of Flexible Manufacturing Systems

At the turn of the twentieth century, Flexible Manufacturing System did not exist. There was no pressing need for efficiency because the markets were national and there was no foreign competition. Manufacturers could tell the consumers what to buy. During that period, Henry Ford had been quoted as saying "People can order any color of car as long as it is black." All the power remained in the hands of the manufacturer and the consumers hardly had any choices.

However, after the Second World War a new era in manufacturing was to come. The discovery of new materials and production techniques increased quality and productivity. The war led to the emergence of open foreign markets and new competition. The focus of the market shifted from manufacturer to consumer. The first Flexible Manufacturing System was patented in 1965 by Theo Williamson who made numerically controlled equipment. Examples of numerically controlled equipment are like CNC lathes or mills which are varying types of FM systems. During the 1970s, with the ever-growing developments in the field of technology, manufacturers started facing difficulties and hence, FM systems became main-stream in manufacturing to accommodate new changes whenever required. During the 1980s for the first time manufacturers had to take in consideration efficiency, quality, and flexibility to stay in business.

The Process of Flexible Manufacturing Systems

A flexible manufacturing system is an integrated manufacturing system of computer-controlled machine tools, transportation and handling systems under the control of a larger computer. Flexibility is attained by having an overall system of control that directs the functions of both the computer-controlled machine tools and the handling systems. These computer systems are designed to be programmed or grouped easily with other devices to be able to allow fast and economical changes in manufacturing process, enabling quick responses to the market changes and allowing mass customization of products. As has been discussed above the flexible manufacturing system can be broadly classified into two types, depending on the nature of flexibility present in the process, Machine Flexibility and Routing Flexibility. Flexible Manufacturing Systems essentially comprise of three main systems.

- **The processing stations:** These are essentially automated CNC machines.
- **The automated material handling and storage system:** These connect the work machines to optimize the flow of parts.
- **Central control computer:** This controls the movement of materials and machine flow.

The Flexible Manufacturing System as a system stands out because it does not follow a fixed set of process steps. The process sequence changes according to requirement to allow maximum efficiency. Sequence of material flow from one tool to another is not fixed nor is the sequence of operations at each tool fixed.

Key Features of Flexible Manufacturing Systems

Some characteristics that differentiate Flexible Manufacturing System from conventional

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manufacturing systems are their technical flexibility, i.e., the ability to quickly change mix, routing, and sequence of operations within the parts envelope and also complexity resulting from the integration, mechanization, and reprogrammable control of operations i.e., parts machining, material handling, and tool change. Some key features of the process are discussed below.

Cell: It consists of several groupings of two or more automated machines within a company. Each grouping is called a cell. All the machines present are controlled by a computer. They are programmed to change quickly from one production run to another. A key feature is the automated flow of materials to the cell and the automated removal of the finish item. Several cells are linked together by means of an automated materials-handling system, and the flow of goods is controlled by a computer. In this manner a computer-integrated manufacturing process is initiated.

Random bypass capability: The material handling system has a random bypass capability, i.e. a part can be moved from any tool in the interconnected system to another because the transport system can bypass any tool along the path, on demand. This implies:

- Each part can traverse a variable route through the system.
- Again, this flexibility in material handling, in combination with multipurpose tools, makes it possible for a flexible manufacturing system to process a great diversity of parts.

Automation: Computers are the heart of automation. They provide the framework for the information systems which direct action and monitor feedback from machine activities. As FMS involve a wide variety of components, each with their own type of computer control, many of these computer components are installed as islands of automation, each with a computer control capable of monitoring and directing the action. Each of the computer controls has its own communication protocol based on the amount of data needed to control the component. Thus, the task of computer integration is to establish interfaces and information flow between a wide range of computer types and models. Computer software provides the ability to transmit timely and accurate status information and to utilize information which has been communicated from other computers in FMS.

Component redundancy: In Flexible Manufacturing System as the equipment is highly integrated, the interruptions of one component affect other components. This results in a greater time to trace the problem when compared with isolated components. In some cases, the interruption might be due to some other integration effect, and greater downtime may result before the actual cause of the problem is found. In this situation, component redundancy provides flexibility with the opportunity for choice, which exists when there are at least two available options. Flexible manufacturing contains functionally equivalent machinery. So in case of failure of one machine the process flow is directed towards a functionally equivalent machine.

Multiple Paths: A path in flexible manufacturing represents a part sequence and requisite fixtures to complete its required operations. In a conventional machine environment, only one path exists for a part because a single fixture remains at a single machine. However, this

is not the case within flexible manufacturing systems, where there are multiple paths. The number of paths which are present within flexible manufacturing is a measure of the degree of flexibility. Obviously, the higher the number of paths, higher is the degree of flexibility.

Flexibility ranks high in Japan €²s manufacturing strategy but not in America €²s. A true flexible factory will not only build different versions of the same car, like a coupe or a station wagon, on the same production line, but also a completely different car. This is what the Japanese factories are setting out to do. The cost of one factory can be spread across five or ten cars. Apart from lower fixed cost, it is also less painful to stop making one of those cars if it fails to sell. FMS as a system of manufacturing process can be compared to other processes in terms of the product volume it generates and its capacity for creating part variations.

The above depicts the position of FMS vis-Ã -vis that of stand-alone machine and transfer lines. The horizontal axis represents production volume level and the vertical axis shows the variability of parts. Transfer lines are very efficient when producing parts at a large volume at high output rate, whereas stand-alone machines are ideally suited for variation in workplace configuration and low production rate. In terms of manufacturing efficiency and productivity, a gap exists between the high production rate transfer machines and the highly flexible machines. FMS, has been regarded as a viable solution to bridge the gap and as a gateway to the automated factory of the future.

The Process: Though the features of this manufacturing innovation process are similar across all types of firms, the manner in which they are adopted and implemented depends on product type, manufacturing, maintenance, process planning and quality control processes. It is also contingent upon the people carrying out these processes; the productive resources being used and the organizational arrangements used to divide and coordinate the processes distinguished.

The description of the layout of a company that has adopted the flexible manufacturing system gives a clear idea of how the system works in practical life. It has all the features as mentioned before of a typical FMS.

Case Study: Toyota's Lean Production System

Toyota is the most efficient auto company in the global industry, thanks to its lean production system, developed in response to problems Toyota's engineers saw with the long production runs of a mass production system. The problems included the creation of large and expensive inventories, the production of a large number of defective products if the initial machine settings were wrong, and the system's inability to accommodate diverse consumer preferences. Toyota then developed a number of techniques designed to reduce equipment setup times–a major source of fixed costs. This made small production runs economical, which eliminated large inventories, fewer defective products, and better responsiveness to consumer demands for product diversity. Process innovations enabled Toyota to produce a more diverse product range at a lower unit cost than was possible with conventional mass production.

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5.17 COMPUTER INTEGRATED MANUFACTURING (CIM)

Computer-integrated manufacturing (CIM) refers to the use of computer-controlled machineries and automation systems in manufacturing products. CIM combines various technologies like computer-aided design (CAD) and computer-aided manufacturing (CAM) to provide an error-free manufacturing process that reduces manual labor and automates repetitive tasks. The CIM approach increases the speed of the manufacturing process and uses real-time sensors and closed-loop control processes to automate the manufacturing process. It is widely used in the automotive, aviation, space and ship-building industries. CIM is a manufacturing approach that provides a complete automation of a manufacturing facility. All the operations are controlled by computers and have a common storage and distribution. The various processes involved in a CIM are listed as follows:

- Computer-aided design
- Prototype manufacture
- Determining the efficient method for manufacturing by calculating the costs and considering the production methods, volume of products, storage and distribution
- Ordering of the necessary materials needed for the manufacturing process
- Computer-aided manufacturing of the products with the help of computer numerical controllers
- Quality controls at each phase of the development.
- Product assembly with the help of robots
- Quality check and automated storage
- Automatic distribution of products from the storage areas to awaiting lorries/trucks
- Automatic updating of logs, financial data and bills in the computer system

CIM is a combination of different applications and technologies like CAD, CAM, computer-aided engineering, robotics, manufacturing resource planning and enterprise management solutions. It can also be considered as an integration of all enterprise operations that work with a common data repository.

The major components of CIM are as follows:

- Data storage, retrieval, manipulation and presentation mechanisms
- Real-time sensors for sensing the current state and for modifying processes
- Data processing algorithms

The Computer Integrated Manufacturing Open System Architecture (CIMOSA) was proposed in 1990 by the AMCIE consortium to provide an open systems architecture that specifies both enterprise modeling and enterprise integration required by CIM environments. The CIM approach has found a wide range of applications in industrial and production engineering, mechanical engineering and electronic design automation. CIM increases the manufacturing productivity and lowers the total cost of manufacturing. It also offers great flexibility, quality and responsiveness.

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5.18 JUST IN TIME (JIT)

The Just-In-Time (JIT) concept is a manufacturing workflow methodology aimed at reducing flow times and costs within production systems and the distribution of materials. The concept was popularized by the productivity of Japanese industry in the early 1970s within the Toyota manufacturing plants that would meet consumer demands with minimum delays using an approach focused on people, plants and systems. The prime goal of JIT is for zero inventories across the organization and its supply chain. This completely utilizes the organizational capabilities and maximizes ROI. The system was so successful in Japan it was copied by many US companies, notably Hewlett-Packard. Successfully implementation is dependent on creating a business wide initiative, encouraging staff engagement and formulating a policy and strategy that can be mobilized.

Just-In-Time (JIT) be applied successfully

- Create a stabilized work schedule.
- Establish long-term supplier-customer relationships.
- Create a purchasing philosophy on supporting frequent small purchases.
- Encourage and ensure employee discipline.
- Identify value-added and non-value added items in shop floor activities.
- Ensure top management commitment for effectiveness and successful implementation.

Advantages of Just in Time (JIT)

- JIT can be applied to a wider variety of business processes including HR, accounting, supply chain, operations management and relationship management.
- JIT can achieve better product quality through elimination of waste in production.
- The JIT approach can reduce the cost of inventories and inventory requirements.

Disadvantages of Just in Time (JIT)

- The JIT system does not cope well with sudden changes to demand and supply.
- Implementing the system can be challenging and time-consuming.

Can a Just In Time manufacturing process prove effective?

In order to make supply chains more effective the concepts of Lean and Agile have been adopted by many organizations, which incorporate a Just-in-time approach.

The lean and agile paradigms, though distinctly different, can be and have been combined within successfully designed and operated total supply chains.

- **Lean** means developing a value stream to eliminate all waste, including time, and to enable a level schedule. Waste is defined as any activity which does not add value, but becomes integral to the production. This is an example of supply chain cooperation in action.
- **Agility** means using market knowledge and a virtual corporation to exploit profitable opportunities in a volatile market place, and the focus is on customer responsiveness and time-based competition.

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5.19 LAYOUT DESIGN PROCEDURE

The design of any layout is governed by a number of factors and the best layout is the one that optimizes all the factors. The factors influencing any layout are categorized into the following eight groups:

- **The material factor:** includes design, variety, quantity, the necessary operations, and their sequence.
- **The main factor:** includes direct workers, supervision and service help, safety and manpower utilization.
- **The machinery factor:** includes the process, producing equipment and tools and their utilization
- **The movement factor:** includes inter and intradepartmental transport and handling at the various operations, storage and inspection, the materials handling equipment.
- **The waiting factor:** includes permanent and temporary storage and delays and their locations.
- **The service factors:** include service relating to employee facilities such as parking lot, locker rooms, toilets, waiting rooms etc.; service relating to materials in terms of quality, production control, scheduling, dispatching, waste control; and service relating to machinery such as maintenance.
- **The building factor:** includes outside and inside building features and utility distribution and equipment.
- **The change factor:** includes versatility, flexibility and expansion

  Each of the above mentioned factors comprise a number of features and the layout engineer must review these in the light of his problem. Usually, the layout design process is a compromise of these various considerations to meet the overall objectives in the best possible manner. The overall layout design procedure can be considered to be composed of four phases Viz.,

  a. Phase I: Location

  b. Phase II: General Overall Layout

  c. Phase III: Detailed layout

  d. Phase IV: Installation

Some important guidelines that help in the layout design are:

- Plan from whole to details
- First plan the ideal and then move to the practical aspects
- Material requirements should be central to the planning of process and machinery.
- modify the process and machinery by different factors to plan the layout
- Though there is always an overlap in the different phases of layout design the major steps that have to be followed in the layout design are outlined as follows:

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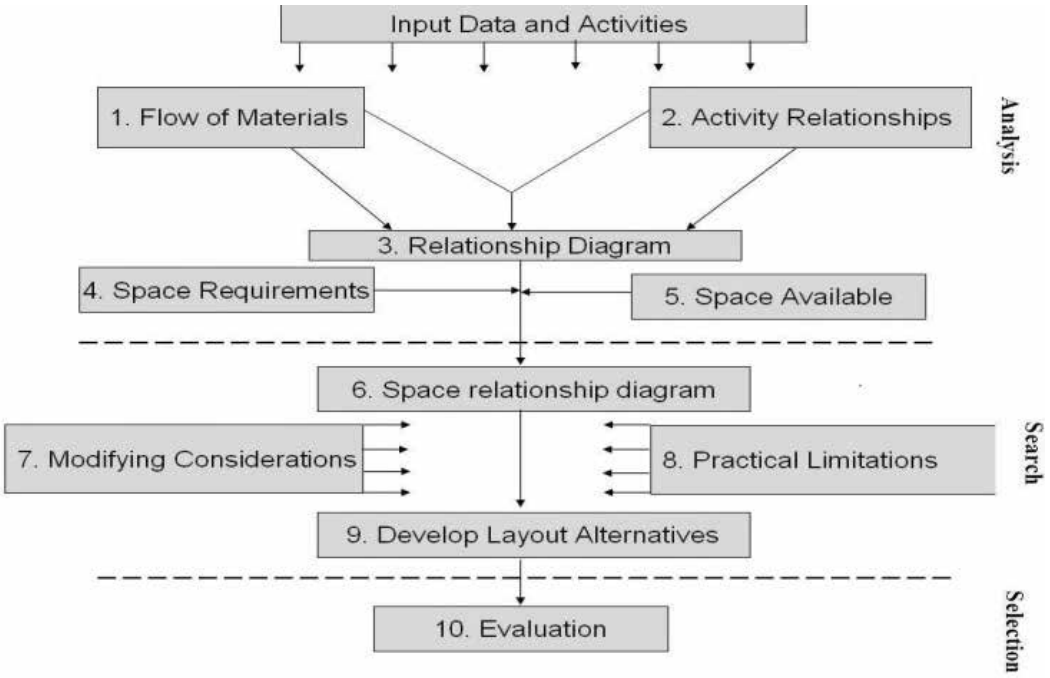
- state the problem in terms of its objective, scope and factors to be considered
- Collect basic data on sales forecasts, production volumes, production schedules, part lists, operations to be performed, work measurement, existing layouts, building drawing etc.
- Analyze data and present it in the form of various charts
- Plan the production process and its arrangement
- Plan the material flow pattern and develop the overall material-handling plan
- Estimate plant and machinery requirements Select material handling equipment
- Determine storage requirements
- Design and plan activity relationships
- Plan auxiliary and service facilities including their arrangement
- Determine space requirements and allocate activity areas
- Develop plot plan and block plan i.e. integrate all plant operations
- Develop detailed layouts and plan building along with its arrangement
- Evaluate, modify and check the layouts
- Install layouts and follow up



The Systematic Layout Planning (SLP) procedure as presented by Francis and White (1974) is shown in given figure. We see that once the appropriate information is gathered, a flow analysis can be combined with an activity analysis to develop the relationship diagram. Space considerations when combined with the relationship diagram lead to the construction of the space relationship diagram. Based on the space relationship diagram

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modifying considerations and practical limitations, a number of alternative layouts are designed and evaluated.

5.20 PROCUREMENT SOFTWARE

Procurement software provides an organization with a set of tools to support the acquisition of goods and services. Contemporary procurement software is digital and enables employees to virtually request a purchase from anywhere in the world. Procurement often involves issuing purchase orders as a form of structure and control.

With a digital procurement solution, allow your employees to request a purchase from virtually anywhere. Whether they are working at a satellite office on their computer or in the field on their phones, employees will be able to quickly and accurately tell your central purchase controller what they need and when they need it. Set a budget planner within your dashboard to keep track of all your procurement processes throughout every department in your organization. Set a budget planner within your dashboard to keep track of all your procurement processes throughout every department in your organization. With an electronic purchase order, quickly and concisely communicate your desired purchases with the vendor without anything going missing.

Digital procurement software enables you to request and approve purchase orders, select and order the product or service, receive and match the invoice and order, and prepare the documentation required for verification of payment.

Prevent employees from ordering before the correct approvals are in place and buying from unlisted vendors. Procurement software can centralize information, which enables an organization to combine orders in order to drive down the cost associated with the purchase.

Procurement software is designed to:

- Automate the purchasing process
- Create purchase orders
- Receive and match the order to the invoice
- Support financial settlement for goods and services purchased and received
- Standardize the overall process that an organization adheres to

The Benefits of Procurement Software:

- **Transparency across your organization**
  Procurement software supports the documentation all transactions. This allows all details of how funds are being spent in respect to vendors, cost, quality; and the time it takes to complete the purchase, to be accessed in one source of truth.
- **Reduction of costs**
  View a detailed history of what has been purchased. Procurement can function to provide insight into which services are being regularly purchased, which suppliers are providing the best value, and areas of high-cost purchases that potentially have more cost-effective alternatives.

- **Improved operational efficiency**
  Procurement software enables a more automated process to reduce the overall hours spent in creating documentation surrounding purchases. This can minimize the likelihood of errors in manual data entry, and enables a company to invest hours saved into other strategic business priorities.
- **Standardized workflow**
  Create structured processes in order to set more control or flexibility in every transaction. This can be implemented from the requisition and carried all the way through to the consolidation of payment information into the accounting system.
- **Integration into the system of record**
  Procurement software integrates with accounting systems, providing a bridge to ensure all transaction information is entered correctly in your system of record. Advanced procurement systems offer different integration possibilities, allowing organizations to have more flexibility as to where information is pushed along the procurement process.
- **Digitized catalogues**
  Organizations have a lot of control and flexibility when it comes to what is accessible through their procurement software. Bundle common items together so everyone knows exactly what needs to be purchased for a common use-case. Restrict purchases to only trusted suppliers that have pre-negotiated agreements.

5.21 LOGISTICS INFORMATION SYSTEMS

Logistic information system is nothing but a part of Management Information System to manage, control and measure the logistical activities. These activities occur within the organization or as well as overall across the supply chain. Logistics information systems are important for achieving logistics efficiency and effectiveness. In an enterprise, logistics information system seeks to achieve the following:

- It ensures of logistics functional operations into a process pursuing customer satisfaction at the lowest total cost.
- Information system facilitates planning and control of the logistical activities related to order fulfillment. It makes the firm more competitive, by making better tactical and strategic decision for the benefits of the firm and its customer.
- Helps provide customers information regarding product availability, order status, and delivery schedules promoting customers' service. It reduces the requirements of inventory and human resources by enabling requirements planning.
- It interfaces with marketing, financial, and manufacturing information systems and provides information to top management to help formulate strategic decisions for the whole firm.
- The use information technology in information systems has enabled quick response to demand making forecasting redundant. This has also helped in implementing "pull" systems like just-in-time making the firm more competitive.

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- It promotes systems that link the operations of the firm, such as manufacturing and distributing, with the suppliers' operations on the one hand the customer on the other.
- In the other cases, organizations are finding that through information they can manage dispersed inventories as if they were single inventory. The benefits of this can be considerable. If inventory management is centralized and decisions on replenishment and other quantities are taken or the basis that is a single stock, then only one safety stock instead of many required. The stock itself can be carried anywhere in the system, either near the point of production or the consumption. This is the concept of 'virtual' inventory management or electronic inventory management.

5.22 ENTERPRISE RESOURCE PLANNING (ERP)

The simplest way to define ERP is to think about all the core business processes needed to run a company: finance, HR, manufacturing, supply chain, services, procurement, and others. At its most basic level, ERP helps to efficiently manage all these processes in an integrated system. It is often referred to as the system of record of the organization. Yet today's ERP systems are anything but basic and have little resemblance to the ERP of decades ago. They are now delivered via the cloud and use the latest technologies – such as artificial intelligence (AI) and machine learning – to provide intelligent automation, greater efficiency, and instant insight across the business. Modern ERP software also connects internal operations with business partners and networks around the world, giving companies the collaboration, agility, and speed they need to be competitive today. ERP is a software system that helps you run your entire business, including processes in finance, human resources, manufacturing, supply chain, services, procurement, and more.

Importance ERP

Sometimes described as "the central nervous system of an enterprise," an ERP system provides the automation, integration, and intelligence that is essential to efficiently run all day-to-day business operations. Most or all of an organization's data should reside in the ERP system to provide a single source of truth across the business. Finance requires an ERP to quickly close the books. Sales need ERP to manage all customer orders. Logistics relies on well-running ERP software to deliver the right products and services to customers on time. Accounts payable needs ERP to pay suppliers correctly and on time. Management needs instant visibility into the company's performance to make timely decisions. And banks and shareholders require accurate financial records, so they count on reliable data and analysis made possible by the ERP system. The importance of ERP software to businesses is illustrated by the growing adoption rate. According to G2, "The global ERP software market is projected to reach USRs. 78.40 billion by 2026, growing at a CAGR of 10.2% from 2019 to 2026."

How do ERP systems work?

An ERP system – also called an ERP suite – is made up of integrated modules or business applications that talk to each other and share common a database. Each ERP

module typically focuses on one business area, but they work together using the same data to meet the company's needs. Finance, accounting, human resources, sales, procurement, logistics, and supply chain are popular starting points. Companies can pick and choose the module they want and can add on and scale as needed. ERP systems also support industry-specific requirements, either as part of the system's core functionality or through application extensions that seamlessly integrate with the suite. ERP software can be bought using a cloud subscription model (software-as-a-service) or a licensing model (on premise).

Common ERP modules

Enterprise resource planning systems include a variety of different modules. Each ERP module supports specific business processes – like finance, procurement, or manufacturing – and provides employees in that department with the transactions and insight they need do their jobs. Every module connects to the ERP system, which delivers a single source of truth and accurate, shared data across departments. The most widely used ERP modules include:

- **Finance:** The finance and accounting module is the backbone of most ERP systems. In addition to managing the general ledger and automating key financial tasks, it helps businesses track accounts payable (AP) and receivable (AR), close the books efficiently, generate financial reports, comply with revenue recognition standards, mitigate financial risk, and more.
- **Human resources management:** Most ERP systems include an HR module that provides core capabilities such as time and attendance and payroll. Add-ons, or even entire human capital management (HCM) suites, can connect to the ERP and deliver more robust HR functionality – everything from workforce analytics to employee experience management.
- **Sourcing and procurement:** The sourcing and procurement module helps businesses procure the materials and services they need to manufacture their goods – or the items they want to resell. The module centralizes and automates purchasing, including requests for quotes, contract creation, and approvals. It can minimize under buying and overbuying, improve supplier negotiations with AI-powered analytics, and even seamlessly connect with buyer networks.

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- **Sales:** The sales module keeps track of communications with prospects and customers – and helps reps use data-driven insights to increase sales and target leads with the right promotions and up sell opportunities. It includes functionality for the order-to-cash process, including order management, contracts, billing, sales performance management, and sales force support.
- **Manufacturing:** The manufacturing module is a key planning and execution component of ERP software. It helps companies simplify complex manufacturing processes and ensure production is in line with demand. This module typically includes functionality for material requirements planning (MRP), production scheduling, manufacturing execution, quality management, and more.
- **Logistics and supply chain management:** Another key component of ERP systems, the supply chain module tracks the movement of goods and supplies throughout an organization's supply chain. The module provides tools for real-time inventory management, warehousing operations, transportation, and logistics – and can help increase supply chain visibility and resilience.
- **Service:** In an ERP, the service module helps companies deliver the reliable, personalized service customers have come to expect. The module can include tools for in-house repairs, spare parts, field service management, and service-based revenue streams. It also provides analytics to help service reps and technicians rapidly solve customer issues and improve loyalty.
- **R&D and engineering:** Feature-rich ERP systems include an R&D and engineering module. This module provides tools for product design and development, product lifecycle management (PLM), product compliance, and more – so companies can quickly and cost-effectively create new innovations.
- **Enterprise asset management:** Robust ERP systems can include an EAM module – which helps asset-intensive businesses minimize downtime and keep their machines and equipment running at peak efficiency. This module includes functionality for predictive maintenance, scheduling, asset operations and planning, environment, health and safety (EHS), and more.

ERP integration

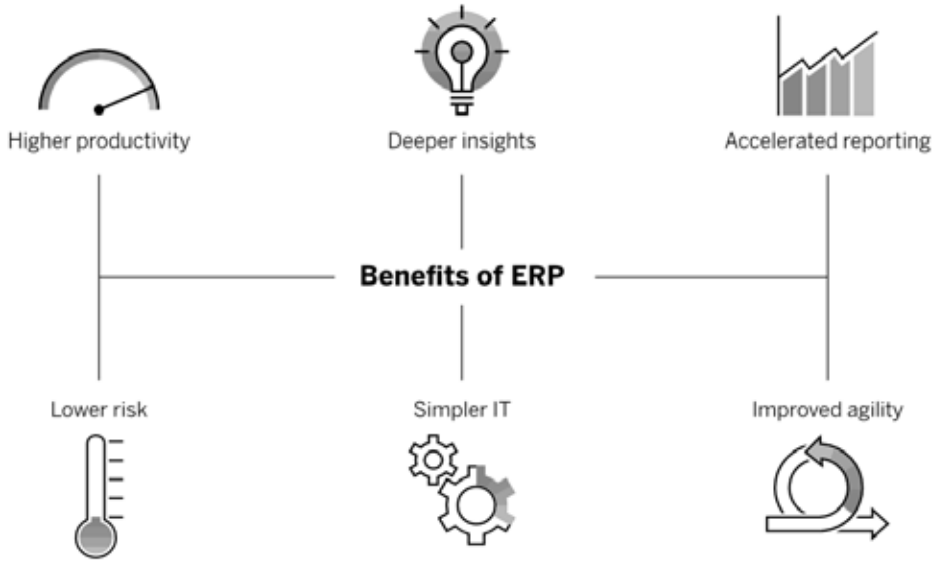
Today's ERP systems provide an enormous range of business functionality, but they still need to connect to and synchronize with other applications and data sources – such as CRM and HCM software, e-commerce platforms, industry-specific solutions, and even other ERPs. With ERP integration, companies can gain a unified view of information from different systems, increase business process efficiency, improve customer experiences, and facilitate collaboration across teams and business partners.

Modern ERP systems are open and flexible – and can easily integrate with a wide range of software products using connectors or customized adaptors, such as application programming interfaces (APIs). Other methods for ERP integration include ESB (enterprise service bus) and iPaaS (integration platform-as-a-service). iPaaS, which offers a cloud-based approach, is a very popular option for modern businesses. iPaaS platforms can

rapidly sync on-premise or cloud-based ERP with SaaS applications from the same vendor or third-parties. They typically require little-to-no coding, they're flexible and relatively inexpensive, and they offer a whole host of other uses – such as automatic API generation, machine learning data integration, Internet of Things (IoT) network integration, prebuilt content, and more.

Six key benefits of ERP

A good ERP system offers many different benefits. Here are the top six:



- **Higher productivity:** Streamline and automate your core business processes to help everyone in your organization do more with fewer resources.
- **Deeper insights:** Eliminate information silos, gain a single source of truth, and get fast answers to mission-critical business questions.
- **Accelerated reporting:** Fast-track business and financial reporting and easily share results. Act on insights and improve performance in real time.
- **Lower risk:** Maximize business visibility and control, ensure compliance with regulatory requirements, and predict and prevent risk.
- **Simpler IT:** By using integrated ERP applications that share a database, you can simplify IT and give everyone an easier way to work.
- **Improved agility:** With efficient operations and ready access to real-time data, you can quickly identify and react to new opportunities.

ERP examples in different industries

Businesses in every industry – from automotive to wholesale distribution – need accurate, real-time information and effective business processes to compete and thrive. Different industries rely on their ERP software for quite different reasons, however. Here are just a few examples:

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- **Utilities** need to constantly review their capital assets, not only to meet demand for future services but also for the replacement of aging assets. Without ERP, the effort to prioritize these major asset investments would be difficult and error prone. ERP also helps solve another critical utility company issue: forecasting of spare parts. Not having the right parts during an outage can create a significant customer service issue. On the other hand, having too many spare parts means excessive costs and out-of-date stock.
- For **wholesalers**, importers, direct store delivery, and 3PL/4PL firms, on-time delivery is key. All of these organizations want to reduce distribution costs, increase inventory turns, and shorten order-to-cash time. To achieve these goals, they need integration of inventory management, purchasing, and logistics functionality, as well as automated processes that are customized to their needs.
- Discrete, batch, and continuous process **manufacturers** all rely on ERP and supply chain systems to meet product quality goals, manage asset utilization, control overtime costs, handle customer returns and more. Manufacturers can also gain end-to-end inventory control by monitoring stock movements, pinpointing top and underperforming products, and managing procurement more efficiently.
- **Service companies** – including accounting, tax, engineering, IT, legal, and other professional services firms – require powerful, real-time mobile ERP technology to balance service delivery commitments with financial health. Key to professional service success is the ability to stay on schedule while managing project profitability, resource utilization, revenue recognition, recurring revenue objectives, and growth opportunities.
- **Retail** has undergone a significant transformation now that e-commerce has merged with other sales channels as well as brick-and-mortar operations. The ability to provide self-service options for identifying, configuring, purchasing, and shipping products is dependent on integrated data. A modern ERP also helps retailers reduce cart abandonments, improve Web site conversions, boost average order value, and increase customer lifetime value.

Types of ERP deployment

Modern ERP systems can be deployed in a number of ways: in a public or private cloud, on premise, or in various hybrid scenarios that combine environments. Here are some of the high-level benefits of each to help you identify the ERP deployment option that makes the most sense for your business.

Cloud ERP

On-premise ERP

Hybrid ERP

- **Cloud ERP**
  With cloud ERP, the software is hosted in the cloud and delivered over the Internet as a service that you subscribe to. The software provider generally takes care of regular maintenance, updates, and security on your behalf. Today, cloud ERP is the most popular deployment method for many reasons – including lower upfront costs, greater scalability and agility, easier integration, and much more.
- **On-Premise ERP**
  This is the traditional model for deploying software where you control everything. The ERP software is typically installed in your data center at the locations of your choice. The installation and maintenance of the hardware and software is your staff's responsibility. Many companies are modernizing and upgrading their on-premise ERP systems to cloud deployments. This requires careful planning of your ERP upgrade as well as a thoughtful process of evaluating ERP software and deployment options.
- **Hybrid ERP**
  For companies that want a mixture of both to meet their business requirements, there is the hybrid cloud ERP model. This is where some of your ERP applications and data will be in the cloud and some on premise. Sometimes this is referred to as two-tier ERP.

The total cost of ERP

The cost of ERP depends on the software vendor, the modules selected, and the deployment method. Generally speaking, cloud-based ERP has lower costs than on-premise ERP because there is no hardware that needs to be purchased – and no expensive in-house IT experts that need to be hired. The vendor handles the maintenance and charges the customer an annual or monthly subscription fee, usually based on the number of users.

When calculating the return on investment (ROI) and total cost of ownership (TCO) of a new ERP implementation, the initial and ongoing workforce costs are just as important as the software selection and deployment costs. With cloud and hybrid options, new factors must be evaluated. For example, software maintenance, facility, computer capacity, downtime, recovery, security, privacy, and IT staff costs are all important considerations. As mentioned, cloud options significantly reduce both capital and operating costs – improving both ROI and TCO.

ERP history: the rapid evolution of ERP

Computerized business applications were born in the accounting and finance world in the 1960's using mainframe computers. These pioneering applications were faster and more accurate than manual processes – but were expensive, limited in functionality, and still slow. Before long, these applications spawned the development of dedicated, standalone solutions such as sales order processing and manufacturing requirements planning (MRP).

In the mid 1980's, competition in the manufacturing sector was exploding and new tools were required. New MRP II software integrated accounting and finance, sales, purchasing, inventory, and manufacturing planning and scheduling – providing the manufacturer with an integrated system. Near the end of the 1990's, ERP was introduced. ERP transformed

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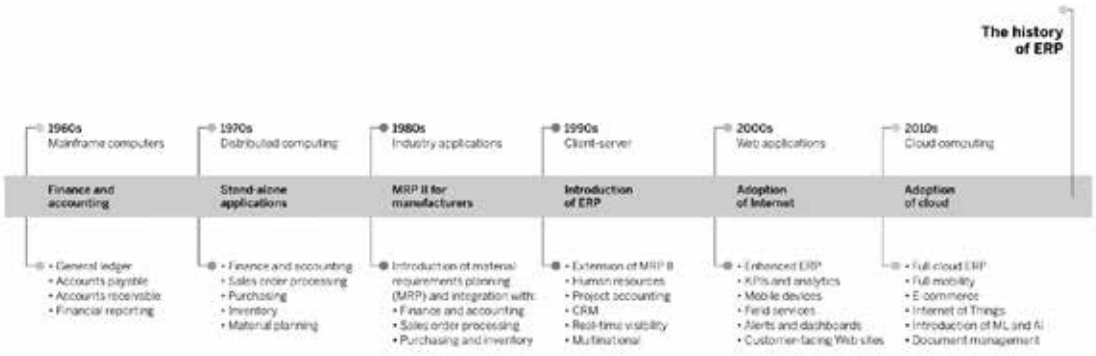
the technology sector by serving a broader range of industries and by combining MRP II, human resources, project accounting, and end-user reporting.

In the short span of the 21st century, faster Internet speeds and new development tools have again revolutionized ERP suites. The introduction of browser-based software paved the way for cloud ERP software, a breakthrough that has expanded both the reach and the functionality of ERP solutions.

Today – in the era of digital transformation – modern ERP systems are increasingly taking advantage of new intelligent technologies such as AI, machine learning, robotic process automation (RPA), the IoT, natural language processing (NLP), and in-memory databases. They provide businesses with the ability to run even more efficient processes, leverage up-to-the-minute insights from both transactional and unstructured data, and ultimately remain competitive in a time of unprecedented change.



The future of ERP

Digital transformation is speeding up – and ERP is at the core. As enterprises adopt digital technologies in every part of the business, they are fundamentally changing the way they operate.

According to Gartner, one of the core digital business accelerators is to "banish drags" – in other words, eliminate any negative force that slows the business down, including outdated processes and systems. So, it's not surprising that companies are already demanding more robust ERP systems. Following are three major trends that build on the momentum we see today:

- **Cloud, cloud, cloud:** Preference for cloud ERP will continue to intensify as more and more companies discover the benefits – including "anywhere" access, reduced cost of hardware and technical support, greater security, and integration with other systems, to name just a few. According to Panorama Research in their 2020 ERP Report, "More than half of organizations are selecting cloud software (63%) instead of on-premises software (37%)." As the speed of business continues to accelerate, cloud becomes even more essential.
- **Vertical integration:** The tug of war between best-of-breed solutions and integrated ERP is officially over. Going forward, we believe that companies will demand the best of both worlds – a fully integrated ERP system with vertical extensions. This allows companies to get the specific functionality they need, without painful

integration issues or data locked in information silos. We also see the shift toward ever greater flexibility, as business processes are tailored to individual company needs.

- **User personalization:** Staff, customers, and suppliers all want content and functionality that matches their specific needs or interests and makes them more productive. The changing demographics of the workforce, particularly in industries such as manufacturing, are also driving interest in low-code, no-code platforms. These platforms allow users to get the experience they want, rather than having to adapt to the software. Users can also expect customized dashboards, AI-driven search, personalized chat, and personalized workflows across devices.

Explore more ERP technology trends – and learn how to systematically evaluate your options, avoid pitfalls, and get started with the right innovations for your business.

Important things to look for in an ERP system

Any modern ERP system will have a long list of capabilities based on the industry they serve and the modules they offer. However, there are 10 fundamental features that all enterprise resource management systems should have:

- **A common database**: Centralized information and single version of the truth – providing consistent, shared data and a cross-functional view of the company.
- **Embedded analytics:** Built-in analytics, self-service BI, reporting, and compliance tools that can deliver intelligent insight for any area of the business.
- **Data visualization:** Visual presentation of key information with dashboards, KPIs, and point-and-click analytics to assist in quick and informed decision-making.
- **Automation.** Automation of repetitive tasks as well as advanced RPA powered by AI and machine learning.
- **Consistent UI/UX:** The same look and feel across modules – as well as easy-to-use configuration and personalization tools for processes, users (including customers and suppliers), business units, locations, and product lines, for example.
- **Integration:** Seamless integration of business processes and workflows – as well as open and easy integration with other software solutions and data sources, including from third parties.
- **New technologies:** Support for AI and machine learning, digital assistants, the IoT, RPA, security and privacy, and mobile.
- **Technology platform:** A fast, proven, and stable technology stack for this long-term investment – including a low-code/no-code platform, iPaaS, data management, and more.
- **Multinational support:** Including for languages, currencies, and local business practices and regulations – as well as technical support for cloud services, training, help desk, and implementation.
- **Choice of deployment:** Cloud, on-premise, or hybrid.

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5.23 MATERIAL RESOURCE PLANNING (MRP)

Material Requirements Planning (**MRP**) is a set of techniques that uses the bill of material data, inventory data, and the master production schedule to calculate requirements for materials. It makes recommendations to release replenishment orders for material. Further, because it is time-phased, it makes recommendations to reschedule open orders when due dates and need dates are not in phase. Time-phased MRP begins with the items listed on the MPS and determines:

- The quantity of all components and materials required to fabricate those items and
- The date that the components and material are required.

Time-phased MRP is accomplished by exploding the bill of material, adjusting for inventory quantities on hand or on order, and offsetting the net requirements by the appropriate lead times.

Manufacturing Resource Planning (**MRP II**) a method for the effective planning of all resources of a manufacturing company. Ideally, it addresses operational planning in units, financial planning in dollars, and has a simulation capability to answer what-if questions. It is made up of a variety of processes, each linked together: business planning, production planning (sales and operations planning), master production scheduling, material requirements planning, capacity requirements planning, and the execution support systems for capacity and material. The output from these systems is integrated with financial reports such as the business plan, purchase commitment report, shipping budget, and inventory projections in dollars. Manufacturing resource planning is a direct outgrowth and extension of closed-loop MRP.

Manufacturing resource planning (**MRP 2**)

Manufacturing resource planning (MRP 2) is a strategy by which a manufacturer optimizes the acquisition, storage and deployment of all resources needed in its production runs. These may include raw materials, components from suppliers, production equipment and personnel, spare parts – any resource needed to complete the production of a finished good. Manufacturing resource planning is abbreviated "MRP 2" (or "MRP II") to distinguish it from material requirements planning (MRP 1). MRP 2 encompasses all the capabilities of MRP 1, which focuses on a manufacturer's inventory of raw materials and supplied components. MRP 1 uses inventory data along with production order and bill of materials (BOM) data to calculate the quantity and timing of purchases of additional incoming goods.

Manufacturing resource planning is handled in modern manufacturing operations management (MOM) systems by advanced planning and scheduling (APS) software. APS software eliminates much of the manual data entry that has accompanied older approaches to manufacturing resource planning. It also enables the MRP 2 system to manage highly diverse product portfolios under stringent customer delivery requirements, as well as complex resource allocation scenarios and last-minute change orders. Manufacturing resource planning software calculates and updates material needs based on actual orders and order forecasts. The complexity of manufacturing operations and scheduling has

increased dramatically in recent years due to growing product and supply-chain complexity, globalization, mass customization and other factors. As a result, the large numbers of variables and data points to consider in MRP software have caused many manufacturers – even small and mid-size businesses – to migrate from paper-based, spreadsheet and homegrown MRP tools to integrated digital tools such as APS.

Manufacturing resource planning relies on the concept of "dependent demand," which refers to the fact that the need for a raw material or intermediate component is dependent upon the demand for the finished product. A manufacturer will forecast demand for a particular finished product – considered an "independent demand" because it arises from an external source, typically the customer or a make-to-stock order – and MRP software calculates the demand for materials based on this forecast. The purpose of manufacturing resource planning today is often tied to just-in-time (JIT) scheduling and just-in-sequence (JIS) methodologies, which seek to minimize both inventory levels and the amount of time a material remains in storage or stationed near the processing equipment that will employ it. Such strategies must also ensure sufficient inventory is present to avoid any shortfalls or production stoppage.

The output of manufacturing resource planning software answers the questions pertaining to acquisition, storage and deployment, including:

- When to order each material
- How much to order
- With which supplier to place each order
- Where to store inventory
- When to move material (and how much) from storage to the production line

Manufacturing resource planning also can be used to accommodate changes in supply or demand. Information about the impact of a natural disaster on a supplier, for example, can be accounted for in the MRP system so that an adequate supply is available when it is needed.

MRP software functionality

Manufacturing resource planning software uses information from bills of materials (BOMs), bills of process (BOPs), product demand forecasts, customer orders, the master production schedule (MPS) and supplier lead time and capacity. It also takes into account:

- Production line capacity
- Production rate
- Availability and training/certification of manufacturing personnel
- Production equipment availability
- Production equipment maintenance requirements

Based on these inputs, MRP software calculates needs and prompts the creation of purchase orders for incoming goods. Manufacturing resource planning conducted on

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a modern APS system enables the planning team to generate plans and schedules in both make-to-order and make-to-stock environments. To enable visualization of the full production schedule and resource allotment, MRP 2 software provides interactive schedule visualization, displaying data as stock profile graphs and capacity usage graphs. Changes made on these graphs are automatically reflected on the master production schedule (MPS).

MRP 2 software tracks inventory levels and resource deployments. As materials are consumed or incorporated into finished products, and as demand and orders change, manufacturing resource planning recalculates need and adjusts material orders as needed. Rather than reacting to supply or demand changes when they occur, modern manufacturing resource planning systems also allow manufacturers to examine "what if" scenarios that enable them to create plans for adjustments and contingencies.

Benefits of manufacturing resource planning

Manufacturing resource planning, especially as performed by integrated APS systems, optimizes the timing of material purchases, minimizes stagnant inventory as well as idle personnel or production equipment, and reduces costs associated with over- and undersupply of needed resources.

Additional benefits

- Minimizes inventory footprint
- Reduces inventory management costs
- Reduces spoilage and material waste
- Minimizes production line idle time
- Lowers production costs
- Improves on-time delivery

5.24 CHAPTER SUMMARY

Global Logistical considerations have always played a strategic role in business. Among retailers and wholesalers, they transcend inventory management and transportation to include one of the most critical factors in business success—location in relation to markets or sources of supply. Among manufacturers, logistics concerns itself with matters as basic as plant location, sourcing of raw materials, and standards of customer service. In recent years, changes in the business environment have forced companies both large and small to pay particularly close attention to how this function relates to others. Government regulation, the health of the nation's transportation system, energy restrictions, and technological developments all represent important considerations in the formulation of a business strategy. As the author shows in this article, many companies have responded to these challenges by developing competitive strategies based in part on such concepts as postponement and speculation, standardization, consolidation, and differentiation. These are companies in which management has conducted either formal or informal logistics audits, has redesigned systems to provide more effective support for corporate strategies, and has taken steps to ensure continued appraisal of opportunities over the long run.

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Global supply chain management involves planning how the entire supply chain will function as an integrated whole, with the aim of generating an optimum level of customer service while being as cost efficient as possible. Other aims include increasing the speed by which your product reaches your customers, as well as flexibility in dealing with customer transactions

Free-trade zone, also called **foreign-trade zone,** formerly **free port**, an area within which goods may be landed, handled, manufactured or reconfigured, and re-exported without the intervention of the customs authorities. Only when the goods are moved to consumers within the country in which the zone is located do they become subject to the prevailing customs duties. Free-trade zones are organized around major seaports, international airports, and national frontiers—areas with many geographic advantages for trade The role that IT plays in supply chain management or SCM is so important. IT provides the tools which can pick up relevant information, break it down for proper analysis and execute it for optimum performance of the supply chain. Data is pivotal to the execution of the supply chain, primarily because it provides the base on which the supply chain managers can take decisions.A Flexible Manufacturing System (FMS) is a manufacturing system in which there is a certain degree of flexibility that allows the system to react in the case of changes, whether predicted or unpredicted. Flexibility is the speed at which a system can react to and accommodate change.

Computer-integrated manufacturing (CIM) refers to the use of computer-controlled machineries and automation systems in manufacturing products. CIM combines various technologies like computer-aided design (CAD) and computer-aided manufacturing (CAM) to provide an error-free manufacturing process that reduces manual labor and automates repetitive tasks. The CIM approach increases the speed of the manufacturing process and uses real-time sensors and closed-loop control processes to automate the manufacturing process

The Just-In-Time (JIT) concept is a manufacturing workflow methodology aimed at reducing flow times and costs within production systems and the distribution of materials. The concept was popularized by the productivity of Japanese industry in the early 1970s within the Toyota manufacturing plants that would meet consumer demands with minimum delays using an approach focused on people, plants and systems. Procurement software provides an organization with a set of tools to support the acquisition of goods and services. Contemporary procurement software is digital and enables employees to virtually request a purchase from anywhere in the world. Procurement often involves issuing purchase orders as a form of structure and control. The simplest way to define ERP is to think about all the core business processes needed to run a company: finance, HR, manufacturing, supply chain, services, procurement, and others. At its most basic level, ERP helps to efficiently manage all these processes in an integrated system. It is often referred to as the system of record of the organization. Manufacturing Resource Planning (MRP II) is a method for the effective planning of all resources of a manufacturing company. Ideally, it addresses operational planning in units, financial planning in dollars, and has a simulation capability to answer what-if questions. It is made up of a variety of processes, each linked together: business planning, production planning (sales and operations planning), master

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production scheduling, material requirements planning, capacity requirements planning, and the execution support systems for capacity and material.

5.25 REVIEW QUESTIONS

SHORT ANSWER TYPE QUESTIONS

1. **What is ERP? What do you understand by ERP integration?**
2. **Define JIT. How can Just-In-Time (JIT) JIT be applied successfully?**
3. **Why is Enterprise Resource Planning (ERP) important?**
4. **What are the key Features of Flexible Manufacturing Systems?**
5. **What do you understand by supply chain? What are the three things all successful supply chain management needs?**

LONG ANSWER TYPE QUESTIONS

1. **What do you understand by Procurement software? Explain the benefits of Procurement software in detail.**
2. **Explain Layout Design Procedure in detail.**
3. **Give a detail account of Global Logistics Management Process.**
4. **Explain Computer Integrated Manufacturing (CIM) in detail.**
5. **Give a detail account of IT in Logistics Management.**

5.26 MULTIPLE CHOICE QUESTIONS

1. **Computer Integrated Manufacturing is_____.**
   a. Extension of CAM
   b. Management philosophy
   c. A type of automation
   d. Link between CAD and CAM
2. **"D" in CAD refers to?**
   a. Design
   b. Dot
   c. Diagram
   d. Digital
3. **Which concept was popularized by the productivity of Japanese industry in the early 1970s within the Toyota manufacturing plants?**
   a. CAD
   b. CAM
   c. JIT
   d. ERP
4. **What is the full form of JIT?**
   a. Just In Time
   b. Just Informational Technology

c. Just Industrial Technology
d. Just Integrated Terminology

5. **What is the full form of FMS?**
   a. Flexible Manufacturing System
   b. Fixed Mobility System
   c. Flexible Mobility System
   d. Free Manufacturing Sources

6. **ERP software can be bought using a cloud subscription model (software-as-a-service) or a licensing model (on premise).**
   a. CAD
   b. JIT
   c. FMS
   d. ERP

7. **ERP is also known as _____.**
   a. the central nervous system of an enterprise
   b. the store house of information
   c. the universal store of an enterprise
   d. the information keeper of an enterprise

8. **_____provides an organization with a set of tools to support the acquisition of goods and services.**
   a. ERP software
   b. CAM software
   c. MRP software
   d. Procurement software

9. **_____is a manufacturing approach that provides a complete automation of a manufacturing facility.**
   a. CAD
   b. CAM
   c. CIM
   d. FMS

10. **What does "M" stand for in HCM?**
    a. Management
    b. Manufacture
    c. Machine
    d. Mobility

♦♦♦♦♦

ANSWER KEY

UNIT I

QUESTION	ANSWER	QUESTION	ANSWER
1.	d.	6.	a.
2.	a.	7.	b.
3.	b.	8.	a.
4.	c.	9.	d.
5.	c.	10.	c.

UNIT II

QUESTION	ANSWER	QUESTION	ANSWER
1.	a.	6.	b.
2.	b.	7.	c.
3.	d.	8.	a.
4.	c.	9.	d.
5.	d.	10.	a.

UNIT III

QUESTION	ANSWER	QUESTION	ANSWER
1.	a.	6.	b.
2.	b.	7.	d.
3.	c.	8.	c.
4.	d.	9.	c.
5.	a.	10.	c.

UNIT IV

QUESTION	ANSWER	QUESTION	ANSWER
1.	d.	6.	a.
2.	b.	7.	b.
3.	a.	8.	b.
4.	a.	9.	b.
5.	c.	10.	b.

UNIT V

QUESTION	ANSWER	QUESTION	ANSWER
1.	b.	6.	d.
2.	a.	7.	a.
3.	c.	8.	d.
4.	a.	9.	c.
5.	a.	10.	a.

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